Association of health insurance coverage and probability of dying in an emergency department or hospital from a motor vehicle traffic injury

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Abstract
Objective: Describe the association of health insurance coverage with the odds of mortality in an emergency department (ED) or hospital for adult victims of a motor vehicle crash.

Methods: This cross-sectional study pooled and averaged 6 years of data, 2009–2014, from the Nationwide Emergency Department Sample (NEDS). Our analysis was restricted to patients 20–85 years old that were treated in an ED for an injury sustained from a motor vehicle traffic crash (N = 2,203,407 average annual hospital discharges). The outcome variables were whether the motor vehicle crash victim died in the ED or hospital. The predictor variable was health insurance status that was measured as uninsured, Medicare, Medicaid, private insurance, and other insurance.

Results: Most patients that died had some form of health insurance with less than a quarter classified as uninsured (23%). Nearly half of the patients that died had private insurance (48%) followed by Medicare (13%), Medicaid (9%), and other insurance (8%). Compared to the uninsured, the multivariate adjusted odds ratios (ORs) for death were significantly (P < 0.001) lower for Medicare (OR = 0.83, 95% confidence interval [CI] = 0.76–0.92), Medicaid (OR = 0.76, 95% CI = 0.69–0.84), private insurance (OR = 0.63, 95% CI = 0.58–0.68), and other insurance (OR = 0.61, 95% CI = 0.54–0.70).

Conclusion: After accounting for hospital and patient characteristics, lack of health insurance was associated with a higher likelihood of death for patients admitted to an ED or hospital for injuries sustained from a motor vehicle crash.

KEYWORDS
emergency care, emergency medicine, health insurance, mortality, motor vehicle, uninsured
1 | INTRODUCTION

1.1 | Background

Motor vehicle crashes are widely acknowledged to be a leading cause of death and global burden of disease. The United States has comparatively higher mortality compared to other countries. Emergency departments (EDs) care for millions of motor vehicle crash victims every year. The focus on reducing motor vehicle traffic injuries and mortality has focused on traffic policies and the built environment with limited attention to the role of EDs and physicians. The Donabedian model is a conceptual framework that can be applied to the study of motor vehicle crash outcomes, especially because insurance is a predictor of survival after accounting for other factors including severity of injury. Past studies have also identified that uninsured ED patients may be more likely to be transferred to another ED compared to insured patients, which then impacts the structure and process of care.

Studies of trauma care outcomes have found that health insurance is a predictor of survival after accounting for other factors including severity of injury. Further underscoring the importance of insurance is that the odds of dying for trauma patients in level 1 trauma centers has been associated with type of health insurance coverage. There is evidence that the availability of trauma surgeons can reduce mortality for patients admitted to a hospital.

1.2 | Importance

The mechanism for persons lacking health insurance to have higher mortality has been linked to the structure and processes of care such as access to quality of care, including car crash victims. Past studies have also identified that uninsured ED patients may be more likely to be transferred to another ED compared to insured patients, which then impacts the structure and process of care.

Studies of trauma care outcomes have found that health insurance is a predictor of survival after accounting for other factors including severity of injury. Further underscoring the importance of insurance is that the odds of dying for trauma patients in level 1 trauma centers has been associated with type of health insurance coverage. There is evidence that the availability of trauma surgeons can reduce mortality for patients admitted to a hospital.

1.3 | Goals of this investigation

The broader role of health care access of ED patients as a risk factor for mortality in the ED has received limited attention, especially for motor vehicle crash victims. Moreover, although the Donabedian model has been validated for use with trauma systems, there are few studies that have applied this framework to car crash outcomes in EDs. Therefore, the objective of this paper is to describe the association of health insurance coverage, an antecedent factor in the Donabedian model, with the odds of mortality in an ED or hospital for adult victims of a motor vehicle crash.

The Bottom Line

In this analysis of 2.2 M emergency department (ED) motor vehicle collision visits in the National Emergency Department Sample, lack of health insurance was associated with higher odds of death. Although potentially limited by confounders, this study highlights the importance of insurance status as a determinant of health outcomes.

2 | METHODS

2.1 | Study design and data source

This cross-sectional study pooled 6 years of data (2009–2014) from the Nationwide Emergency Department Sample (NEDS) to generate average annual weighted counts, adjusted for sampling design. The NEDS is an all-payer database of hospital-owned ED visits in the United States as part of the Healthcare Cost and Utilization Project (HCUP) administered by the Agency for Healthcare Research and Quality. The unit of analysis in NEDS is the hospital discharge rather than a patient. The database enables national estimates of ED use by combining over 30 million annual ED visits from the State Inpatient Databases and State Emergency Department Databases. The data do not include patient identifiers. The de-identified data contain several data elements from discharge records including diagnosis and procedure codes, mortality status at discharge, patient demographics, payment source, ED charges, and hospital characteristics. A detailed description of HCUP and more information on the design of the NEDS has been published elsewhere. This study used de-identified, publicly available data and was determined exempt by the Drexel University Institutional Review Board (protocol number 2106008623). We followed the STROBE reporting guidelines for observational, cross-sectional studies.

2.2 | Selection of participants

We restricted our analysis to patients 20–85 years old that were treated in an ED for an injury sustained from a motor vehicle traffic crash. We excluded persons 16–19 years old to reduce the variability in education status and health insurance status. We included patient discharges in the ED for an injury sustained from a motor vehicle crash as defined by code 2607 in the clinical classification software, which corresponds to ICD-9-CM codes E810.00 to E819.99, E968.5, and E988.5. Records were included if any diagnosis that met the criteria was present on the discharge record. The final sample size from the pooled records meeting the inclusion criteria was 2,203,407 hospital discharges, representing an annual average during 2009–2014. A flowchart showing the study sample selection is provided in Figure 1. A substantial number of persons 20–85 years old with
a motor vehicle traffic injury did not have an injury severity score ranging from 1–75 (n = 334,604; 13%) and were excluded, as were records missing any of the variables used in the multivariate analyses. HCUP NEDS documentation reports that some records with an injury severity score because the list of diagnoses accepted by the injury severity score algorithm is more restrictive than the list of diagnoses used by HCUP to identify injuries.

2.3 | Measurements

The primary outcome variable was whether the motor vehicle crash victim died in the ED or hospital. We also disaggregated deaths to investigate ED deaths and hospital deaths as outcomes separately. The predictor variable was health insurance status as indicated in the NEDS expected primary payer variable and was measured as uninsured (combination of self-pay and no charge), Medicare, Medicaid, private insurance, and other health insurance (worker’s compensation, TRICARE/CHAMPUS, CHAMPVA, Title V, and other government programs). Patient demographic characteristics included sex (male or female), age (20–44 years, 45–64 years, and 65–85 years), and median income of patient’s zip code divided into quartiles. HCUP generates an injury severity score by using a publicly available Stata program that implements the Baker & O’Neill Injury Severity Score (ISS) algorithm to classify injuries on a scale from 1 to 75 with the highest score indicating the most severe injury.40–42 We categorized the injury scores as mild to moderate (1 to 15) and severe or profound (16 or greater).40–42 Hospital characteristics included hospital region (Northeast, Midwest, South, West), hospital location and teaching status as determined from the American Hospital Association Annual Survey of Hospitals (nonmetropolitan, metropolitan teaching, metropolitan non-teaching), and hospital trauma level (nontrauma, level III, level II, and level I). Because of changes in the hospital trauma level variable throughout NEDS years, some records were originally classified in collapsed categories including “nontrauma or level III,” “level I or II,” and “level I, II, or III.” We recoded each of these levels to their corresponding lowest trauma level so that “nontrauma or level III” became nontrauma, “LEVEL I or II” became level II, and “level I, II, or III” became level III. We compared this approach with excluding records in the collapsed levels listwise from the analysis, but results were substantively unchanged.

2.4 | Statistical analysis

All analyses accounted for the NEDS complex sampling design including hospitals as the primary sampling unit, stratified sampling according to the NEDS hospital sampling strata, and weighting of all estimates to the universe of discharges using the NEDS discharge weight variable. All estimates reflected annual averages for the 6 included years by dividing the discharge weight variable by 6 in the combined 2009–2014 dataset prior to analysis. One- and 2-way tabulations were conducted in SAS version 9.4 using PROC SURVEYFREQ. The NEDS complex sampling design was accounted for with the STRATA, CLUSTER, and WEIGHT statements in PROC SURVEYFREQ, and subdomain analysis for the study sample was achieved via multiway tables for each level of a dichotomous study sample membership indicator. All logistic regressions were derived via maximum likelihood estimation and adjusted ORs and 95% CIs were also calculated for insurance status from multivariate-adjusted logistic regression models that predicted patient mortality, including all deaths combined and ED and hospital deaths separately, from injuries sustained from a motor vehicle crash was associated with health insurance status after accounting for patient and hospital characteristics. Control variables were selected based on availability in the NEDS database, relevance as indicated by existing literature, and unadjusted associations with dying in the ED or hospital. Variable interactions were not considered as the primary association of interest was the main effect of insurance status. Unadjusted ORs and 95% CIs were also calculated for insurance status from a simple logistic regression model of all deaths combined.

To investigate model fit and multicollinearity, the Stata user-written command svylogitgof and a variance inflation check was run after...
TABLE 1 Weighted proportion (annual average) of emergency department discharges related to a motor vehicle traffic injury among patients 20–85 years old, Nationwide Emergency Department Sample, 2009–2014

| Primary payer (expected) | No.   | %   |
|--------------------------|-------|-----|
| Uninsured                | 497,507 | 23  |
| Medicare                 | 106,181 | 5   |
| Medicaid                 | 202,552 | 9   |
| Private including HMO    | 1,183,110 | 54  |
| Other                    | 214,057 | 10  |

| Hospital teaching status | No.   | %   |
|--------------------------|-------|-----|
| Non-metropolitan         | 319,403 | 14  |
| Metropolitan non-teaching| 878,579 | 40  |
| Metropolitan teaching    | 1,005,426 | 46  |

| Hospital region          | No.   | %   |
|--------------------------|-------|-----|
| Northeast                | 400,433 | 18  |
| Midwest                  | 391,544 | 18  |
| South                    | 1,059,813 | 48  |
| West                     | 351,618 | 16  |

| Hospital trauma level    | No.   | %   |
|--------------------------|-------|-----|
| Nontrauma                | 1,275,431 | 58  |
| Level III                | 247,615 | 11  |
| Level II                 | 347,075 | 16  |
| Level I                  | 333,286 | 15  |

| Year | No.   | %   |
|------|-------|-----|
| 2009 | 359,639 | 16  |
| 2010 | 380,212 | 17  |
| 2011 | 362,687 | 16  |
| 2012 | 369,940 | 17  |
| 2013 | 358,359 | 16  |
| 2014 | 372,570 | 17  |

| Patient age, y           | No.   | %   |
|--------------------------|-------|-----|
| 20–44                     | 1,396,701 | 63  |
| 45–64                     | 621,530 | 28  |
| 65–85                     | 185,176 | 8   |

| Patient gender           | No.   | %   |
|--------------------------|-------|-----|
| Female                   | 1,154,644 | 52  |
| Male                     | 1,048,763 | 48  |

| Patient injury severity score | No.   | %   |
|-------------------------------|-------|-----|
| Mild or moderate (1–15)       | 2,150,832 | 98  |
| Severe or profound (16+)      | 52,576 | 2   |

| Patient zip code median income | No. | % |
|-------------------------------|-----|---|
| Quartile 1 (low)              | 698,543 | 32 |
| Quartile 2                    | 592,403 | 27 |
| Quartile 3                    | 512,488 | 23 |
| Quartile 4 (high)             | 399,974 | 18 |

(Continues)

TABLE 1 (Continued)

| Full sample (n = 2,203,407), | No. | % |
|-------------------------------|-----|---|
| Patient died                  |     |   |
| No                             | 2,194,355 | 99.6 |
| Yes                            | 9053 | 0.4 |
| Died in ED                     | 4263 | 0.2 |
| Died in hospital               | 4790 | 0.2 |

Abbreviations: ED, emergency department; HMO, health maintenance organization.

estimation of the main model of all deaths combined via the Stata command estat vif. The initial model also included patient residence urbanicity as a covariate. The mean variance inflation factor (VIF) of the initial model was 1.95 and only hospital teaching status and patient residence urbanicity had VIFs > 5. Although guidance on acceptable VIFs ranges slightly in the literature, one published standard is that multicollinearity is said to be present if the VIF is higher than 5 to 10. To reduce multicollinearity, patient residence urbanicity was then dropped from the final model—the mean VIF reduced to 1.52 and no variables had VIFs > 3. Patient residence urbanicity was dropped rather than hospital teaching status because it was non-significant in the initial model. The svylogitgof command, which implements an F-adjusted mean residual test, indicated lack of fit both in the initial model (F-adjusted test statistic = 15.4; P < 0.001) and the final model (F-adjusted test statistic = 15.7; P < 0.001). This indicated that additional variables would be needed for improved fit. With large samples, goodness-of-fit tests increase in power and often indicate significant lack of fit even with low levels of systematic error. Because we felt our model was conceptually sound, we accepted the lack of fit as a limitation and impetus for future research to consider additional variables.

3 RESULTS

3.1 Characteristics of study subjects

Table 1 presents the descriptive statistics for the sample of discharges that meet the eligibility criteria. There was a weighted annual average of 9053 patients 20–85 years old that died in the ED or hospital during the study period representing <1% of the discharge outcomes. Approximately half of these deaths occurred in the ED (47%), and the remaining deaths occurred in the hospital (53%). The majority of all sample discharges had private health insurance (54%) followed by uninsured (23%), other (10%), Medicaid (9%), and the least common health insurance status was Medicare (5%). Most discharges related to motor vehicle crash injuries occurred at metropolitan hospitals (86%), nontrauma hospitals (58%), and hospitals located in the South (48%). Most patients were 20–44 years old (63%), female (52%), resided in a low (32%), or second quartile (27%) median income area and were classified as mild on the injury severity score (98%).
Table 2 presents column percentages for persons that died in the ED or hospital and for persons that did not die by the study variables. Most patients that died had some form of health insurance with less than a quarter classified as uninsured (22%). Nearly half of the patients that died had private insurance (48%) followed by Medicare (13%), Medicaid (9%), and other insurance (8%). Most patients died in a metropolitan teaching hospital (66%), a hospital in the South (49%), and a level I or II trauma hospital (70%). A notable patient characteristic was that the majority of patients that died were male (70%) even though the proportion of males reported in Table 1 was less than half (48%).

### Main results

Table 3 presents the odds of dying in the ED or hospital of injuries after being admitted to a hospital for injuries sustained in a motor vehicle crash. Results are presented both unadjusted and fully adjusted for all variables. Unadjusted, discharged visits in which Medicare was the expected primary payer had 2.78 times greater odds of resulting in death (95% CI, 2.53–3.05) while the other insurance payers were not significantly different from uninsured. After accounting for hospital and patient characteristics, patient discharges with some form of health insurance as the expected primary payer had a lower likelihood of death. Compared to uninsured patient discharges, the ORs for mortality were significantly (<0.001) lower for Medicare (OR, 0.83; 95% CI, 0.76–0.92), Medicaid (OR, 0.76; 95% CI, 0.69–0.84), private insurance (OR, 0.63; 95% CI, 0.58–0.68), and other insurance (OR, 0.61; 95% CI, 0.54–0.70). Statistically significant findings from the hospital characteristics were that odds of mortality were lower for metropolitan hospitals compared to non-metropolitan hospitals, higher for hospitals located in the South or West compared to the Northeast, and lower for nontrauma hospitals compared to level I, II, or III hospitals. Statistically significant findings from the patient characteristics were that odds of mortality were higher for patients 45–85 years old compared to patients 20–44 years old, male sex patients compared to female patients, and severe/profound injury severity compared to mild/moderate injury severity.

Table 4 presents the odds of dying in the ED and in the hospital separately. Results were adjusted for the same patient and hospital characteristics as those reported in Table 3. Associations with dying in the ED were substantively similar to associations with all deaths, but we observed an attenuation of health insurance associations with dying in the hospital. There was no significant difference in odds of dying in the hospital for those with Medicare or Medicaid as the expected primary payer compared to uninsured patient discharges. The ORs for private insurance and other insurance, although still significant (<0.001), decreased in magnitude to 0.83 (95% CI, 0.75–0.93) and 0.80 (95% CI, 0.76–0.95), respectively. As well, the associations of increased injury severity, although large in magnitude and significant for both types of deaths (<0.001), attenuated for deaths in ED and strengthened for deaths in the hospital.
TABLE 3  Unadjusted and multivariate adjusted odds of dying in the ED or hospital (combined) from a motor vehicle traffic injury among patients 20–85 years old, Nationwide Emergency Department Sample, 2009–2014

| Died in ED or hospital | Unadjusted | Fully adjusted |
|------------------------|------------|----------------|
|                        | OR 95% CI  | OR 95% CI      |
| **Primary payer (expected)** |            |                |
| Uninsured (ref)        | –          | –              |
| Medicare               | 2.78***    | 0.83***        | 0.76–0.92 |
| Medicaid               | 0.98       | 0.76***        | 0.69–0.84 |
| Private including HMO  | 0.92       | 0.63***        | 0.58–0.68 |
| Other                  | 0.86       | 0.61***        | 0.54–0.70 |
| **Hospital trauma level** |          |                |
| Nontrauma (ref)        | –          | –              |
| Level III              | 2.56***    | 1.82***        | 1.56–2.13 |
| Level II               | 5.01***    | 3.19***        | 2.85–3.58 |
| Level I                | 7.89***    | 3.75***        | 3.26–4.32 |
| **Hospital teaching status** |      |                |
| Non-metropolitan (ref) | –          | –              |
| Metropolitan non-teaching | 2.15*** | 0.62***        | 0.54–0.72 |
| Metropolitan teaching  | 0.87*      | 0.62***        | 0.55–0.71 |
| **Hospital region**    |            |                |
| Northeast (ref)        | –          | –              |
| Midwest                | 1.21*      | 0.95           | 0.85–1.05 |
| South                  | 1.22*      | 1.11*          | 1.00–1.23 |
| West                   | 1.36***    | 1.18*          | 1.05–1.32 |
| **Year**               |            |                |
| 2009 (ref)             | –          | –              |
| 2010                   | 1.02       | 1.04           | 0.94–1.15 |
| 2011                   | 0.91       | 0.86***        | 0.78–0.95 |
| 2012                   | 0.83       | 0.77***        | 0.69–0.86 |
| 2013                   | 0.90       | 0.83***        | 0.75–0.91 |
| 2014                   | 0.90       | 0.76***        | 0.69–0.84 |
| **Age, y**             |            |                |
| 20–44 (ref)            | –          | –              |
| 45–64                  | 1.86***    | 1.58***        | 1.51–1.66 |
| 65–85                  | 4.73***    | 3.41***        | 3.17–3.66 |
| **Gender**             |            |                |
| Female (ref)           | –          | –              |
| Male                   | 2.58***    | 1.79***        | 1.70–1.89 |
| **Injury severity score** |        |                |
| Mild or moderate (1–15) (ref) | – | – | – |
| Severe or profound (16+) | 47.45***   | 24.27***       | 22.11–26.65 |
| **Zip code median income (patient)** |   | |
| Quartile 1 (ref)       | –          | –              |
| Quartile 2             | 1.05       | 1.05           | 0.99–1.10 |
| Quartile 3             | 0.97       | 1.01           | 0.95–1.08 |
| Quartile 4             | 0.94       | 0.96           | 0.90–1.03 |

Abbreviations: CI, confidence interval; ED, emergency department; HMO, health maintenance organization; OR, odds ratio.

*P < 0.05, **P < 0.01, ***P < 0.001.
### TABLE 4  Multivariate adjusted odds of dying in the ED or hospital (disaggregated) from a motor vehicle traffic injury among patients 20–85 years old, Nationwide Emergency Department Sample, 2009–2014

|                           | Died in ED |              | Died in hospital |              |
|---------------------------|------------|--------------|------------------|--------------|
|                           | OR         | 95% CI       | OR               | 95% CI       |
| **Primary payer (expected)** |            |              |                  |              |
| Uninsured (ref)           |            |              |                  |              |
| Medicare                  | 0.68***    | 0.59–0.78    | 1.08             | 0.94–1.24    |
| Medicaid                  | 0.56***    | 0.48–0.65    | 1.06             | 0.93–1.21    |
| Private including HMO     | 0.51***    | 0.46–0.55    | 0.83***          | 0.75–0.93    |
| Other                     | 0.51***    | 0.42–0.61    | 0.80***          | 0.67–0.95    |
| **Hospital trauma level** |            |              |                  |              |
| Nontrauma (ref)           |            |              |                  |              |
| Level III                 | 1.48***    | 1.23–1.79    | 3.96**           | 3.02–5.20    |
| Level II                  | 2.27***    | 1.95–2.64    | 7.40***          | 5.93–9.22    |
| Level I                   | 2.71***    | 2.17–3.39    | 7.99***          | 6.29–10.15   |
| **Hospital teaching status** |          |              |                  |              |
| Non-metropolitan (ref)    |            |              |                  |              |
| Metropolitan non-teaching | 0.40***    | 0.34–0.48    | 2.08***          | 1.51–2.87    |
| Metropolitan teaching     | 0.50***    | 0.43–0.57    | 1.67***          | 1.22–2.29    |
| **Hospital region**       |            |              |                  |              |
| Northeast (ref)           |            |              |                  |              |
| Midwest                   | 0.94       | 0.82–1.09    | 0.98             | 0.86–1.12    |
| South                     | 1.05       | 0.90–1.23    | 1.12             | 1.00–1.26    |
| West                      | 1.13       | 0.95–1.34    | 1.21*            | 1.05–1.41    |
| **Year**                  |            |              |                  |              |
| 2009 (ref)                |            |              |                  |              |
| 2010                      | 1.04       | 0.90–1.20    | 1.02             | 0.91–1.14    |
| 2011                      | 0.86*      | 0.74–1.00    | 0.85*            | 0.75–0.96    |
| 2012                      | 0.80**     | 0.69–0.92    | 0.74**           | 0.65–0.85    |
| 2013                      | 0.93       | 0.80–1.07    | 0.75**           | 0.67–0.84    |
| 2014                      | 0.77***    | 0.67–0.89    | 0.74***          | 0.66–0.83    |
| **Age, y**                |            |              |                  |              |
| 20–44 (ref)               |            |              |                  |              |
| 45–64                     | 1.68***    | 1.57–1.80    | 1.49***          | 1.39–1.59    |
| 65–85                     | 3.18***    | 2.88–3.51    | 3.51***          | 3.18–3.88    |
| **Gender**                |            |              |                  |              |
| Female (ref)              |            |              |                  |              |
| Male                      | 2.07***    | 1.93–2.22    | 1.53***          | 1.43–1.64    |
| **Injury severity score** |            |              |                  |              |
| Mild or moderate (1–15) (ref) |          |              |                  |              |
| Severe or profound (16+)  | 9.34***    | 8.03–10.86   | 52.59***         | 45.80–60.39  |
| **Zip code median income (patient)** | |              |                  |              |
| Quartile 1 (ref)          |            |              |                  |              |
| Quartile 2                | 1.06       | 0.98–1.15    | 1.03             | 0.96–1.11    |
| Quartile 3                | 1.03       | 0.94–1.13    | 0.98             | 0.91–1.07    |
| Quartile 4                | 1.00       | 0.90–1.10    | 0.92             | 0.84–1.02    |

Abbreviations: CI, confidence interval; ED, emergency department; HMO, health maintenance organization; OR, odds ratio.

\*P < 0.05, \**P < 0.01, \***P < 0.001.
4 | LIMITATIONS

The study findings should be interpreted within the limitations of the data. The data have limited patient demographic characteristics that might be associated with health insurance status such as education, race/ethnicity, and employment. It is possible that the association between mortality and health insurance status could be reduced if these other patient characteristics could have been included. For example, less risk adverse individuals may be less likely to purchase insurance and more likely to drive recklessly, and individuals unable to afford health insurance may be more likely to drive older cars with possibly inferior safety technologies or poorly maintained cars, leading to higher injury severity. Another limitation is that the data we accessed did not have contextual identifiers to allow linking the file with other neighborhood characteristics. Other studies of trauma outcomes have found that the supply of surgeons in an area has been reduced mortality for patients admitted to a hospital. Another limitation is that the data do not have a measure for car insurance, which pays some medical bills for persons that have liability coverage or have extended medical care coverage through the car insurance provider. Finally, the data reported are hospital discharges and do not include follow-up data on patients after discharge. It is possible that health insurance and access to care could be associated with survival after discharge especially for patients treated at nontrauma hospitals and with limited access to care near their residence.

5 | DISCUSSION

We found that lack of health insurance was associated with a higher likelihood of death for patients admitted to an ED or hospital for injuries sustained from a motor vehicle crash even after accounting for hospital and patient characteristics. Health insurance is a well-documented risk factor for poor outcomes from trauma across hospitals, but the evidence regarding death in an ED or hospital for motor vehicle injuries was limited. Our results support a prior study that documented risk factor for poor outcomes from trauma across hospitals and, by extension, potentially reduce the global burden of deaths from motor vehicle crashes. It also bears noting that patients are not randomly assigned to hospitals and more detailed data on patient characteristics would help to illuminate the antecedent factors identified in the conceptual model that could affect the odds of mortality. Moreover, patient and hospital factors are not randomly distributed in the population of car crash victims. As supporting evidence, we found a substantial change in the findings for the association of health insurance with mortality between the unadjusted and adjusted models. Therefore, further investigation is warranted to measure other patient and hospital characteristics suggested by the conceptual model. There is also a need for future studies that can consider the improvements in health insurance coverage and other policy changes brought by the Affordable Care Act.

The focus on government interventions to prevent car crashes from occurring and improve the survivability of car crashes has been on public policies and improvements to the built environment or car safety. The trends in car crash injuries and deaths over time indicate that hospitals can expect to treat millions more vehicle crash victims each year. If after further research, health insurance continues to be shown to be a risk factor for death in the ED or hospital, independent of the quality of the care team and hospital resources, then policy interventions that improve the health insurance coverage of patients are needed. Improving health insurance coverage could have a positive effect on hospital discharge outcomes for motor vehicle injuries and, by extension, potentially reduce the global burden of deaths from motor vehicle crashes.

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AUTHOR CONTRIBUTIONS

JPS conceived the study and created the research design. AWB provided statistical advice on study design, analyzed the data, and drafted the methods and results. LS obtained the data, coordinated the analysis, and reviewed the draft. FAW provided advice on the research design. JPS drafted the manuscript, and all authors contributed substantially to its revision. JPS takes responsibility for the paper as a whole.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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