Annals of Epidemiology 26 (2016) 1–6

Contents lists available at ScienceDirect

Annals of Epidemiology

journal homepage: www.annalsofepidemiology.org

Original article

Race and ethnicity, neighborhood poverty and pediatric firearm hospitalizations in the United States

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ARTICLE INFO

Article history:
Received 2 February 2015
Accepted 8 October 2015
Available online 30 October 2015

Keywords:
Firearm
Injury
Pediatric
Motor vehicle accidents
Trends
In-hospital mortality

ABSTRACT

Purpose: To better understand the effects of race and/or ethnicity and neighborhood poverty on pediatric firearm injuries in the United States, we compared overall and intent-specific firearm hospitalizations (FH) with those of pedestrian motor vehicle crash hospitalizations (PMVH).
Methods: We used Nationwide Inpatient Sample data (1998–2011) among 0–15 year-olds in a 1:1 case-case study; 4725 FH and 4725 PMVH matched by age, year, and region.
Results: Risk of FH versus PMVH was 64% higher among black children, Odds ratio (OR) = 1.64, 95% confidence interval (95% CI) = 1.44–1.87, as compared to white children ($P < .0001$); this risk did not vary by neighborhood poverty (P interaction = .52). Risk of homicide FH versus PMVH was 842% higher among black (OR = 8.42, 95% CI = 6.27–11.3), 452% higher among Hispanics (OR = 4.52, 95% CI = 3.33–6.13) and 233% higher among other race (OR = 2.33, 95% CI = 1.52–3.59) compared to white children. There was a lower risk for unintentional FH among black OR = 0.73, 95% CI = 0.62–0.87, Hispanics (OR = 0.60, 95% CI = 0.49–0.74), and other (OR = 0.63, 95% CI = 0.47–0.83) compared to whites. These intent-specific risks attributed to race did not vary by neighborhood affluence.
Conclusions: Black children were at greater likelihood of FH compared to white children regardless of neighborhood economic status. Minority children had an increased likelihood of intentional FH and a decreased likelihood of unintentional FH as compared to white children irrespective of neighborhood income.

Firearm injuries are one of the three major causes of death in children [1]. Importantly, for every pediatric firearm fatality, there are seven to eight nonfatal firearm injuries [2]. Although nonfatal firearm injury rates declined slightly from 8.25 per 100,000 in 2001 to 7.35 in 2011 [2], a recent study reported that on average, 20 pediatric firearm hospitalizations (FH) occur every day among those younger than 20 years of age in the United States [3]. FH are associated with high hospitalization costs, severe injuries, and persisting disabilities [4–6].

Racial and/or ethnic and income differences in the occurrence of injury-related hospitalization have been well established [7–10]. In particular, there are racial and/or ethnic differences in pediatric firearm injuries, with 50% of emergency room firearm-related visits being among black children [9]. Injury-related hospitalizations and fatality are also associated with residence in low-income neighborhoods [10]. The risk of all-cause injury and assault injuries is more likely in children from low-income households [10,11].

Parallels have been drawn between firearm injuries and motor vehicle accidents (MVAs) in the context of gun control. MVAs have been drastically reduced because of effective legislative and public health approach [12], whereas gun violence prevention is also

The authors have no conflicts of interest to disclose.

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http://dx.doi.org/10.1016/j.annepidem.2015.10.009
1047-2797/

amenable to reduction by application of the same methods [13]. Of particular importance is that, younger age groups were found to be more likely to retain pedestrian MVA injuries, whereas older age groups were liable to firearm, assault, and occupant MVA injuries [14]. Among all MVA injuries, pedestrian injuries are more severe than occupant injuries and significantly more injured pedestrians occurred at intersections in poor areas [15].

However, to our knowledge, there have been no studies that have explored whether the increased risk of FH among minorities varies by neighborhood income. Simply put, is the increase in risk of FH among minority children only present in low-income neighborhoods? In this analysis, we compared FH to pedestrian motor vehicle crash related hospitalizations (PMVH), informed by previous reports [16] that draw parallels between efforts that have successfully reduced motor vehicle related injury in the United States over the past decades and potential efforts that could successfully influence firearm injury.

Methods

Data

Data were derived from the Healthcare Cost and Utilization Project (HCUP), Nationwide Inpatient Sample (NIS), a longitudinal database by the Agency for Healthcare Research and Quality [17]. The NIS is a 20% stratified sample of U.S. hospitals from state hospitalizations, which draws from over 1000 hospitals in 46 states, capturing approximately 8 million acute hospital stays each year. Firearm and pedestrian motor vehicle crash related injury hospitalizations were derived from secondary diagnostic *International Classification of Diseases, ninth edition* (ICD-9) codes as described in Supplementary Appendix 1. Having one of 32 diagnostic ICD-9 codes in Supplementary Appendix 1 was classified as PMVH. Intent of FH was categorized into suicide, homicide, unintentional, undetermined, and legal using ICD-9 E-codes. We used NIS data sets from 1998 to 2011 to compare FH and PMVH. The data sets were first restricted to all hospitalizations between the age of 0–15 years because of distinct firearm injury differences between children and adolescents [18], followed by exclusion of all neonatal hospitalizations (defined by primary diagnostic ICD-9 code in Supplementary Appendix 2), resulting in a total of 83,129,094 survey-weighted hospitalization records (unweighted = 16,998,470). For comparison of FH versus PMVH, we further restricted the data to include only FH (survey weighted, $n = 23{,}259$, unweighted, $n = 4725$) and PMVH (survey weighted, $n = 115{,}737$, unweighted, $n = 23{,}387$).

Study design

To determine the impact of race and ethnicity, we used a 1:1 matched case-case design; matched for survey year, age categories (0–5, 6–10, and 11–15 years), and U.S. census regions. Case control studies is a common study design in epidemiology used to determine the strength, magnitude, and direction of associations between exposure variables and an outcome of interest, whereas a variant, case-case design is used when the condition of interest can be a comparison of several groups that may have distinct risk factors and obtained from the same surveillance system [19]. Here, the common surveillance system is the injury-related inpatient hospitalization data, where the common group is injury and the subgroups that are compared are FH and PMVH. Therefore, the main advantage of the case-case design in this case is to limit selection, and information biases as the control cases have similar clinical features and are identified through the same system and is subject to the same biases as cases [19,20]. Cases could not be matched based on hospitals which were primary stratification units (PSUs) because the sample sizes within each PSU will be insufficient to yield standard errors. U.S. census regions (geographical unit of U.S. census region was states) were used as broader approximations for PSUs. The cases were pediatric FH, and control cases were PMVH matched in a 1:1 ratio. We used survey year, age, and U.S. census regions as variables to be matched for depending on the significant differences in these variables between the two groups, FH versus PMVH.

Variables

The main exposure of interest was race and ethnicity for the case-case study between FH versus PMVH. Race and/or ethnicity was categorized into white, black, Hispanic, and other (pooled from Asian or Pacific Islander, Native American, other races). NIS provides a quartile classification of the estimated median household income of residents in the patient's ZIP code. The quartiles are identified by values of 1 to 4, indicating the poorest to wealthiest populations. The lowest income quartile ranges from $1 to $28,999 in 1998 to $1 to $38,999 in 2011. Neighborhood economic status was categorized as high versus low income based on the median zip code income of the hospitalized patient. The neighborhood was categorized as low income if the hospitalized patient was living in a neighborhood with median income $\leq$$25,000 during survey years 1998 to 2002, or if the median household income of the neighborhood belonged to the lowest national quartile for survey years 2003 to 2011. The other patient level covariates used in the analysis were gender (male, female), primary payer (private, Medicaid/other), and U.S. census regions (Northeast, Midwest, South, West).

Statistical analysis

Rates per 100,000 pediatric hospitalizations for FH and PMVH from 1998 to 2011 were assessed using survey-weighted proportions separately for each survey year. Analysis of matched case-case study was performed using unweighted conditional logistic regression to calculate odds ratios (ORs) and 95% confidence intervals (CIs). FH was compared against PMVH to assess the impact of race and/or ethnicity and other individual level covariates without survey weights to account for matched analysis. Although the strength of the association (OR) assesses the association between race/ethnicity and FH, it is important to interpret this association in comparison with PMVH. We obtained an adjusted estimate of risk of race and/or ethnicity by adjusting for covariates that significantly improved the likelihood of the model. Effect modification by neighborhood income status was assessed, and the difference in effect was assessed using appropriate interaction tests. Survey-adjusted analysis could not be performed due to low sample sizes (resulting in nonestimable standard errors) within primary sampling units for estimation of conditional ORs and stratified analysis. All analyses were performed using STATA, 13.1 (StataCorp LP; College Station, TX).

Results

During 14 years, from 1998 to 2011, of the 16,998,470 unweighted counts of hospitalizations among 0 to 15 year old, 4725 were FH (0.03%), and 23,387 were PMVH (0.14%). Both FH and PMVH rates significantly declined from 1998 to 2011 (Supplemental Table 1). Among all pediatric FH, 1834 (38.9%) were assault FH, 2443 (51.7%) were unintentional and/or accidental, 145 (3.1%) were suicide FH, 282 (6.0%) were of undetermined intent and 19 (0.4%) were legal FH. After 1:1 matching by age, year, and U.S. census region, 9.8% were between 0 and 5 years, 15.9% were