



Mapping Child Safety Seat Use in Cases of Fatal or Incapacitating Child Motor Vehicle Injury in Cook County, Illinois from 2011 to 2015

Victoria A. Salow¹ · Norma-Jean E. Simon² · Karen Sheehan¹

Published online: 22 February 2019
© Springer Science+Business Media, LLC, part of Springer Nature 2019

Abstract

Child safety seat use reduces the risk of fatal injury by 71% for infants and 54% for toddlers, yet more than one-third of child passengers killed in traffic crashes in the US are unrestrained. Nearly half (47%) of crash injuries occur within 5 miles of the injured person's home. Mapping the location of motor vehicle crashes resulting in serious or fatal injury to unrestrained child passengers may pinpoint high-risk neighborhoods. Illinois Department of Transportation data were used to map crashes that resulted in a fatal or incapacitating injury to a child passenger (age 0 to 8) in Cook County, IL from 2011 to 2015. Maptitude® Geographic Information System (GIS) software was used to identify hot spots of unrestrained child passenger injury on the South Side and West Side of Chicago. Of 174 zip codes in Cook County, 3 zip codes on the South Side of Chicago (60620, 60621; 60628) accounted for 11% of the total unrestrained fatalities and incapacitating injuries among children. Results of this study reveal the feasibility of detecting geographic disparities in child passenger safety at the zip code and neighborhood level and indicate the potential for more targeted allocation of resources.

Keywords Injury prevention · Child passenger safety · Mapping · GIS

Background

Despite a decade of decreasing child motor vehicle traffic fatalities in the United States, recent data suggest this trend is reversing [1]. In 2016, child motor vehicle fatalities rose to the highest level since 2009 with an average of three children killed in motor vehicle traffic crashes per day in the United States [2]. Proper use of child safety seats is known to

reduce the risk of fatal injury by 71 percent for infants (ages less than one year) and 54 percent for toddlers (ages one to four); [3] yet, more than one-third (39%) of child passenger fatalities in the United States in 2015 were unrestrained [1].

Child safety seat education and distribution programs have demonstrated effectiveness at increasing child safety seat use; [4, 5] however, the resource intensive nature of these programs makes large-scale implementation difficult. The National Highway Traffic Safety Administration reports that nearly half (47%) of crash injuries occur within 5 miles of the injured person's home [6]. Geospatial methods have been used to explore road traffic incidence and prevalence of road traffic injury in addition to environmental risk factors for road traffic injury. Unrestrained child passenger injury and the identification of at-risk child passenger populations has not been explored [7]. Geospatial analysis of motor vehicle crash locations resulting in serious or fatal injury to unrestrained child passengers has the potential to identify neighborhoods with a high burden of unrestrained injuries and to inform targeted child passenger safety efforts in a novel way. The objectives of this study were to map the locations of all motor vehicle crashes in Cook County, Illinois from 2011 to 2015 that resulted in serious or fatal injury to an unrestrained child passenger less than 9 years of age and

The motor vehicle crash data referenced herein was provided by the Illinois Department of Transportation. Any conclusions drawn from analysis of the aforementioned data are the sole responsibility of the data recipient(s). Additionally, for coding years 2015 to present, the Bureau of Data Collection uses the exact latitude/longitude supplied by the investigating law enforcement agency to locate crashes. Therefore, location data may vary in previous years since data prior to 2015 was physically located by bureau personnel.

✉ Victoria A. Salow
vsalow@luriechildrens.org

¹ Stanley Manne Children's Research Institute, Ann & Robert H. Lurie Children's Hospital of Chicago, 225 E. Chicago Ave, Box 157, Chicago, IL 60611-2991, USA

² Pediatric Emergency Medicine Division, Ann & Robert H. Lurie Children's Hospital of Chicago, Chicago, IL, USA

to identify hot spots of unrestrained child passenger injury in order to target outreach programs.

Methods

The focus area of this study was Cook County, Illinois. At the time of the 2010 Census, Cook County had a total population of 5,194,675 people and Chicago, the largest city within Cook County, had a total population of 2,695,598 people [8]. Traffic crash data for Cook County were obtained from the Illinois Department of Transportation for years 2011 through 2015. Data were collected by responding officers at the scene of the crash using the Illinois Traffic Crash Report SR 1050 Form. The analytical dataset was restricted to (1) child passengers, 8 years of age or younger, where safety restraint use was known (i.e. child restraint used, seatbelt used or unrestrained), (2) child passengers who sustained an incapacitating or fatal injury, and (3) crashes involving a passenger car, pickup truck, mini-van, or sport utility vehicle. Incapacitating injury in Illinois is defined as, “any injury, other than fatal injury, which prevents the injured person from walking, driving, or normally continuing the activities he/she was

capable of performing before the injury occurred. This includes severe lacerations, broken/distorted limbs, skull injuries, chest injuries, and abdominal injuries.” [9].

Maptitude® Geographic Information System (GIS) software was used to create three maps: (1) all cases of fatal or incapacitating injury to a child passenger (regardless of safety restraint use), (2) all cases of fatal or incapacitating injury to a child passenger who was restrained with a seatbelt (in violation of Illinois’ Child Passenger Protection Act) or who was unrestrained, and (3) all cases of fatal or incapacitating injury to a child passenger who was unrestrained (not using a seatbelt or a child safety seat). A Maptitude® density grid showing injury hot spots was created for the second map (unrestrained child passengers and child passengers restrained with a seatbelt) and the third map (unrestrained child passengers) using the default quartic methods.

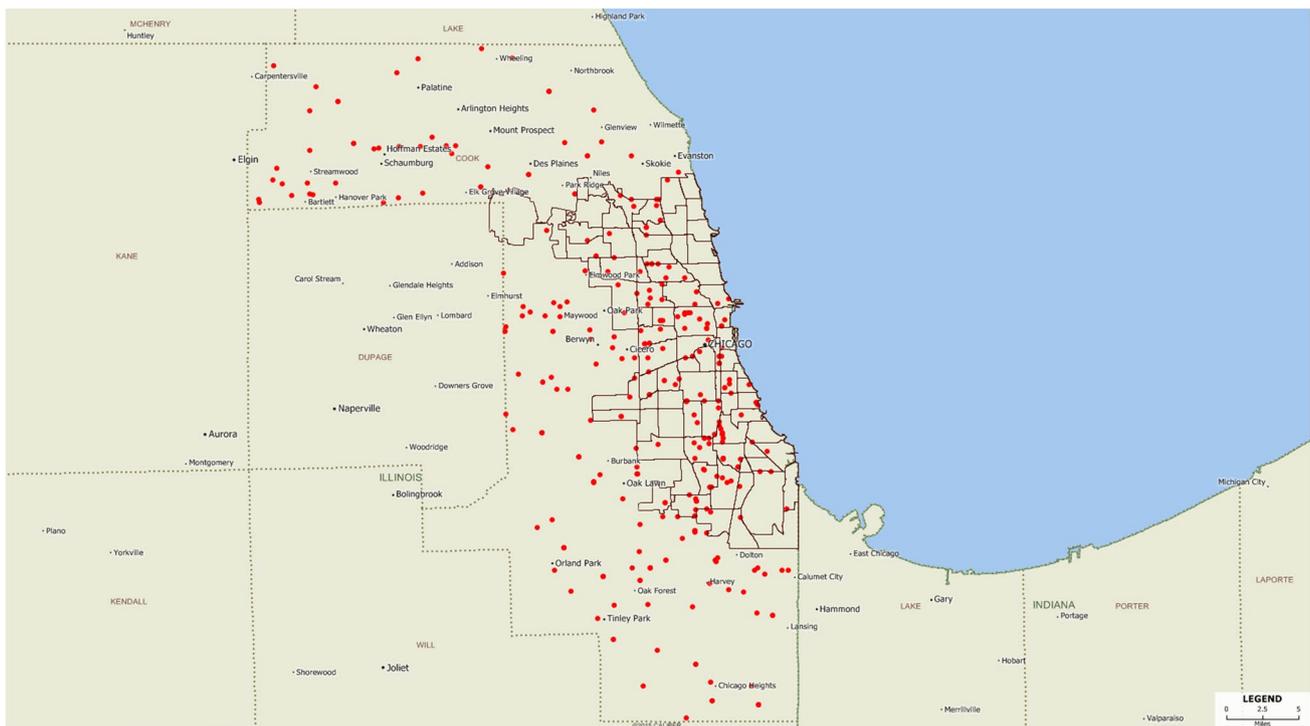


Fig. 1 All crashes resulting in fatal or incapacitating injury to a child passenger (regardless of safety restraint use) in Cook County, Illinois 2011–2015 (n=316)

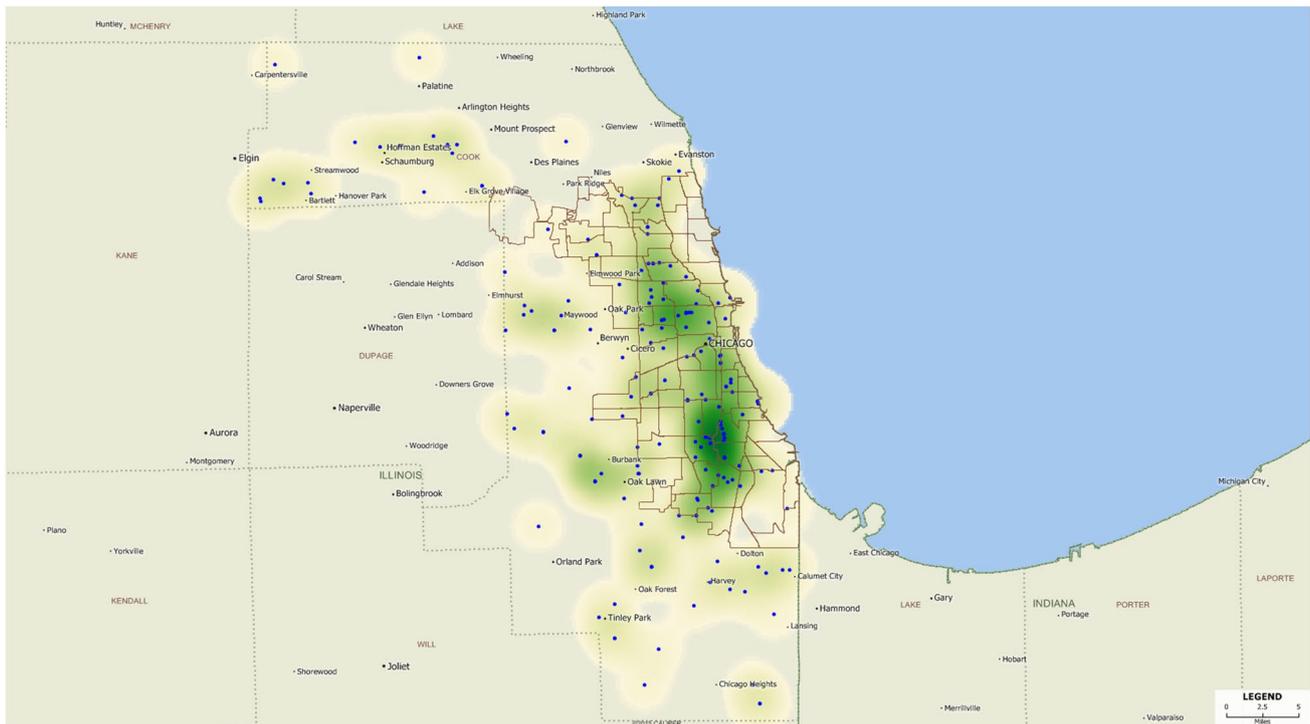


Fig. 2 All crashes resulting in fatal or incapacitating injury to a child passenger not restrained in a child safety seat (restrained by a seatbelt or unrestrained) in Cook County, Illinois 2011–2015 ($n = 195$)

Results

During the five year study period, 702,483 crashes occurred in Cook County, Illinois involving 53,582 children 8 years of age or younger. The final dataset included 331 child passengers (53% female) who sustained a fatal (2%) or incapacitating (98%) injury. Approximately one-third (38%) of children were restrained with a child safety seat, half (49%) were restrained inappropriately with a seatbelt, and 13% were unrestrained. Crash location data was available for 316 cases and 63% of cases occurred in Chicago (Fig. 1). Of 195 cases of fatal or incapacitating injury to a child passenger who was restrained with a seatbelt (in violation of Illinois' Child Passenger Protection Act) or who was unrestrained, 70% occurred within the city of Chicago and two higher density regions emerged (Fig. 2). Of 41 cases that resulted in a fatal or incapacitating injury to a child passenger who was unrestrained (not using a seatbelt or a child safety seat), 63% occurred within the city of Chicago and one higher density region emerged (Fig. 3). Of 174 zip codes in Cook County, 3 zip codes (60620, 60621; 60,628) accounted for 11% of the total cases of fatal or incapacitating injury to a child passenger who was unrestrained.

Discussion

The ultimate goal of child safety seat education and distribution program is to reduce morbidity and mortality among crash involved child passengers by increasing the total number of child passengers properly restrained. As such, it is critical that programs identify children most at-risk for traveling unrestrained and consequently most at-risk for serious injury. While counts and rates of injury or fatality among child passengers within larger geographic regions such as a state or county are helpful indicators of the overall state of child passenger safety, resource allocation decisions are better informed by data that pinpoint at-risk areas. The results of this study reveal the feasibility of identifying geographic disparities in child passenger safety at the zip code and neighborhood level and indicate the potential for targeted interventions. Differences in Fig. 2 (child passengers restrained by a seatbelt or unrestrained) and Fig. 3 (unrestrained child passengers) may indicate barriers to proper child restraint use beyond economic factors. Because every vehicle has a seatbelt, unrestrained cases may indicate different cultural or social norms regarding child restraint practices than seatbelt restrained cases. These potential differences between high-risk neighborhoods should be investigated and may need to be addressed before child safety seat

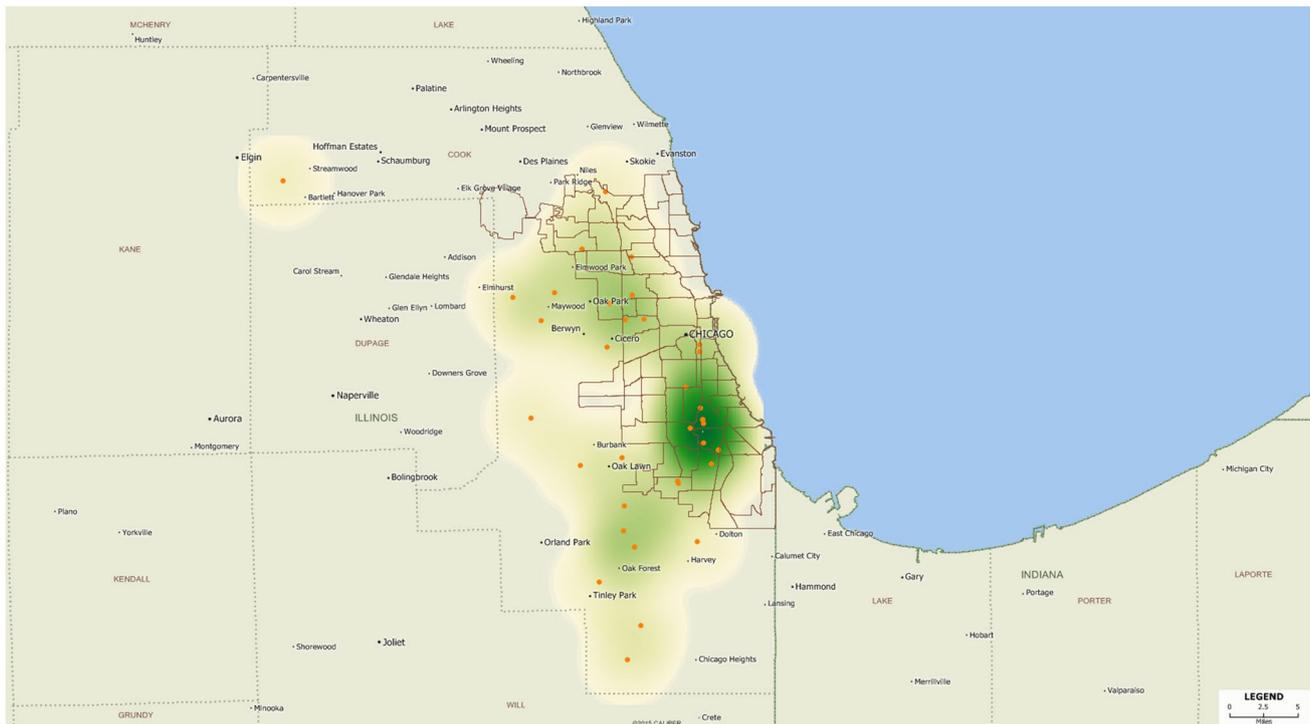


Fig. 3 All crashes resulting in fatal or incapacitating injury to an unrestrained child passenger (not restrained by a child safety seat or by a seat-belt) in Cook County, Illinois 2011–2015 (n = 41)

education and distribution programs can be implemented successfully.

Limitations

This study only examined data from Cook County, Illinois. Future studies are needed to determine whether similar geographic disparities exist in comparable communities. The residential addresses of the child passengers included in this study were not available, so we could not determine whether the children lived within the identified injury hot spots. A linked database of police crash data and hospital emergency department data would have allowed us to ascertain where the unrestrained children who suffer serious outcomes live in addition to where they sustained their injuries. Finally, this study only examined location data and does not allow for the examination of additional factors that might impact child passenger safety. Despite these limitations, this study provides a novel data-driven approach to improving child passenger safety.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

References

1. National Highway Traffic Safety Administration. (2017). Traffic safety facts 2015 data: children. DOT HS 812 383. Retrieved from <https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812383>.
2. National Highway Traffic Safety Administration. (2018). Traffic safety facts 2016 data: children. DOT HS 812 491. Retrieved from <https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812491>.
3. National Highway Traffic Safety Administration. (1996). Revised estimates of child restraint effectiveness. DOT HS 96 855. Retrieved from <https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/96855>.
4. Ehiri, J. E., Ejere, H. O., Magnussen, L., Emusu, D., King, W., & Osberg, J. S. (2006). Interventions for promoting booster seat use in four to eight year olds travelling in motor vehicles. *Cochrane Database of Systematic Reviews*, 1, 1–31.
5. Task Force on Community Preventive Services. (2001). Recommendations to reduce injuries to motor vehicle occupants: Increasing child safety seat use, increasing safety belt use, and reducing alcohol-impaired driving. *American Journal of Preventive Medicine*, 21(4S), 16–22.
6. National Highway Traffic Safety Administration. (2008). 2007 Motor Vehicle Occupant Safety Survey (MVOSS): Volume 4 crash injury and emergency medical services report. DOT HS 810 977. Retrieved from <https://one.nhtsa.gov/Driving-Safety/Research-&-Evaluation/2007-Motor-Vehicle-Occupant-Safety-Survey>.
7. Singh, H., Fortington, L. V., Thompson, H., & Finch, C. F. (2016). An overview of geospatial methods used in unintentional injury epidemiology. *Injury Epidemiology*, 3(1), 1–12.

8. United States Census Bureau. QuickFacts Cook County, Illinois. (n.d.). Retrieved from <https://www.census.gov/quickfacts/fact/table/chicagocityillinois,cookcountyillinois/POP010210>.
9. Illinois Department of Transportation Division of Traffic Safety. (2013). Illinois traffic crash report SR 1050: Instruction manual for law enforcement agencies. Retrieved from <http://www.idot.illinois.gov/assets/uploads/files/transportation-system/manuals-guides-&-handbooks/safety/illinois%20traffic%20crash%20report%20sr%201050%202013.pdf>.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.