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What is This?
Inpatient hospital outcomes following injury in Suriname: lessons for prevention

Etienne Pracht

Abstract: Traumatic injury is an important and indiscriminant contributor to mortality. Hypothesizing that outcomes from severe injuries do not vary by demographic factors or socioeconomic status, this research analyzed the relationship between race, ethnicity, injury characteristics, and fatality following hospitalization in Suriname. Data were obtained for all hospital episodes in 2008 from the only hospital within the greater Paramaribo area that provides emergency department services. A logistic regression was used to analyze the subset of 544 non-elderly adult trauma victims to assess the contribution of patient demographics and anatomic injury severity to outcome, which was defined as mortality during acute hospitalization. The specific demographics included were patient age, gender, race, and insurance status. Injury severity was measured using the International Classification Injury Severity Score. The results indicate that age, insurance status, injury type, and injury severity were significant predictors for survival. While the uninsured experienced a higher rate of mortality, the model suggests this result is not due to physiologic reasons but behavioral and socioeconomic. The higher mortality is driven by greater injury severity, which increases not only the mortality rate but also the cost of care. Injury severity itself, independent of all other factors, is the most important contributor. The results suggest that a reduction of 10% in injury severity, around the mean, would reduce the probability of mortality by 70%. This suggests that targeting risk-taking behavior, perhaps relating to compliance with safety practices (e.g. seat belt and helmet laws), driver education, and road safety measures can play important roles in reducing mortality and morbidity from injury in Suriname. (Global Health Promotion, 2014; 21(1): 29–39).

Keywords: inpatient outcomes, disparities, injury, socioeconomic status, Suriname

Introduction

External causes are the second leading reason of mortality, after cardiovascular disease, in Suriname, accounting for almost 14% of all deaths (1). In 2009 the rate of traffic-related fatalities was 22 per 100,000 population, 18% higher than the average of developing countries (18 per 100,000) (1). Furthermore, as is the case with the global experience, external causes of death in Suriname have been and are expected to continue rising (2). To understand the extent of the problem and the methods for limiting accidents and injuries numerous studies have been conducted, primarily in developed countries. However, few have focused on developing nations. One objective of this study is to help fill this gap and provide valuable insights into the healthcare system of one developing country, Suriname. In particular, this paper examines inpatient outcomes following traumatic injury in Suriname, focusing on the relative influence of injury severity, injury type, demographic factors, and socioeconomic status. Understanding the
magnitude of importance concerning contributing factors is essential for crafting effective policy to promote and benefit the health status of a population. The significance of injury within this context is explained below. A search of medical/health care databases (Pubmed and Medline) using the keywords Suriname and Injury (or trauma) generated no comparable matches to the current study. The outcome of interest is mortality.

Why study outcomes from injuries instead of another medical condition? Mortality from external causes, injuries and violence is ranked by both the Pan American Health Organization and internal studies as the second leading cause of death in Suriname, accounting for almost 14% of all deaths in the country (1,3). Injury is indiscriminate and relatively random, affecting virtually every segment of society, regardless of age, sex, or race. However, its greatest impact is on the young and most economically productive cohorts of society, resulting not just in substantial mortality but also loss in quality adjusted life years (2). Therefore, in terms of lost economic and, perhaps more importantly, human potential, understanding outcomes following injury is important. The payoff to society and individuals from mitigating or even eliminating the adverse effects of injury can be substantial.

Health promotion approaches, in the context of injury, are typically linked to prevention efforts. However, equally as important is minimization of harm when injuries inevitably do happen. Therefore, complementing outright prevention, health promotion through risk reduction and access to prompt and effective medical assistance when injury events occur is of vital importance. Thus, another objective of this paper is to enhance the understanding of the relative influence of factors contributing to mortality, thereby providing valuable insight and guidance to policy makers concerning decisions involving the allocation of scarce health promotion resources.

The rest of the paper is organized into four sections. The background section provides a brief discussion of the geography and demographic makeup of the country, the organization of the healthcare system, and the hospital and emergency services sectors. The second section describes the methods used to examine trauma-related outcomes. The definition of a trauma patient is provided in this section, following the discussion concerning injury type and severity. The third section discusses the results. The final section provides conclusions and a discussion of the findings.

Background

The country, its population, and its healthcare system

A brief description of the geographical population concentrations may be helpful in understanding the data and model to be discussed below. Suriname is a Caribbean nation which gained its independence from the Netherlands in 1975 and is located on the Northern edge of continental South America (Figure 1). Population data was obtained from the Census 2004 Coverage Evaluation: Seventh General Population and Housing Census in Suriname, published by the Algemeen Bureau voor de Statistiek Censuskantoor (General Bureau for Statistics Census Office) in 2006 (4). Suriname’s land size (163,820 km²) is slightly less than five times that of the Netherlands (33,893 km²). The population, which was 492,829 according to the 2004 census, overwhelmingly resides within the coastal region of the country. Almost half of the population (49.3%) lives within the greater Paramaribo area, while another 17.45% resides in Wanica, the district immediately adjacent to it. The values in parentheses (Figure 1) accompanying the district names show the percentage of the population living within the area. Outside Paramaribo and Wanica, the greatest population densities are in the westernmost District Nickerie (7.43%) and in Commewijne (5%) located directly east of Paramaribo. The Sipaliwini district covers the interior region of the country and accounts for 6.93% of the population.

The population is relatively youthful, with only 8.6% aged 60 years or older. Children aged 0–14 years account for almost 30% of the population, while non-elderly adults, defined here as everyone 15–59 years of age, make up the remaining 61% of the population. The ethnic composition of the population can be best described as a global melting pot of cultures. While there is substantial integration of ethnicities, the population can be broadly divided into three larger and several smaller groups. Hindustanis, Creoles, and Javanese account for, respectively, 37, 31, and 15% of the population. Other ethnicities include Maroons, American Indians, Chinese, and whites (5).
Suriname’s healthcare system may be classified as a social insurance type system, more or less mimicking the Bismarck model (6) that exists in several industrialized nations, including Germany, the Netherlands, France and Japan. One defining feature of this type of system is the close cooperation between the public and private sectors. For example, while Suriname’s healthcare system has an established Ministry of Health (MOH) it is characterized by a relatively high degree of decentralization and autonomy. The MOH in Suriname supervises, monitors and coordinates health services but is itself not a provider (7). The three public hospitals in the country have a high degree of autonomy and are independently managed with individual boards (7). On the other hand, Suriname’s social insurance model also has a recognized parallel system to provide a social safety net for those without health insurance. Health insurance coverage is provided through a mix of public and private plans. The State Health Insurance Fund covers civil servants and their dependents, while others (typically individuals and small businesses) can contribute on a voluntary basis. The State Health Insurance Fund covers approximately 35% of the population (8). A sizable proportion of the population living below the poverty line (approximately 42%) receives coverage through a healthcare card from the Ministry of Social Affairs (8). The remainder of the population, living in or near the country’s cities, is either privately insured or pays out of pocket. Finally, medical missions play an important role concerning populations in the interior of the country (8).

**Data and methods**

*Geographic emergency room services breakdown*

Suriname has three public and two private hospitals. Four of the five hospitals in the country

![Figure 1. Location of Academische Ziekenhuis relative to population.](image-url)
are located in Paramaribo: Academische Ziekenhuis, Stichting Lands Hospitaal, Sint Vincentius Ziekenhuis and Diakonessen Ziekenhuis (Figure 2). The fifth hospital, Streekziekenhuis Nickerie, is located in the northwestern corner of the country. The combined total number of available hospital beds is 1318, or approximately 2.7 beds per 1000 population. Academische Ziekenhuis (AZ) is centrally located and supports one of two emergency rooms (ERs) in the country. The second ER is associated with Streekziekenhuis Nickerie. All traumatic injury victims who require immediate emergency care are triaged to one of the two ERs in the country.

The dataset used for this study did not contain individual identifiers but included demographic characteristics, insurance status and up to 10 diagnoses associated with all hospitalization episodes occurring in 2008 at AZ. Traumatic injury victims were identified using the diagnosis codes (see below). Patients with injuries that are severe enough to result in hospitalization can be triaged to either of the country’s two ERs. While this study was based on the data of just one of the two hospitals with an ER, it likely missed only a small fraction of injury-related hospitalizations in Suriname. First, AZ is a 465 bed hospital and is substantially larger compared with its counterpart in the district of Nickerie with 78 beds. Second, and perhaps more importantly, over 66.7% of the population lives within Paramaribo and Wanica, which lie within 25 km of the AZ ER. This is illustrated in Figure 2, which also shows all major roads in the country, indicating the locations of population centers. Based solely on linear distance from the ERs, only the populations of Nickerie and part of Coronie, accounting for only 8% of the population, reside closer to Streekziekenhuis Nickerie. Not including the Sipaliwini district, 85% of the population resides closer to AZ.

Methods

The analysis was largely descriptive in design, and focused on the hospitalized non-elderly adult trauma population with emphasis on demographic and geographic distribution, insurance type and status, and injury type and severity. This is augmented with a logistic regression model developed and estimated to examine the relative impact of sociodemographic factors, geography, injury type and severity, and insurance type and status on mortality following

Figure 2. Hospitals with emergency room services in Suriname with 25, 50, and 100 km buffers and major roadways.
hospitalization. The development of the model benefited heavily from previous research done concerning the effectiveness of trauma systems in the United States (9–11).

The model was estimated first for the country as a whole and then including only residents of the capital, Paramaribo. The reason for the latter, restricted, sub-sample was to eliminate a potential source of bias. The timely transportation of injured individuals from the interior of the country is likely to differ significantly compared with those living within the capital city. This may affect not only the effectiveness of inpatient treatment but also the mortality status of the patient upon arrival at the hospital. Because the outcome of interest is defined as inpatient mortality, this assumed, but difficult to quantify, dynamic may bias the results.

The remainder of this section briefly discusses the selection of model variables. Because the theoretical justifications for their inclusion are provided in the existing literature (10), the present discussion will be kept to a minimum. This study uses the ICD Injury Severity Score (ICISS) to control for patients’ injury severity. Higher ICISS values indicate a lower level of severity, thus a negative relationship is hypothesized between the odds of mortality and the ICISS (12–16). ICISS scores are calculated from survival risk ratios (SRRs) which are dependent on the particular dataset being used, creating the potential for bias. To eliminate this potential source of bias, the SRRs used to calculate the ICISS here were derived from a database that is completely independent of the data used in this study, particularly the Florida inpatient hospital databases from 1991 to 2007, benefiting from the historic survival data recorded of over 2.1 million trauma-related hospital episodes. An extra step was required in the calculations since the Florida hospital data uses the ICD9-CM, as opposed to the ICD10-CM convention that was implemented by AZ in Suriname. Before proceeding, it should be noted that the AZ data did not report the second digit after the decimal point for the ICD10 diagnosis fields. The absence of the second digit after the decimal implies that the SRRs are averages applied to small groups of closely related diagnoses identified to the first digit following the decimal. This averaging has two important potential impacts. First, it can blunt the explanatory power of the resulting ICISS. Second, in a related point, because the second digit following the decimal often implies more acute severity, the resulting localized average ICISS scores may underestimate severity. Despite these limitations, controlling for severity in the logistic regression model is important for the overall integrity of the estimates.

In addition to injury severity the model also controlled for the six main types of injury: traumatic brain injury (TBI), skull and spinal cord injuries (SSCI) excluding TBI, fractures excluding TBI and SSCI, injuries involving the thorax, vascular injuries and burns. In the logistic regression model, TBI patients were omitted as the control. Approximately 15% of patients had more than one type of injury, indicating that these variables are not mutually exclusive. To determine whether this potential source of colinearity affected the estimation results, the regressions were executed separately using only observations without overlapping injury types. A comparison of the results did not reveal any significant difference in either the coefficients or the associated p-values.

Finally, the model also controlled for patient demographic factors: age, gender and ethnicity (10). Ethnicity was included in the model, not because it was expected to directly impact mortality, but to control for potential unobserved characteristics that may be disproportionately associated with different ethnicities, for example occupational risks. The control for this variable was the largest ethnic group represented in the sample, Hindustanis. Three major ethnicity variables are included, indicating whether the patient was Creole, Indonesian or Maroon. A fourth composite variable indicating other race was also included in the model.

Finally, the model also controlled for the patient’s insurance status. To the extent that insurance status influences access to emergency care, it may affect clinical outcomes. Insurance status does not measure some physiologic determinant of outcome, but it may act as a surrogate for the presence of patient behaviors and environmental factors that predispose to relatively elevated risk of mortality. The absence of insurance coverage also hinders access to a usual and regular source of care that, over time, has the potential to lessen the individual’s stock of health or physiologic reserves. Numerous studies, focusing on the US population, have documented the association between lack of insurance coverage and poor clinical outcomes (11,17,18).
Results

Frequencies

There were 18,689 hospital episodes recorded in the dataset, including 965 traumatic injury patients. Non-elderly adults, consisting of individuals aged 15–59 years, accounted for 544 or 56.4% of traumatic injury patients. Pediatric and elderly patients made up, respectively, 21.4 and 22.3% of the traumatic injury inpatient population. All data reported in the following considered only those non-elderly adults. The average age of non-traumatic injury (35.4) and traumatic injury (35.7) patients was virtually identical. However, the inpatient mortality rate of traumatic injury patients (4%) was a full percentage point higher compared with that of their non-traumatic injury counterparts (3%). Furthermore, the average length of stay associated with traumatic injury hospitalizations (5.8 days) was slightly higher than that of non-traumatic injury patients (5.5 days). The data in Table 1 provide a breakdown by geographic region; however, only the overall (column 2) and Paramaribo (column 3) values will be discussed below. The last column of the table shows the corresponding values for patients who did not have their district of residence recorded. Caution is suggested in interpreting these values given the small sub-sample size in some cells, which applies to most districts. The exceptions are Paramaribo and Wanica.

The majority of traumatic injury patients, 57%, were residents of Paramaribo. Wanica, which is nearest to Paramaribo, accounted for another 20% of patients, leaving only 23% of patients distributed among the remaining eight districts. The data imply considerable geographic variation in the rate of uninsured for this inpatient population, averaging 7.72% for the country. The inpatient mortality rate of the overall trauma adult population was 4.04%. The corresponding value for Paramaribo residents was 5.48%. It is noteworthy that the data indicated that no trauma patients from Wanica died. While it was impossible to verify this statistic, it should be treated with some skepticism and is likely the result of missing values, particularly of the patients’ district variable. The mortality rate of patients without a recorded district (last column) provides some evidence for this conjecture and supports the decision to estimate the final model containing only Paramaribo residents.

There are four major ethnic groups represented in the inpatient traumatic injury population, Hindustanis, Creoles, Indonesians and Maroons, which respectively account for 34.38, 27.94, 11.03, and 12.68% of the sample. There exists considerable geographic variability in the ethnic makeup of the population, as reflected in the sample of traumatic injury patients.

The bottom half of Table 1 contains the distribution of patients by injury type and injury severity. Injuries are not mutually exclusive, as indicated by the fact that the columns add to over 100%. Injuries are classified into six groups: TBI, SSCI which exclude TBI, other fractures which exclude TBI and SSCI, injuries to the thorax and abdomen, vascular injuries and burns. In the overall trauma population, the most common injury type was fractures other than TBI and SSCI. Approximately 21 and 24% of patients were diagnosed with TBI and SSCI. The remaining injury types were much less frequent. Indeed, there were no patients in the dataset with a recorded vascular injury

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Table 2 shows the breakdown of injury severity for the uninsured and by the major ethnic groups. The most noticeable difference based on insurance status is the drop in the percentage for the former in the lowest severity category, indicating 0.95 < ICISS < 1. The percentage of patients in this lowest severity category dropped from 52 to 40% for, respectively, the insured and uninsured. Concerning ethnicity and severity, the data suggest a more even distribution. The table also shows the distribution of injury type by insurance status and ethnicity. Focusing on insurance status, the most notable difference concerns SSCI injuries: 38% of the uninsured were classified as having suffered a SSCI injury. On the other hand, the percentage of patients with TBI was the same (21%) regardless of insurance status. Concerning ethnicity, the most notable difference is associated with the Javan ethnicity for which injuries to the thorax are disproportionately high. Injuries to the thorax include blast injuries, blunt trauma, bruises, concussions, crushing, hematoma, laceration, puncture, tears and ruptures of internal organs.

Logistic regression

The model was estimated using the overall trauma population and for Paramaribo residents only (Table
### Table 1. Frequencies for hospitalized trauma victims.*

<table>
<thead>
<tr>
<th>All</th>
<th>Parama-ribo</th>
<th>Wanica</th>
<th>Commewijne</th>
<th>Saramacca</th>
<th>Coronie</th>
<th>Nickerie</th>
<th>Para</th>
<th>Broko-pondoland</th>
<th>Marowijne</th>
<th>Sipaliwini</th>
<th>Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>544</td>
<td>310</td>
<td>109</td>
<td>30</td>
<td>25</td>
<td>4</td>
<td>7</td>
<td>32</td>
<td>1</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Age in years</td>
<td>35.7</td>
<td>36.2</td>
<td>37.4</td>
<td>38.1</td>
<td>33.5</td>
<td>37.7</td>
<td>32.7</td>
<td>30.3</td>
<td>26.0</td>
<td>27.9</td>
<td>31.0</td>
</tr>
<tr>
<td>Length of stay</td>
<td>5.8</td>
<td>5.9</td>
<td>6.3</td>
<td>5.6</td>
<td>6.9</td>
<td>8.3</td>
<td>6.1</td>
<td>3.8</td>
<td>6.0</td>
<td>2.2</td>
<td>13.7</td>
</tr>
<tr>
<td>Uninsured</td>
<td>7.7</td>
<td>11.3</td>
<td>4.6</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>3.1</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Died</td>
<td>4.0</td>
<td>5.5</td>
<td>0.0</td>
<td>3.3</td>
<td>4.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hindustani</td>
<td>34.4</td>
<td>30.3</td>
<td>47.7</td>
<td>50.0</td>
<td>72.0</td>
<td>0.0</td>
<td>57.1</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>23.5</td>
</tr>
<tr>
<td>Creole</td>
<td>27.9</td>
<td>34.2</td>
<td>12.8</td>
<td>16.7</td>
<td>8.0</td>
<td>100.0</td>
<td>14.3</td>
<td>37.5</td>
<td>1.0</td>
<td>16.7</td>
<td>0.0</td>
</tr>
<tr>
<td>Indonesian</td>
<td>11.0</td>
<td>6.5</td>
<td>20.2</td>
<td>33.3</td>
<td>12.0</td>
<td>0.0</td>
<td>14.3</td>
<td>9.4</td>
<td>0.0</td>
<td>0.0</td>
<td>5.9</td>
</tr>
<tr>
<td>Maroon</td>
<td>12.7</td>
<td>12.9</td>
<td>9.2</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>25.0</td>
<td>83.3</td>
<td>66.7</td>
<td>23.5</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>14.0</td>
<td>16.1</td>
<td>10.1</td>
<td>0.0</td>
<td>8.0</td>
<td>0.0</td>
<td>14.3</td>
<td>28.1</td>
<td>0.0</td>
<td>33.3</td>
<td>11.8</td>
</tr>
<tr>
<td>Injury type and severity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TBI</td>
<td>21.1</td>
<td>20.7</td>
<td>22.9</td>
<td>16.7</td>
<td>20.0</td>
<td>50.0</td>
<td>14.3</td>
<td>28.1</td>
<td>33.3</td>
<td>0.0</td>
<td>11.8</td>
</tr>
<tr>
<td>SSCS</td>
<td>23.9</td>
<td>23.5</td>
<td>27.5</td>
<td>30.0</td>
<td>12.0</td>
<td>0.0</td>
<td>0.0</td>
<td>21.9</td>
<td>33.3</td>
<td>0.0</td>
<td>35.3</td>
</tr>
<tr>
<td>Fracture</td>
<td>73.2</td>
<td>76.8</td>
<td>76.1</td>
<td>53.3</td>
<td>60.0</td>
<td>75.0</td>
<td>85.7</td>
<td>59.4</td>
<td>1.0</td>
<td>50.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Thorax</td>
<td>7.2</td>
<td>6.1</td>
<td>3.7</td>
<td>16.7</td>
<td>20.0</td>
<td>25.0</td>
<td>14.3</td>
<td>6.3</td>
<td>0.0</td>
<td>0.0</td>
<td>11.8</td>
</tr>
<tr>
<td>Vascular</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Burn</td>
<td>3.5</td>
<td>3.2</td>
<td>0.9</td>
<td>13.3</td>
<td>4.0</td>
<td>0.0</td>
<td>14.3</td>
<td>6.3</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

*With the exception of age and length of stay, all values are percentages.
For each geographic definition, the whole of Suriname or restricted to Paramaribo, the model was originally estimated using (a) age in years and (b) four age groups (see above) using individuals aged 21–30 as the control. With the exception of the 51–60-year-old group, all age group variables were highly and consistently insignificant. Omitting the insignificant age variables did not alter the results and they were, subsequently, removed from the final model, changing the control age group to the 15–50 age group. The model performs poorly when all observations are included, with only the age and severity measure explaining mortality. This is likely due to the suspected data problems related to the non-Paramaribo observations. The following discussion will therefore focus solely on the results from Paramaribo.

The most important predictor for mortality, as expected, is injury severity. The marginal effect, derived from the cumulative distribution function,
suggests that an increase/decrease of 10% in severity, at the average, increases/decreases the probability of mortality by approximately 70%. The results indicate that older individuals are at greater risk of mortality following injury, holding all other factors constant. The second specification of the age variable suggests that the increased mortality attributable to age is concentrated within the 51–60-year-old cohort, with the 15–50-year-old group serving as the control. Neither gender nor race was associated with statistically significant mortality in the model. Concerning injury type, SSCIs were associated with lower mortality compared with TBI, while other fractures, injuries to the thorax, and burns were not statistically significant. Finally, insurance status (i.e. not having insurance) was associated with significantly higher mortality. The marginal effect indicates an increase of 8% in the probability of mortality after controlling for injury severity, injury type, and demographics.

Discussion and implications

Summary

The objective of this study was to examine inpatient outcomes following injury in Suriname. Understanding the explanatory power of the factors that influence outcomes following injury is the first step in crafting relevant and effective policy or other health-related interventions. The findings suggest three areas of relevance: the absence of disparities based on population demographics, the presence of disparities relating to economic status and the importance of the severity of injuries.

The results suggest that older individuals experience a greater probability of mortality following injury. This is not surprising since physiologic reserves decline with age while at the same time, the likelihood of comorbidities increases. Pertaining to the demographic variables, after controlling for the effects of injury severity using ICISS scores and injury type, the results did not indicate any statistically significant disparities relating to race or ethnicity.

In contrast, insurance status is associated with significantly higher mortality following injury and hospitalization, after controlling for injury severity and type. The stratification by severity using the ICISS scores indicate that the uninsured are less likely to be in the least severe category (0.95 < ICISS < 1). An ICISS score in this category indicates that fewer than 5% of patients in the SRR database, which was derived from hospitalizations in the US state of Florida, did not survive the specific combination of injuries. The uninsured were heavily concentrated in the 0.9 < ICISS <= 0.95 category; 43% of the uninsured fell into this category, compared with only 23% of their insured counterparts. Insurance status is a reflection of both socioeconomic status and state of health (18). While all have access to emergency care, the uninsured probably lack a regular source of care, resulting in lower health status, increasing their risk of mortality in the event of a traumatic shock to their physiology.

Finally, the models were executed separately for Suriname as a whole and the more densely populated Paramaribo area. The absolute values of the coefficients associated with the ICISS variable were significantly larger in the Paramaribo area equation, which appears to suggest that the effect of severity in explaining mortality is higher in the capital city where most hospitals are located. Indirectly, this implies that chances of death are higher in the area with greater access to health services. This seemingly contradictory result may be due to differentials in timely transport, or lack thereof, of accident victims. Holding constant the initial severity of an injury, the likelihood of death prior to arrival at the hospital is much greater for severely injured residents living in the interior of the country. Their deaths will not be reflected in the inpatient data and, therefore, the variation in injury severity, as recorded for survivors upon hospitalization, is likely to be significantly smaller for patients involved in accidents in the interior of the country. Conversely, the relative variation in injury severity, used to predict mortality, will be greater for accidents in or near the capital where the emergency department is located. This greater variation in severity is then reflected in the estimated coefficient of the ICISS variable. Therefore, this result should not be interpreted as ‘greater access to health services being associated with higher mortality.’ It should also not be interpreted as severity being less important a predictor for mortality for non-Paramaribo residents.

Discussion

While the findings concerning the demographic and socioeconomic variables provide valuable
insights concerning injury outcomes, the most important factor, by far, is injury severity. The injury ICISS stratification uses a continuous variable that accounts for both anatomic injury and physiologic derangement. The logistic regression results suggest that a 10% reduction around the average severity reduces the probability of mortality by approximately 70%. In comparison, one existing study examining mortality associated with injury in an elderly population in Florida reported a marginal effect for severity of approximately 42% (19). The results of the study indicate that the marginal effect of severity, as measured by the ICISS score, increases with age. This is as expected, as younger adults tend to have higher physical reserves and are, therefore, more likely to survive given the level of severity. Thus, in a direct comparison of the age group used in this study, the difference would probably be larger. Unfortunately, an extensive search on Pubmed and Medline revealed no studies focusing on injury in developing countries that also reported the marginal effects of severity on mortality.

In 2008 there were 90 traffic-related deaths in Suriname, translating into approximately 0.18 per 1000 people in the country. Not including the sparsely populated Sipaliwini area, the rate ranged from 0.13 in Saramacca (with only two deaths) to 1.73 in Coronie (with five deaths). In the capital city Paramaribo, the rate was 0.15 per 1000 people. Similarly, the MOH reported that 112, or over 26% of all deaths attributable to external causes, were related to traffic accidents in 2009. The highest rate was associated with riders of motorized 2–3-wheeled vehicles, followed by 4-wheeled vehicles (1). While it was not possible to link specific observations in the sample analyzed here to these traffic-related fatalities, those who did not expire at the scene of the accident most likely were transported to the emergency department of the hospital in question – as it is the largest of only two in the country – and were, therefore, included in the data.

Conclusions

This result suggests that injury prevention is of fundamental importance to reduce traffic-related mortality. Strategies that avoid injury altogether are, for obvious reasons, important and include efforts to combat driving under the influence of drugs or avoiding driving under unsafe conditions (e.g. at night or during heavy rainfall). However, to produce significant survival gains, equally as important are strategies that reduce the severity of injury in case of an adverse event. Examples of such strategies include higher safety belt and helmet usage. Driver safety information, whether disseminated through formal courses or popular media, alerting drivers to ways to avoid traffic violations and crashes can also play an important role in terms of prevention. These approaches all focus on drivers as the most important cause of injury and resulting severity. However, equally as important is the traffic environment; invariably blaming drivers for all accidents obscures from the public view proven and long-lasting solutions that further emphasize prevention and promotion from a public health perspective. Recognizing that all drivers can make mistakes, the promotion of evidence-based engineering principles in designing and maintaining safe roadways and, particularly, intersections, can produce significant reductions in mortality and morbidity resulting from traffic accidents (20).

A few potential weaknesses of this study are noteworthy. The findings of this study were based on a dataset that was constructed for administrative purposes. Therefore, it was not possible to account for the influence of direct physiologic measures or indicators of the pre-hospital condition of the patients. It is also noteworthy that the population in Suriname is extremely diverse, and racial and ethnic integration is significant, making it difficult to impossible to test for differences that may relate to these demographic variables.

Regardless of the potential weaknesses in the data, it is clear that significant improvements can be anticipated from at least two areas. The most important is prevention, which may be interpreted as both accident avoidance and, perhaps more importantly, reduction of the severity of injuries, recognizing that, despite our best efforts, sometimes accidents are unavoidable. A comprehensive strategy to reduce mortality from injury should include driver education, traffic engineering solutions, and law enforcement. Finally, the role of insurance status should not be ignored. The significance of this variable indicates that greater access to care can be as important as environmental and educational factors.

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**Notes**

i. While the official age for adulthood is older than 15 years, the traumatic injury literature suggests that physiologically, 15- or 16-year-old individuals differ little, if at all, to older adults. Furthermore, this definition has the added benefit that it conforms to the age breakdowns used by the Suriname Census.

ii. Hindustanis, sometimes also referred to as East Indians, are all people descendent from immigrants originating from India, which was previously named Hindustan. It is the designation used in the hospital records and maintained in this paper.

iii. Maroons are descendants of African slaves who were brought to Suriname in the 17th and 18th century but, subsequently, escaped into the interior of the country.

iv. It could not be determined whether this reflected actual cases or if it was due to an error in the data. However, previous research using substantially larger datasets from Florida (US) also reported few vascular injuries.

v. In a separate, unpublished, analysis of the Florida data for the non-elderly adult population using the same model as Pracht et al. (19), the marginal effect of severity on mortality was 23%.

vi. The data for this statistic were obtained from the police department (De Brigadier van Politie) through communication with the Medical Director at Academische Ziekenhuis. For comparison, the rate of traffic-related fatalities in the United States was 0.12 per 1000 people.

**References**