



Original communication

Ecologic factors relating to firearm injuries and gun violence in Chicago



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ABSTRACT

Background: Firearm violence is a major burden on Chicago with greater than 1500 gunshot injuries occurring annually. Identifying ecologic variables related to the incidence of firearm-related injuries and crime could prove useful for developing new strategies for reducing gun-related injuries.

Methods: The Illinois Trauma Registry (ITSR) and the Chicago Police Department's CLEAR (Citizen Law Enforcement Analysis and Reporting) dataset were retrospectively analyzed to investigate group-level factors potentially related to the incidence of gun-related injuries and crime in Chicago from 1999 through 2012. Multivariate linear regression was used to evaluate the effects of day of the week, daily maximum temperature, precipitation, and snow on the incidence of firearm-related injuries and crime.

Results: A total of 18,655 gunshot wounds occurred during the study period (ITSR, 1999–2009). There were 156,866 acts of gun violence identified in the CLEAR dataset (2002–2012). Day of the week, daily maximum temperature, and precipitation were associated with differential risks of gun injury and violence. Rain decreased firearm-related injuries by 9.80% [RR: 0.902, 95% CI: 0.854–0.950] and crime by 7.00% [RR: 0.930, 95% CI: 0.910–0.950]. Gunshot wounds were 33% [RR: 1.33, 95% CI: 1.29–1.37] more frequent on Fridays and Saturdays and gun crime was 18% [RR: 1.18, 95% CI: 1.16–1.20] more common on these days. Snow was not associated with firearm-related injuries or crime.

Conclusions: Day of the week, daily maximum temperature, and rain are associated with the incidence of firearm-related injuries and crime. Understanding the effects of these variables may allow for the development of predictive models and for risk-adjusting injury and crime data.

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1. Introduction

Firearm-related violence is a substantial burden on the health-care and judicial systems.¹ In 2009, greater than 13,000 Americans died from non-accidental trauma, and more than 67% of these deaths were directly attributable to firearm-related injuries.² Firearm-related violence is the second leading cause of death for Americans ages 15 to 19.¹ For black Americans ages 15 to 34, assault and homicide are the leading causes of death.¹ In 2012, the city of Chicago gained countrywide notoriety as 500 murders, the national

high, occurred within city limits.^{3,4} In the last year for which official statistics are available, 2011, the Chicago Police Department attributed 83.4% of the 433 homicides to firearm-related injuries.⁵

Epidemiological research has uncovered various ecological factors that seem to influence violent crime and trauma occurrence. In the past, studies have either analyzed crime rates or trauma rates, not comparing the two related events and their predictors.

Research studying crime occurrence has found summer, the second and third quarters of the year, hotter years, and higher temperatures to predict more crime.^{6–9} The temporality of these associations varies between studies, with some researchers choosing to analyze quarterly or monthly values of crime rates and ecological variables, affecting the feasibility of practical applications of this research, including hospital and police staffing policies.^{6,7} Studies that have employed daily values were either limited to less than a year of data or focused mainly on temperature effects, not analyzing other ecological variables such as rainfall.^{9,10}

Abbreviations: ITSR, Illinois Trauma Registry; CLEAR, Chicago Police Department's Citizen Law Enforcement Analysis and Reporting Dataset.

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Moreover, murder rates and undetermined violent deaths have not been associated with temperature in all studies.^{6,11}

Similar to research employing crime data, studies analyzing trauma occurrence have varied in terms of their methodologies, their chosen ecological variables, and their conclusions. Depending on the type of trauma, numerous weather-related variables, including temperature and rainfall, were found to predict admissions in an Accident and Emergency (A&E) department in England,¹² but not in an A&E department in Wales.¹³ In the US, Rising et al. (2006) found that temperature, rainfall, time of day, day of week, and month of year were all associated with trauma admissions to one hospital.¹⁴ The effect of violence on these relationships was not determined as all trauma admissions were used, and most studies that have analyzed violence-related admissions have only analyzed temporal variables.^{15,16}

The temporal and meteorological variables related to firearm violence have not been extensively studied. Other variables, including gun ownership and the number of firearm laws in a state, have been associated with firearm-related homicides and fatalities respectively.^{17,18}

This study seeks to discover the temporal and weather-related variables that are common or unique to crime and trauma occurrence as they relate to firearm-associated violence in Chicago. Specifically, the effect of daily maximum temperature, snow, rain and day of the week were analyzed to quantify their effects on the daily incidence of both gunshot injuries and gun-related crime. This is the first study to both quantify the effect of these ecologic factors on gun violence and crime in any major US city and to directly compare incident gunshot injury data with firearm-related crime data.

2. Methods

The Illinois Trauma Registry (ITSR) and the Chicago Police Department's CLEAR (Citizen Law Enforcement Analysis and Reporting) dataset were retrospectively analyzed to investigate group-level factors potentially related to the incidence of gunshot wounds and firearm-related crime in Chicago from 1999 through 2012.

Gunshot wound data was obtained by analyzing The Illinois Trauma Registry, which was created and is maintained by the Illinois Department of Public Health.¹⁹ This database contains deidentified injury-specific data on injuries which present to hospitals in Illinois that are identified as trauma centers. Because the data are deidentified, Institutional Review Board status is "exempted". Approximately one-third of Illinois hospitals are so designated. Of note, those who die at the scene of a traumatic injury but are not transported to a trauma center are not included in this database. Patients that die in the emergency department or are discharged within 12 h are also not included. Data from the years 1999–2009 were available to the authors and were included in the analysis. Data were initially restricted to entries occurring in the city of Chicago by using the "city scene" field. Injuries attributable to gunshot wounds were then identified using ICD-9 E-codes specific for firearm-related injuries. E-codes are supplemental coding labels included in ICD-9 for the purposes of injury research and prevention strategies. Specifically, E-codes 965.0 through 965.9 were included. The daily incidence of gunshot wounds was then calculated by summing the total number of appropriate entries for each day in the study period.

Firearm-related crime data were obtained from the Chicago Police Department's CLEAR dataset.²⁰ Included in this database are demographics relating to reported crimes occurring in the city of Chicago. Data from the years 2002 through 2012 were included in the analysis. Data were initially restricted using Illinois Uniform

Crime Reporting codes (IUCR) to include only reported crimes relating to firearms. Entries relating to twenty-seven such IUCR codes were included in the analyses. For example, the analysis included all reported crimes occurring during the study period and identified by IUCR code 271, which describes aggravated sexual assault where a handgun was used. The daily incidence of reported gun crime was then calculated by adding the total number of appropriately restricted entries for each day in the study period.

Historical temperature and weather-related data were obtained from the National Oceanic and Atmospheric Administration (NOAA). Daily maximum temperatures, precipitation, and snow levels for Chicago were obtained from NOAA Monthly Climate Summaries for the city of Chicago (Midway Airport weather station).

Each day in the study period was identified as a day with rain if the total 24 h rainfall (midnight to midnight) exceeded 30 thousandths of an inch. Similarly, days were identified as having snow if greater than 30 thousandths of an inch of snow fell in the 24 h period.

Multivariate linear regression and t-tests were used to evaluate the effects of day of the week, daily maximum temperature, precipitation, and snow on the daily incidence firearm-related violence and injuries.

Statistical calculations were performed using Stata 10 and Microsoft Office Excel 2011.^{21,22}

3. Results

A total of 18,655 gunshot injuries occurred during the study period (ITSR, 1999–2009). There were 156,866 acts of gun violence identified in the CLEAR dataset (2002–2012).

Fig. 1 depicts the total number of gunshot wounds occurring on each of the days of the week for the study period (ITSR, 1999–2009). Fig. 2 depicts the total number of reported firearm-related crimes occurring on each of the days of the week during the study period (CLEAR, 2002–2012).

Noting an increase in both gunshot wounds and firearm-related crimes on weekends (Fridays and Saturdays), these two days were compared to all other days using t-tests. Gunshot wounds were on average 33% [RR: 1.33, 95% CI: 1.29–1.37] more frequent on Fridays and Saturdays (ITSR) and gun crime was on average 18% [RR: 1.18, 95% CI: 1.16–1.20] more common on these days (CLEAR).

Fig. 3 depicts the daily number of gunshot wounds as a function of daily maximum temperature for the study period (ITSR, 1999–2009). Fig. 4 depicts the daily number of firearm-related crimes as a function of daily maximum temperature (CLEAR, 2002–2012). Table 1 describes calculated daily relative risks as a

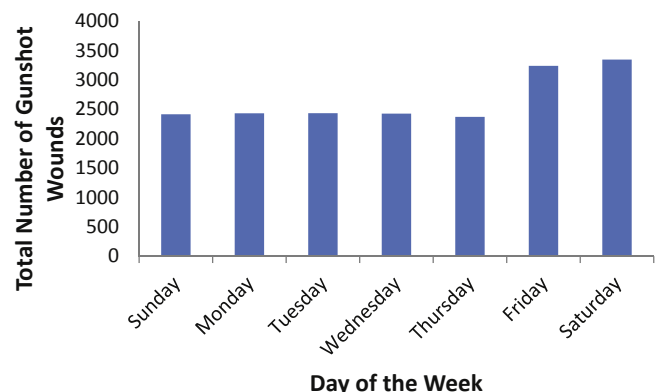


Fig. 1. Total number of gunshot wounds for each day of the week (ITSR, 1999–2009).

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