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Alcohol availability and youth homicide in the 91 largest US cities, 1984–2006

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Abstract

The aggregate relationship between homicide and alcohol availability is well established across a number of national and sub-national settings in North America, Europe and some parts of Asia. However, results linking youth homicide and alcohol availability at the retail level are largely absent from the literature, especially at the city level and across longer time periods. In a multivariate, pooled time series and cross-section study, youth homicide offending rates for two age groups, 13–17 and 18–24, were analysed for the 91 largest cities in the USA between 1984 and 2006. Data for social and economic characteristics, drug use, street gang activity and gun availability were also used as time series measures. Data on the availability of alcohol for each city were gathered from the US Census of Economic Activity, which is conducted every 5 years. These data were used to construct an annual time series for the density of retail alcohol outlets in each city. Results indicated that net of other variables, several of which had significant impacts on youth homicide, the density of alcohol outlets had a significant positive effect on youth homicide for those aged 13–17 and 18–24. Such positive effects have been found for adults in national and neighbourhood level studies, but this is the first study to report such evidence for teenagers and young adults. An important policy implication of these findings is that the reduction of the density of retail alcohol outlets in a city may be an effective tool for violent crime reduction among such youth. [Parker RN, Williams KR, McCaffree KJ, Acensio EK, Browne A, Strom KJ, Barrick K. Alcohol availability and youth homicide in the 91 largest US cities, 1984–2006. *Drug Alcohol Rev* 2011;30:505–514]

Key words: alcohol availability, youth violence, homicide.

Introduction

Most previous studies of youth homicide analysed *trends* at the *national* level [1–3] or assessed whether city characteristics accounted for *intercity* variation of youth homicide *rates* [4,5]. Only recently have studies empirically examined *within-city* changes (i.e. trends) in homicide rates over time and determined whether city characteristics account for variations in those trends [6,7]. However, although Baumer [7] disaggregated homicide rates, comparing those involving youth versus adults, no study has focused exclusively on intercity variation in *youth* homicide *trends*. Absent from these recent studies is the integration of alcohol availability

(i.e. the density of alcohol outlets), despite the burgeoning research literature showing relatively strong estimated effects of alcohol availability and crime, including homicide rates [8–14]. Granted, Baumer [7] included a proxy for alcohol consumption (i.e. the per cent of traffic fatalities involving a drunk driver), but he found no statistically significant estimated effects on trends in youth or adult homicide.

The present study addresses this gap in the homicide research literature by focusing on intercity variation in trends of youth homicide (ages 13–17 and 18–24) and incorporating the density of alcohol outlets in the analysis. Doing so not only extends recent research on youth homicide trends, but it also extends research on the

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relation between alcohol outlet density and criminal violence. This is the case because research on that relation has also not focused on youth ([13,14] excepted). In addition, this study joins a few in the literature that have examined the relationship between violence and outlet density longitudinally [15–17], although these studies examined neither homicide nor youth.

Background

Two literatures are reviewed below. The first provides a rationale for expecting empirical relations between alcohol availability (i.e. the density of retail alcohol outlets), alcohol consumption and homicide. The second provides a rationale for including other city characteristics in the analysis.

Alcohol outlet density, access and violence

The relation between alcohol and violence has been well documented in many studies [18–34]. Concerning access, alcohol outlet density might impact youth access to alcohol through a variety of mechanisms. Youth may be sold alcohol illegally by commercial establishments (most likely off-site establishments). Youth may 'shoulder tap' an unknown adult and ask him/her to buy alcoholic products on their behalf. Youth may find and use the alcoholic products of their parents or be allowed to drink alcoholic beverages at home. Youth might also procure alcoholic beverages from non-family friends or acquaintances that are of legal drinking age or friends who are under-age that have illegally obtained alcohol [35].

Similarly, access and consumption may be linked to homicide through a variety of mechanisms. Numerous perspectives from which to derive the expectation of a relation between access to alcohol, consumption of alcohol and homicide have been discussed previously [27,30–32]. With regard to the impact of alcohol consumption on victims, it may lead to violence because victims under the influence are more vulnerable and thus attractive targets for potential offenders [36–38], which holds for adolescent victimisation as well [39]. With regard to the impact of alcohol on offenders, it may be linked to lethal violence because it limits one's ability to process information and to understand social and personal cues in interaction environments, thus transforming what would otherwise be a relatively minor provocation into a serious insult, to which an individual responds in a violent manner while under the influence of alcohol [33,34]. This theory of alcohol myopia is defined as a 'state of shortsightedness in which superficially understood, immediate aspect of experience have a disproportionate influence on behaviours and emotions' [33].

Another perspective is that alcohol leads to violence among people with dispositional aggressivity [39]. Actors attempt to maintain identities salient to their self-image both for the satisfaction of others and the security of their own self-conception [40]. Wells *et al.* advanced a theoretical model that takes into account the subjective need of aggressive perpetrators to maintain their own masculine identity consistent with the expectations of others, the situation, and general cultural beliefs and attitudes about the role of alcohol in aggression [41].

In addition to identity, 'situational disinhibition' is important for explaining alcohol-fuelled violence [32,42]. This perspective posits that both active and passive constraints operate in the interaction of individuals in situations constrained by norms proscribing the use of violence as a means for dispute resolution; the effects of alcohol may act to 'disinhibit' active constraint. Some research suggests that disinhibition is most likely to occur in those situations in which the normative frameworks prohibiting violence are weakest, or alternatively, where normative frameworks prohibiting violence co-exist with contradictory norms [27,32]. Face-value support for this theory can be found in the frequently noted association between alcohol and spousal violence and homicide (e.g. [27,40–43]).

In short, a number of links between alcohol availability, alcohol consumption and homicide are plausible, thus justifying the incorporation of a measure of availability in the analysis reported below, specifically, the density of retail alcohol outlets within cities. Now consider the rationale for other city characteristics as determinants of youth homicide trends.

City characteristics as determinants of homicide

A number of factors have been offered to explain changes in the homicide rate, including, structural disadvantage, availability and use of firearms, drug trafficking and open air drug markets, and gang activities. Among these factors, structural disadvantage has been most strongly and consistently documented across empirical studies of youth and adult homicide [2,43–48]. Indeed, Pridemore has contended that the 'relationship between poverty and homicide rates is the most consistent finding in the literature' across time periods, levels of analysis, measures of poverty, and model and relationship specifications [49, p.144].

The presence of firearms has also been associated with shifts in homicide trends, particularly in relationship to illicit drug market activity and gang activity. Youth homicides during the 1980s and early 1990s primarily involved firearms [50]. Blumstein has speculated that, as adult sellers dominating drug markets were imprisoned, crack markets were increasingly

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staffed by young inexperienced street sellers who, lacking maturity and other skills, resolved conflicts with overwhelming force, often through the use of firearms [1]. The explosion of volatile drug markets linked to the introduction of crack cocaine in the 1980s is one of the most popular explanations offered for the suddenness and extremity of the homicide epidemic [43,51–53].

A related issue facing US cities in the past three decades has been the proliferation of gang violence [19]. More than one-third of jurisdictions in the National Youth Gang Survey reported gang problems in 2007, the highest annual estimate since before 2000. Reports of gang-related homicides tend to be concentrated in America's most populous cities, many of which suffer from long-standing and persistent gang problems [19–21]. Longitudinal studies have documented that youth are more prone to serious and violent offenses when actively involved with a gang than before or after that affiliation [22]. Adolescent gang members in large cities account for a disproportionate share of serious violent offenses committed by juveniles, including homicide.

In short, structural disadvantage, firearm availability, drug market activity, as well as gang presence and activities have been documented in previous research as important determinants of homicide rate variation. The question for the present research is whether they are also important determinants of intercity variation in the trends of youth homicide, 1984–2006, and how estimated effects of these city characteristics compare with the density of retail alcohol outlets.

Methods

The data for the dependent measures, youth homicide offending, came from the United States Department of Justice's Supplemental Homicide Report. This source provided data on every homicide reported to or discovered by police and other law enforcement agencies in the USA. It included detailed data on the age of the offender, allowing the construction of two series for each city (Appendix 1 lists the sample of cities). The homicide rate per 100 000 for offenders aged 13–17 and aged 18–24 included both men and women because the latter were so infrequent that their measurement as a distinctive rate would be unstable and misleading; women made up approximately 7% of the known offenders during this period.

The SHR has non-trivial missing data due to non-reporting and missing information on reported incidents, typically offender characteristics because the offender is unknown at the time of the incident; approximately 36% of the cases were missing offender age during this period. Previous studies using SHR data have developed methods of compensating for these

missing data [54–59]. Other investigators have recommended the use of multiple imputation (MI) to address this problem ([60,61]; see also [62,63] for general discussions of MI).

The focus of the analysis was on a specific offender characteristic, age (i.e. adolescents 13–17 and young adults 18–24). To compensate for missing data on age of offenders, MI was conducted at the incident level for each year in the 23 year time frame, using the total number of incidents within the original sample of 100 cities combined. This procedure was conducted on the assumption that the data were missing at random (not completely at random); that is, the likelihood of missing data on age of offender is unrelated to age of victim, and the factors producing the missing data are unrelated to the parameters of estimated models [62].

Given this assumption, MI was executed in stata/SE 10.1 using the iterative chain equation procedure [64,65]. The iterative chain equation command included the age, race (Black compared with non-Latino white), ethnicity (non-Latino compared with Latino) and gender of victims; circumstances of homicide incidents (gang-related, narcotics-related, firearm-related, conflict-related, alcohol-related, homicides involving arguments over money or property, and felony homicides); and city size (large compared with smaller cities in the total population). The imputation process involves filling in missing values by drawing from a conditional distribution of missing values, given complete data on other variables. This is done multiple times (five times in the present analysis), generating multiple data sets with slightly different imputed values for missing data. Typically, each data set is analysed, and the results are pooled across data sets for the final results. This procedure allows for an (upward) adjustment of standard errors, which are typically underestimated with most other methods of compensating for missing data, thus increasing the chances of Type I error in tests of statistical significance [62].

The method used here departed from the standard MI process in that, once the five imputed data sets were created, values were aggregated across these files, yielding a single data set with no missing values. The incident-level data were then aggregated to the city level to create a file with 'raw' (ignoring missing data) and multiply imputed frequencies of youth homicide for each city and for each year. Once this procedure was completed for all 23 years, the files were merged to create a time series data set for all 100 cities in the original sample. As all substantive analyses were conducted at the city level, aggregating across the five multiply imputed data files at the incident level and then aggregating to the city level should not adversely influence standard errors and thus tests of statistical significance.

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Measures dependent and independent variables

Age-specific homicide offender rates were constructed based on the population of potential offenders in each age group in the population of the city. Age data for these rates were based on US Decennial Census figures for 1980, 1990 and 2000. They were annualised with linear extrapolation to produce a time series for each age category and city. For the final period beyond the 2000 data, estimates and projections made by the US Census Bureau and reported in the County and City Data Book series 2007 report were used as mid-decade anchor points for the extrapolation. Where possible, mid-census estimates from the same source were used in 1985 and 1995 to provide mid-decade anchor points for the extrapolation.

The extrapolation methods used here employed the principle of maximum likelihood to generate credible estimates for the missing observation points between the known observation points. The assumption is, for example, that a 0.1% change between the known data anchor points of 1985 and 1990 is allocated approximately 20% each year in a steady increase or decrease.

Independent variables were selected based on previous research [66] on intercity variation in rates and trends of overall homicide as reviewed above, including alcohol availability, structural disadvantage, the proportion of housing units occupied by those who own the unit, the proportion of the population aged 18–24, gang activity, drug market activity and firearm availability. These variables were converted into time series in a similar manner to that described above for the homicide data.

Alcohol availability. The alcohol availability measure used here was taken from a US Bureau of the Census data collection series currently known as the Economic Census. These data are collected every 5 years in years that end in 2 and 7 during each decade. Data from 1982, 1987, 1992, 1997, 2002 and 2007 were utilised to construct the time series for this variable for each city using the extrapolation methods previously described. The measure used here includes the number of beer, wine and liquor stores. The establishments counted in this category are those primarily engaged in selling packaged alcohol beverages (e.g. beer, wine, liquor and ale) for off-site consumption at the retail level [67]. This category does not include grocery stores, convenience stores or other retail establishments that sell such alcoholic beverages for off-site or on-site consumption, but whose primary business involves other products, such as food. It does not include establishments that serve alcohol for on-site consumption, such as eating and drinking places, lounges, taverns, bars and restaurants. Per capita retail alcohol outlet density was constructed by dividing the number of outlets from this source by the population, extrapolated annually as described above.

Structural disadvantage, age composition and owner-occupied housing. A weighted structural disadvantage scale was constructed by conducting principal components factor analysis of five different indicators of disadvantage conventionally used in previous research. Factors loading for the years 1980, 1990 and 2000, respectively, are in parentheses by each indicator: per cent in poverty (0.92, 0.95, 0.94), per cent unemployed (0.80, 0.90, 0.77), per cent on public assistance (0.91, 0.87, 0.78), per cent female headed households with children (0.96, 0.95, 0.92) and per cent African American (0.83, 0.82, 0.73). Eigenvalues were 3.91, 4.05 and 3.47 for the three census years from 1980 to 2000. These data and the measures of age composition and owner-occupied housing were extracted from the County and City Data Book series and the 1980, 1990 and 2000 decennial census databases.

Drug market activity. Youthful offenders and gang members in urban areas often become associated with or involved in drug sales/distribution. A number of studies have linked such involvement to youth homicide [2,61,68–70]. A critical question is whether drug arrest statistics reflect changes in local law enforcement policy rather than drug market activity [61,69]. For example, drug arrests may increase or decrease because of shifts in drug enforcement policy and resources, which in turn may be driven by social and political factors not necessarily related to actual changes in local drug activity.

Given the limitations of drug arrest data, the use of an alternative proxy measure of drug market activity drawn from the SHR was explored. Specifically, the SHR provided data on the number of 'narcotics-related' homicides and the per cent of homicides at the city level that were narcotics-related was calculated as a proxy for drug market activity. Although local police classify incidents as narcotics-related (or not), this measure should not be as contaminated by enforcement policies as an arrest proxy and should be more reflective of the relative proportion of lethal violence within cities related to local drug market activity.

Firearm availability. Another important measure given our focus on youth homicide is firearm availability. A recent review of influential studies compared different proxy measures for the prevalence of firearm ownership with survey estimates [71]. 'Per cent of suicides with a firearm' consistently performed better than other proxy measures in cross-sectional comparisons [72]. For this study, the Division of Vital Statistics at the

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Table 1. *Descriptive statistics*

Variable	Mean	Standard deviation	Minimum	Maximum
Homicide offenders 13–17 per 100 000	35.22	36.32	0	399.95
Homicide offenders 18–24 per 100 000	52.45	50.32	0	464.94
Homicide offenders 25+ per 100 000	9.37	7.40	0	51.42
Structural disadvantage	0.00	1.00	−1.88	3.90
Owner-occupied housing units (%)	50.13	8.73	12.09	69.36
Per cent of population aged 18–24	12.22	2.57	6.30	23.54
Gun suicide ratio	0.52	0.15	0.07	0.98
Gang homicide (%)	3.07	8.18	0.00	70.59
Narcotics-related homicide (%)	6.22	7.79	0.00	100.00

National Center for Health Statistics provided their Multiple Cause of Death file for the years of 1989–2005. These data were used to construct a proxy for firearm availability in 1990 and 2000—the ratio of firearm suicides to total suicides. Cause of death information was reported at the individual level, but also included indicators for the city of residence of the decedent and the county of the occurrence of the suicide. City of residence was used to construct the ratio of firearms to total suicides. The extrapolation methods described previously were used to estimate the firearm suicide ration for missing years in the time series.

Youth gang presence and activity. A proxy measure for gang presence and activity was derived from the SHR homicide data—the proportion of all homicides in a given city and year classified as gang-related. Classification criteria are likely to vary across police agencies reporting homicide data to the FBI, but reliability of classification is a problem with any data that might be used to measure youth gang presence and activity [73]. To explore this matter empirically, the proxy measure was compared with another measured derived from the annual National Youth Gangs Survey (NYGS), conducted by the National Youth Gang Center [20]. This nationwide annual survey of law enforcement agencies included reports on gang homicides as well as the number of gangs within cities and the number of gang members.

The average gang membership for the period 1996–1999 and 2000–2004 reported in the NYGS for each city in the sample was calculated. The association between these averages and the average number of homicides classified as gang-related in the SHR for the same two periods was estimated. The associations were very strong: $r = 0.954$ for the 1996–1999 period and $r = 0.887$ for the 2000–2004 period. The association between the annual gang-related homicides in the SHR with those reported in the NYGS was also estimated.

Again, the associations were very strong, ranging from a low of $r = 0.682$ in 1999 to a high of $r = 0.960$ in 2001. These associations suggested that the proxy measure of gang presence and activity drawn from the SHR data was defensible.

Table 1 gives descriptive statistics for all variables. It shows that the range of the age-specific youth homicide rates in the largest urban centres in the USA is extreme. That is also the case for the per cent of total homicides that are gang-related or narcotics-related.

Analytic strategy

The relations between the independent variables and age-specific youth homicide trends were estimated with a set of techniques known collectively as panel models or pooled cross-sectional time series models. Pooled models offer a number of advantages over conventional time series and/or cross-sectional approaches [74]. Two advantages were particularly important for the present study: (i) the estimation of models that accounted simultaneously for both cross-sectional variation and dynamic processes (and the implications that both sets of processes have for the error in equation structures) and (ii) the question of statistical power. This second advantage involved the ability to detect effects that may be difficult to discern because of numerical limits on the observations in space or time. The pooled model approach addressed this issue, as the available degrees of freedom for the analysis was the number of cross-sections multiplied by the number of years in the time frame (for the present study, 91 cities by 23 years, $N = 2093$). This city-year sample size provided ample power for the detection of effects in the multivariate models estimated.

The literature reviewed above guided the selection of city characteristics included in the multivariate models estimated. The temporal trend was also estimated. The national youth homicide trend from 1984–2006 for

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both 13- to 17-year-olds and 18- to 24-year-olds had a distinctive and well-known pattern—a rapid escalation during the 'epidemic' years (1984–1993), a precipitous drop from that time to the new millennium, and an upturn thereafter. To determine whether this pattern held across cities, the time trend was estimated directly. Specifically, a third-order polynomial specification was estimated that included time, time-squared and time-cubed. The assumption was that if the trend in large cities reflects the national trend, the time effect should be positive, indicating the rapid increase in the early years, the time-squared term should be negative, indicating the decline during the middle years and the time-squared term should be positive, indicating the upturn in the later years of the time frame. The overall analytical objective was to determine whether the city characteristics independently predict variation in the age-specific homicide trends once this temporal pattern had been empirically estimated.

Results

A key methodological issue in analysing pooled cross-sectional time series models is the impact of heterogeneity among the cross-sections. However, the impact of such variation can be assessed using the Hausman test [75]. Table 2 gives the results of the Hausman test for the age-specific youth homicide rates. The test was statistically significant for homicides involving youth

13–17 and 18–24 years of age. This result indicated the appropriateness of the fixed effects model in which the unit-specific heterogeneity is included via the specification of dummy variables for each cross-section or city. Results reported below were based on the fixed effects model.

Substantive findings

Table 3 reports the results for the fixed effects pooled models for homicide offending rates in the two age groups. First, the positive time coefficient corresponded to the escalating youth homicide rates during the early 'epidemic' years of the 23 year series (e.g. the mid-1980s to the early 1990s). The negative time-squared coefficient reflected the downturn in the time series after the early 1990s, while the positive time-cubed coefficient captured the upturn of homicide rates

Table 2. *Hausman test results*

Dependent variable	Hausman test	Probability
Homicide offenders 13–17	31.97	0.0002
Homicide offenders 18–24	109.45	0.0000

Chi-square for Hausman test with 9 degrees of freedom for both dependent variables.

Table 3. *Pooled cross-section time series results: youth homicide, 91 large cities 1984–2006*

Model parameters (fixed effects)	Offenders 13–17		Offenders 18–24	
	Coefficient	Standard error	Coefficient	Standard error
Constant	−72.82*	23.59	−42.19	23.62
Time	12.44*	0.97	7.21*	0.97
Time-squared	−1.10*	0.10	−0.51*	0.10
Time-cubed	0.03*	0.003	0.01*	0.003
Structural disadvantage	16.25*	3.11	20.95*	3.11
Owner-occupied housing units (%)	0.64	0.36	0.27	0.36
Per cent of population aged 18–24	1.24	0.82	0.78	0.83
Gun suicide ratio	28.77*	12.48	38.10*	12.50
Narcotics-related homicides (%)	0.47*	0.08	0.38*	0.08
Gang homicide (%)	1.15*	0.13	0.63*	0.13
Alcohol outlet density	22.52*	8.20	46.64*	8.21
R-square		Overall R-square		Overall R-square
Between cities	0.28		0.24	
Within cities	0.22	0.22	0.15	0.21
Overall F-test	d.f. = 10, 1992	56.27*	d.f. = 10, 1992	34.45*
Rho (due to city-specific effects)	0.351		0.657	
F-test for all city effects equal 0	d.f. = 90, 1992	7.65*	d.f. = 90, 1992	23.98*

*$P \leq 0.05$; N = 2093.

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during the more recent years of the period. These results were similar across the models for the two offender age groups, indicating the expected empirical pattern in the general time trends of youth homicide offending.

The structural disadvantage scale was found to influence both aged 13- to 17-year-old offenders and their counterparts aged 18–24. However, neither owner-occupied housing units nor the proportion of young people in the population had statistically significant estimated effects on either offender age group. As expected, the estimate effects of the measures of firearm availability, narcotics trafficking and use, and violent youth gangs were statistically significant and positive on both age offender rates (see Table 3). Finally, the results in Table 3 also show that the estimated effects of the measure of alcohol availability were also statistically significant and positive on youth homicide offending for both young offenders and older offenders.

Sensitivity analyses

Sensitivity tests were calculated to ensure the extrapolation methods used for the independent variables were not influenced by the over-time variation in the data. Such tests were conducting using a jack knife procedure in which each year of data were systematically omitted 1 year at a time throughout the entire time series. If a year-to-year artefact was introduced by the extrapolation methods, the exclusion of a year in the middle of the sequence should disrupt any such contrived effect. The 22 resulting coefficients were used to construct a sampling distribution and a standard error for each independent variable. The findings were exactly the same as those reported in Table 3 above in terms of direction and significance of each predictor variable.

To examine whether the MI methods introduced a particular bias in one or a handful of cities, a similar procedure was utilised on the cross-sections, such that each city was systematically excluded one at a time from the analysis. The resulting distribution of estimate effects, in this case 90 replications of the model, was used to estimate a mean coefficient and a standard error. Once again, the results were the same as the year-to-year exclusion sensitivity analysis.

Finally, a model was estimated with data from available Census and mid-Census with 91 cross-sections and 5 time points (i.e. 1985, 1990, 1995, 2000 and 2005) and 3 time points, using only census years (i.e. 1980, 1990 and 2000). The economic census data for retail alcohol retail outlet density ending in 2 were used to correspond with the census year only analysis. The economic data collected in the year ending in 7 were used to correspond with the mid-census estimates in the first analysis with 5 time points. Once again, these

results replicated the findings reported in Table 3, meaning the direction and statistical significance of estimated effects of the major predictors was identical to that reported in Table 3. The over-time changes in the homicide rates captured by third-order polynomial terms could not be replicated by these final sensitivity analyses. Regardless, the results reported in Table 3 appeared to be robust, that is, not significantly influenced by the data management procedures implemented in this research.

Discussion and conclusion

The results reported in this article demonstrated the importance of the relations between alcohol and youth homicide in large US cities and contributed to the literature in several important ways. Although many studies have shown significant net effects of alcohol measures on violence within single cities, the neighbourhood level or census track level, this study found evidence of such effects utilising data national in scope and covering a significant amount of over-time variation. The time period included in the study was significant because of the enormous increases and declines in youth homicide during the reference period. The results extended the findings of a recent systematic literature review, which found that retail alcohol outlet density and violence are significantly related [8]. The findings also showed that other factors, including structural disadvantage, narcotic drug activity, firearm availability and gang influence had significant and theoretically predicted estimated effects on youth homicide in both age groups examined. In sum, the study's results supported the theoretical notion that alcohol availability was a significant determinant of lethal violence committed by adolescents and young adults, net of several major theoretically derived and empirically supported predictors of homicide rate variation identified in previous research. These results also add to a growing literature that shows that the relationship between outlet density and violence holds longitudinally for different types of violence in different social and national contexts [15–17].

The findings of this study have important policy implications. Despite many attempts to mobilise policy makers and despite some well-known attempts to implement programs, no sustainable effort national in scope has been devised and implemented to prevent youth violence based on reducing structural disadvantage, firearm availability, illegal drug market activity, or gang presence and activity. Conversely, a number of local and national studies have shown that reducing alcohol availability via alcohol policy or other related interventions have reduced such violence [9–12]. The findings of the present study suggest that reducing retail

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alcohol outlet density should significantly govern the trends of youth homicide. Hence, these results offer promise for guiding effective violence prevention and reduction strategies, especially those targeting alcohol availability among adolescents and young adults.

Acknowledgements

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Appendix 1

Cities included in this research:

Akron, Albuquerque, Amarillo, Anaheim, Anchorage, Atlanta, Austin, Baltimore, Baton Rouge, Birmingham, Boston, Buffalo, Charlotte, Chattanooga, Chicago, Cincinnati, Cleveland, Colorado Springs, Columbus (GA), Columbus (OH), Corpus Christi, Dallas, Dayton, Denver,
Des Moines, Detroit, District Of Columbia, El Paso, Flint, Fort Lauderdale, Fort Wayne, Fort Worth,
Fresno, Gary, Grand Rapids, Greensboro, Honolulu, Houston, Indianapolis, Jackson, Jacksonville,
Jersey City, Kansas City, Knoxville, Las Vegas, Lexington-Fayette, Lincoln, Little Rock, Long Beach, Los Angeles, Louisville, Lubbock, Madison, Memphis, Miami, Milwaukee, Minneapolis, Mobile, Montgomery, Nashville-Davidson, New Orleans, New York City, Newark, Norfolk, Oakland,
Oklahoma City, Omaha, Philadelphia, Phoenix, Pittsburgh, Portland, Providence, Raleigh, Richmond, Riverside, Rochester, Sacramento, Salt Lake City, San Antonio, San Diego, San Francisco, San Jose,
Santa Ana, Seattle, Shreveport, Spokane, Springfield (MA), St Petersburg, St. Louis, St. Paul, Stockton, Syracuse, Tacoma, Tampa, Toledo, Tucson, Tulsa, Virginia Beach, Wichita, Worcester

Note: Cities that are underlined here were dropped from the analysis reported here because of excessive missing data in the Supplemental Homicide Report; 'excessive' is defined here as 10 or more years of missing homicide reports between 1984 and 2006.