Original Article

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Fatal and Nonfatal Injury Patterns of Stranded Motorists

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ABSTRACT

Because nonfatal and fatal incidents for stranded motorists are not separated from vehicular accidents, little data are available on incident characteristics. To close this gap, data fields were inserted into databases at a medical examiner's office and two trauma centers to collect injury-related information. Forensic nurses and pathologists aided in forming a collaboration among the agencies involved and supported data collection efforts. Data collected over a 5-year period were examined for injury patterns to determine risk factors affecting these patterns. Of the total sample (N = 219), 24.7% had spinal injuries resulting in fatal injuries for 46 of 54 individuals. The odds were stranded motorists with spine-related injuries (C1–C7) had 9.13 times higher risk for a fatal outcome compared with those without spine-related injuries. Severe injuries (Abbreviated Injury Scale scores ≥ 4) noted for head/neck (29.7%) and chest (24.2%) were significantly associated with fatality. Of the 219 cases, 22.8% were inside of a stopped vehicle, and 77.2% were outside a vehicle at the time of injury. Outcomes illustrated the success of the interprofessional collaboration between trauma centers and a medicolegal death investigation agency that resulted in data useful for forensic nurses and pathologists documenting evidence, emergency and trauma responding personnel in patient priority stabilization, and injury prevention specialists for highway safety programs.

KEY WORDS:

Fatal roadway injuries; forensic nursing; highway injury pattern; stranded motorist

Among the millions of people who travel the nation's freeways and public roads, some will encounter or become a stranded motorist. Some 287.3 million cars were registered in the United States by the end of 2020 (Mitic, 2021). The National Highway Traffic Safety Administration (NHTSA) projected an estimated 36,120 people died in motor vehicle traffic crashes in 2019, giving a fatality rate of 1.10 fatalities per 10,000 (NHTSA, 2019). An earlier seminal NHTSA report noted the critical reason for highway crashes was assigned to the driver in 94% of the crashes and about 2% to a vehicle mechanical failure (NHTSA, 2015). Although traffic injury and fatality reports are available, stranded motorist statistics are subsumed under traffic fatalities. Few reports on estimates of stranded motorist statistics exist.

In a 2012 news release, the American Automobile Association announced the expectation of 7.9 million stranded motorists in summer travel (American Automobile Association, 2012). However, state departments of public safety issue traveler's guidelines and states have established hotlines and roadside assistance programs to aid stranded motorists. For instance, the Arizona Department of Public Safety announced officers assisted 75,235 stranded motorists throughout the

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state in 2018 (Arizona Department of Public Safety, 2020). The first known peer-reviewed article on stranded motorist deaths was published in 2015 (Drake et al., 2015).

Background

This study is an outgrowth of Drake et al.'s (2015) initial pilot study, albeit the research was expanded to include data on nonfatal as well as fatal incidences. As such, the definition of stranded motorist is based on that in the original study and refers to an occupant of a vehicle that is stopped in or on the side of a public road (Drake et al., 2015). In this definition, a stopped vehicle may be stationary because of mechanical failure, involvement in a prior collision, personal reasons, or having stopped to render aid, and an occupant may be either inside or outside the stopped vehicle. A stranded motorist incident is one that involves nonintentional injury or death to a stopped vehicle's occupant.

In the initial pilot study, an examination of Harris County, Texas medical examiner data showed 46 stranded motorist deaths occurred between 2004 and 2014 (Drake et al., 2015). To identify stranded motorist incidences that also included nonfatal outcomes, the Harris County Institute of Forensic Sciences and two local Level 1 trauma centers, Memorial Hermann Hospital-Texas Medical Center and Harris Health System-Ben Taub General Hospital, formed a collaborative effort to prospectively identify and track stranded motorist injuries and fatalities. Forensic nurses, along with other forensic professionals, trauma surgeons, injury prevention specialists, and policy decision makers, were key in establishing this collaboration. The intent of the collaboration was to provide information that could aid in devising strategies to minimize roadside injuries and death. To this end, data fields were added into the medical examiner database and the respective trauma registries to distinguish stranded motorist incidents from other vehicle or auto-pedestrian incidents. The intent was also to capture data that would aid injury prevention specialists, including forensic nurses as well as surgeons, for prevention efforts.

Using data extracted from these novel data fields, this study examined cases that occurred between 2014 and 2018 to delineate injury patterns for fatal and nonfatal outcomes specific to circumstances identified as stranded motorist incidences. The data collected from trauma centers' registry data and Harris County Institute of Forensic Sciences autopsy and death investigator reports provided a consistent set of variables pertinent to surviving or deceased stranded motorists. Thus, data were available to expand the body of knowledge on the epidemiology of fatal and nonfatal stranded motorist injuries.

The aims of the study were (a) to examine differences of injury pattern of stranded motorist incidences in relation to mortality and (b) to determine the effect of associated risk factors on the injury pattern. The goal was to discern characteristics of fatal and nonfatal injuries to aid trauma providers and forensic experts in patient documentation and collaborative communication with forensic investigators to examine transportation factors specific to stranded motorist events.

Method

Given that the study was a retrospective review of 219 identified incidences, the team designed a data compilation form for consistency in extracting demographic, temporal, and crash variables as well as injury-related information. To identify the extent of injury, the team assigned Abbreviated Injury Scale (AIS) scores per injury on a 1–6 scale, where 1 = *minor injury* and 6 = *maximal for each identified subject*, and calculated Injury Severity Scores (ISSs) based on worst injuries sustained on a 7-point scale from *no injury* to *nonsurvivable*. When information was available, transportation incident data were linked to police crash reports for the abstraction of scene information.

The study was approved by the Committee for the Protection of Human Subjects Institutional Review Boards at the University of Texas Health Science Center at Houston and Baylor College of Medicine. Individual identifying data were redacted, and each stranded motorist subject was assigned a unique code.

Sample

The team identified 219 stranded motorist incidences where individuals died or sustained an injury. These incidents were crashes of a stationary vehicle on a public road where a person was either inside (n = 50, 22.8%) or outside (n = 169, 77.2%) a stationary vehicle when struck by another vehicle.

Variables

The variables extracted related to personal characteristics (e.g., age, gender, racial background, body mass index), temporal factors (time, day, season of accident), posted speed limit, toxicology substances detected (if analyzed), and body region(s) injured (e.g., head, chest/spine, abdomen, extremities). Of specific interest was whether the individual was inside or outside a stationary vehicle when the injury occurred. A second set of variables dealt with severity of injury (AIS and ISS). The use of restraints, as in airbag or seatbelt use at the time of incident; the reason stranded; the posted speed where crash occurred; and whether the striking vehicle stopped or not were noted.

Analysis

The sample (N = 219) was stratified based on whether the incident outcome was nonfatal (n = 135, 61.6%) or fatal (n = 84, 38.4%). Data were analyzed using chi-square and Mann–Whitney U tests for significant differences of

TABLE 1. Demographics, Physical Location in Relation to Vehicle, Substance Usage, Time of Collision, and Environmental Factors for Nonfatal Versus Fatal Stranded Motorist Incidences

	Total *N* (%)	Nonfatal *n* (%)	Fatal *n* (%)	*p* Value[a]
Total	219	135 (61.6)	84 (38.4)	
Age, median (IQR; years)	34.6 (25.1–51.1)	34.6 (24.5–50.1)	33.4 (25.9–52.8)	0.484[b]
Gender				
Male	163 (74.4)	95 (70.4)	68 (81.0)	0.081
Female	56 (25.6)	40 (29.6)	16 (19.0)	
Race				
White	50 (22.8)	31 (23.0)	19 (22.6)	0.006
African American	67 (30.6)	39 (28.9)	28 (33.3)	
Hispanic	76 (34.7)	41 (30.4)	35 (41.7)	
Other	26 (11.9)	24 (17.7)	2 (2.4)	
BMI[c]				
<18.5	8 (3.8)	6 (4.7)	2 (2.4)	0.443
18.5–24.9	63 (29.9)	42 (33.1)	21 (25.0)	
25–29.9	63 (29.9)	36 (28.3)	27 (32.1)	
30 or over	77 (36.5)	43 (33.9)	34 (40.5)	
Body surface in relationship to striking vehicle[d]				
Outside of vehicle[d]	169 (77.2)	103 (76.3)	66 (78.6)	0.697
Inside of vehicle[e]	50 (22.8)	32 (23.7)	18 (21.4)	
Substances[f]				
Present	48 (21.9)	36 (26.7)	12 (14.3)	<0.001
Not present	31 (14.2)	30 (22.2)	1 (1.2)	
Not conducted	140 (63.9)	69 (51.1)	71 (84.5)	
Time of collision[g,h]				
Day	56 (26.9)	41 (33.1)	15 (17.9)	0.015
Night	152 (73.1)	83 (66.9)	69 (82.1)	
Time of collision: season				
Spring	59 (26.9)	41 (30.4)	18 (21.4)	0.224
Summer	45 (20.5)	27 (20.0)	18 (21.4)	
Autumn	53 (24.2)	27 (20.0)	26 (31.0)	
Winter	62 (28.3)	40 (29.6)	22 (26.2)	
Time of collision: weekday				
Sunday	43 (19.6)	25 (18.5)	18 (21.4)	0.268
Monday	25 (11.4)	21 (15.6)	4 (4.8)	
Tuesday	20 (9.1)	10 (7.4)	10 (11.9)	
Wednesday	22 (10.0)	14 (10.4)	8 (9.5)	
Thursday	34 (15.5)	19 (14.1)	15 (17.9)	
Friday	32 (14.6)	21 (15.6)	11 (13.1)	
Saturday	43 (19.6)	25 (18.5)	18 (21.4)	
Time of collision: weekday vs. weekend				
Weekday	133 (60.7)	85 (63.0)	48 (57.1)	0.391
Weekend	86 (39.3)	50 (37.0)	36 (42.9)	

(continues)

TABLE 1. Demographics, Physical Location in Relation to Vehicle, Substance Usage, Time of Collision, and Environmental Factors for Nonfatal Versus Fatal Stranded Motorist Incidences, Continued

	Total *N* (%)	Nonfatal *n* (%)	Fatal *n* (%)	*p* Value[a]
Reason stopped[h]				
Mechanical	66 (53.6)	22 (56.4)	44 (52.4)	0.939
Secondary incident	27 (22.0)	8 (20.5)	19 (22.6)	
Rendering aid	12 (9.8)	3 (7.7)	9 (10.7)	
Other or unknown	18 (14.6)	6 (15.4)	12 (14.3)	
Posted speed in area of impact[h]				
Under 45 mph	13 (12.4)	6 (28.6)	7 (8.3)	NA[i]
46–65 mph	89 (84.8)	15 (71.4)	74 (88.1)	
Over 66 mph	3 (2.9)	0 (0)	3 (3.6)	
FSRA[h]				
Yes	10 (7.6)	0 (0)	10 (11.9)	NA[i]
No	121 (92.4)	47 (100.0)	74 (88.1)	

Note. BMI = body mass index; FSRA = Failure to stop and render aid; IQR = Interquartile range.
[a]Chi-square test was fit to test for vital status differences among categories of gender, race, physical location of injured, substance usage, time of incident, and environmental factors. Significance level was at 0.05.
[b]Mann–Whitney *U* test was used to compare the distribution of age between alive and dead cases. Significance level was at 0.05.
[c]Eight alive cases' BMI information were unknown.
[c]The physical location of injured before being struck by a moving vehicle. This could include inside or outside the vehicle.
[d]The person injured may have been a driver or occupant of a driver; however, when injured that person was outside a vehicle.
[e]The person injured was inside a vehicle as either a driver or an occupant.
[f]Either clinical or forensic toxicology testing. Positive findings include the presence of the following: cocaine, amphetamine, opioids, alcohol, marijuana, and so forth.
[g]Day represents 7 a.m.–7 p.m., and night represents 7:01 p.m.–6:59 a.m., according to when injury occurred or admission to the hospital after injury.
[h]Participants with missing data or no information were excluded from analysis.
[i]Category with a value of zero is not appropriate for a chi-square test.

categorical variables. Categories with missing data (no information) were not included in the chi-square tests. Binary logistic regression was used to assess significant differences between the nonfatal versus fatal injury groups in relation to spinal injuries, body surface impacted, and ISSs. Significance level was set at 0.05 ($p < 0.05$). Univariate environmental factors, such as substance usage (as determined by hospital or postmortem drug/ethanol testing at the time of the incident), failure to stop and render aid (hit and run), posted speed in the area of impact, and time of day of occurrence, were considered independent variables in a backward logistic regression model of mortality and morbidity. Significant *p* values in the univariate chi-square test were used to explore the association with mortality status. Analysis was accomplished using SAS Version 9.3 (Delwiche & Slaughter, 2003).

Results

As shown in Table 1, most incidences occurred at night ($n = 152$, 73.1%) at posted speeds between 45 and 65 mph ($n = 89$, 84.8%). For the nonfatal group ($n = 135$), individuals sustaining injuries were predominately male ($n = 95$, 70.4%), Hispanic or Black ($n = 104$, 77%), and outside the vehicle at the time of injury ($n = 103$, 76.3%). For the group sustaining fatal injuries ($n = 84$), 68 (81.0%) were male, 65 (77%) were Hispanic or Black, and 66 (78.6%) were outside the vehicle.

As shown in Table 2, of the total sample ($N = 219$), 54 (24.7%) had spinal injuries that resulted in fatal injuries for 46 individuals (85.2%). In terms of AIS, severe injuries (AIS ≥ 4) of the head and neck ($n = 65$, 29.7%), chest ($n = 53$, 24.2%), extremities ($n = 27$, 12.3%), and abdomen ($n = 23$, 10.5%) were significantly associated with fatality. Higher median ISSs (≥16) were also associated with fatal outcomes ($n = 134$, 61.2%).

The number of individuals injured while inside the impacted vehicle was 50 (22.8%), whereas 169 (77.2%) were injured outside the vehicle. As shown in Table 3, 13 (26%) had spinal injuries. Nonfatal injuries occurred in 32 individuals (64.0%), and of the 26 individuals inside a stationary vehicle struck from the rear, fatality resulted in 17 cases (94.4%). In terms of AIS scores, severe injuries (AIS ≥ 4) of the head and neck ($n = 13$, 26%) and chest ($n = 10$, 20%) were significantly associated with fatality.

Results of a binary logistic regression used to assess the independent variables' effect on mortality are shown in Table 4. Spine injuries ($p < 0.0002$) and ISS ($p < 0.0001$) were significant in predicting mortality. The odds ratio for spine injury (*OR* = 9.134, 95% CI [2.284, 36.523])

TABLE 2. Stranded Motorist Injury Pattern Differences Stratified by Vital Status

	Total N (%)	Nonfatal n (%)	Fatal n (%)	p Value[a]
Spine injury (C1–C7 and AOD)				
Yes	54 (24.7)	8 (5.9)	46 (54.8)	<0.001
No	165 (75.3)	127 (94.1)	38 (45.2)	
AIS head and neck				
No injury	97 (44.3)	86 (63.7)	11 (13.1)	<0.001
≤3	57 (26.0)	38 (28.1)	19 (22.6)	
≥4	65 (29.7)	11 (8.1)	54 (64.3)	
AIS face				
No injury	171 (78.1)	110 (81.5)	61 (72.6)	0.170
≤3	47 (21.5)	25 (18.5)	22 (26.2)	
≥4	1 (0.5)	0 (0.0)	1 (1.2)	
AIS chest				
No injury	98 (44.7)	93 (68.9)	5 (6.0)	<0.001
≤3	68 (31.1)	37 (27.4)	31 (36.9)	
≥4	53 (24.2)	5 (3.7)	48 (57.1)	
AIS abdomen				
No injury	117 (53.4)	99 (73.3)	18 (21.4)	<0.001
≤3	79 (36.1)	29 (21.5)	50 (59.5)	
≥4	23 (10.5)	7 (5.2)	16 (19.0)	
AIS extremity				
No injury	57 (26.0)	40 (29.6)	17 (20.2)	0.012
≤3	135 (61.6)	85 (63.0)	50 (59.5)	
≥4	27 (12.3)	10 (7.4)	17 (20.2)	
AIS external				
No injury	70 (32.0)	47 (34.8)	23 (27.4)	0.362
≤3	148 (67.6)	87 (64.4)	61 (72.6)	
≥4	1 (0.5)	1 (0.7)	0 (0.0)	
AIS ≥ 4				
True	75 (34.2)	19 (14.1)	56 (66.7)	<0.001
False	144 (65.8)	116 (85.9)	28 (33.3)	
ISS, median (IQR)	21.0 (10.0–41.0)	13.0 (9.0–19.0)	48.0 (33.3–75.0)	<0.001[b]
ISS ≥ 16				
≥16	134 (61.2)	52 (38.5)	82 (97.6)	<0.001
<16	85 (38.8)	83 (61.5)	2 (2.4)	

Note. AIS = Abbreviated Injury Scale; AOD = atlanto-occipital disarticulation; ISS = Injury Severity Score; IQR = Interquartile range.
[a]Chi-square test was fit to test for vital status differences among categories of gender, race, physical location of injured, substance usage, time of incident, and environmental factors. Significance level was at 0.05.
[b]Mann–Whitney *U* test was used to compare the distribution of age between alive and dead cases. Significance level was at 0.05.

was significant and positive for fatality. A positive effect also was found for higher severity scores (OR = 1.136, 95% CI [1.063, 1.213]).

The occurrence of collision injury by hour and season are shown in Figure 1. The occurrences were almost evenly distributed during daytime but showed an increasing frequency during nighttime, specifically in the rush hour and sleepiness periods (6:00–11:00 p.m. and 2:00–4:00 a.m.). The number of occurrences of fatal versus nonfatal injuries was similar (n = 26 fatal and n = 27 nonfatal) for the autumn season.

TABLE 3. Characteristics of Stranded Motorists Inside the Vehicle at the Time of Injury

	Inside the Vehicle			
	Total *N* (%)	Nonfatal *n* (%)	Fatal *n* (%)	*p* Value
Inside of vehicle	50	32 (64.0%)	18 (36.0%)	
Rear-end collision (hit from rear)[a]				
Yes	26 (52.0)	9 (28.1)	17 (94.4)	NA[b]
No	2 (4.0)	1 (3.1)	1 (5.6)	
Unknown	22 (44.0)	22 (68.8)	0 (0)	
Occupant restrained				
Yes	25 (50.0)	16 (50.0)	9 (50.0)	1.000
No	25 (50.0)	16 (50.0)	9 (50.0)	
BMI[c]				
<18.5	2 (4.3)	1 (3.4)	1 (5.6)	0.180
18.5–24.9	14 (29.8)	12 (41.4)	2 (11.1)	
25–29.9	12 (25.5)	6 (20.7)	6 (33.3)	
30 or over	19 (40.4)	10 (34.5)	9 (50.0)	
Spine injury				
No	37 (74.0)	30 (93.8)	7 (38.9)	<0.001
Yes	13 (26.0)	2 (6.3)	11 (61.1)	
AIS head and neck				
No injury	24 (48.0)	18 (56.3)	6 (33.3)	0.001
≤3	13 (26.0)	11 (34.4)	2 (11.1)	
≥4	13 (26.0)	3 (9.4)	10 (55.6)	
AIS face				
No injury	42 (84.0)	27 (84.4)	15 (83.3)	0.923
≤3	8 (16.0)	5 (15.6)	3 (16.7)	
AIS chest				
No injury	18 (36.0)	17 (53.1)	1 (5.6)	<0.001
≤3	22 (44.0)	13 (40.6)	9 (50.0)	
≥4	10 (20.0)	2 (6.3)	8 (44.4)	
AIS abdomen				
No injury	25 (50.0)	19 (59.4)	6 (33.3)	0.145
≤3	19 (38.0)	9 (28.1)	10 (55.6)	
≥4	6 (12.0)	4 (12.5)	2 (11.1)	
AIS extremity				
No injury	20 (40.0)	13 (40.6)	7 (38.9)	0.403
≤3	29 (58.0)	19 (59.4)	10 (55.6)	
≥4	1 (2.0)	0 (0.0)	1 (5.6)	
AIS external				
No injury	19 (38.0)	12 (37.5)	7 (38.9)	0.923
≤3	31 (62.0)	20 (62.5)	11 (61.1)	

Note. AIS = Abbreviated Injury Scale; BMI = Body mass index; NA = not applicable.
[a]SM occupants of vehicle remaining inside the vehicle and sustained a rear impact collision.
[b]Category with a value of zero is not appropriate for a chi-square test.
[c]Three alive cases' BMI information were unknown.

TABLE 4. Parameter Estimates Arising From Binary Logistic Regression Models for Nonfatal Versus Fatal Cases (N = 219)

	Coefficient Estimate		95% CI for *OR*			
Outcome: Alive Versus Dead	**Estimate**	***SE***	**Odds Ratio**	**Lower**	**Upper**	***p* Value**
Spine injury	2.212	0.707	9.134	2.284	36.523	0.002
Inside vs. outside vehicle	0.051	0.661	1.052	0.288	3.843	0.939
ISS	0.127	0.034	1.136	1.063	1.213	<0.001
AIS ≥ 4	−1.001	0.760	0.367	0.083	1.631	0.188
ISS ≥ 16	1.676	0.954	5.346	0.825	34.653	0.079
Presence of substances[a]						
Yes	−2.905	0.843	0.055	0.010	0.285	0.001
No	−4.104	1.174	0.017	0.002	0.165	<0.001

Note. AIS = Abbreviated Injury Scale; ISS = Injury Severity Score.
[a]The reference group was "not tested."

Discussion

The probability of sustaining an injury increases for individuals of stopped vehicles who stand outside the vehicle. Stranded motorist incidents and general motor vehicle crashes have similar outcomes in that higher ISSs and cervical spine injuries are associated with mortality (Attergrim et al., 2018; Elgin et al., 2019; Roden-Foreman et al., 2019). Study results underlined the finding that spinal injuries (C1–C7) were significantly associated with fatality: The odds were stranded motorists with spine-related injuries had 9.13 times higher risk in prediction for a fatal outcome compared with stranded motorists without spinal injuries.

In terms of AIS scores, injury patterns for surviving stranded motorists showed the highest occurring injuries were those of extremities (n = 95), head and neck (n = 49), and chest (n = 42). This pattern differed for fatal injuries, where the highest occurring injuries were of chest (n = 79), head and neck (n = 73), extremities (n = 67), and abdomen (n = 66). To maximize chances for survival, implications of results indicate first responders should stabilize for spinal, head, and neck injuries. In addition, first responders should provide rapid hemorrhage control for chest and abdominal injuries (Kalkwarf et al., 2020).

In relation to additional variables, results show that stranded vehicles were usually because of mechanical failure, a common cause of stopped vehicles on public roads (e.g., Texas Transtar, 2021). Incidences where a passing motorist or government official stopped to render aid were few, yet a fatal outcome occurred in nine of 12 incidences. Less than half (36.1%) of the stranded motorists had either forensic toxicology or clinical drug panel testing performed, and nearly one quarter of those tested had alcohol or Class IV prescription drugs present at the time of the incident. Drugs and alcohol contribute to impaired driving, the cause of more than half of all car crashes (MedlinePlus, 2020). A National Safety Council reports that impaired driving accidents are more likely to occur at night, specifically on weekends between the hours of midnight and 3 a.m. (National Safety Council, 2021).

A potential concern arose in relation to trauma injury coding discrepancies between medical examiner's forensic specialists and certified coding analysts of trauma registries. Santos et al. (2019) also noticed an ISS disconnect between injuries identified at autopsy and their representative AIS score. Thus, some severe injuries routinely identified at autopsy are

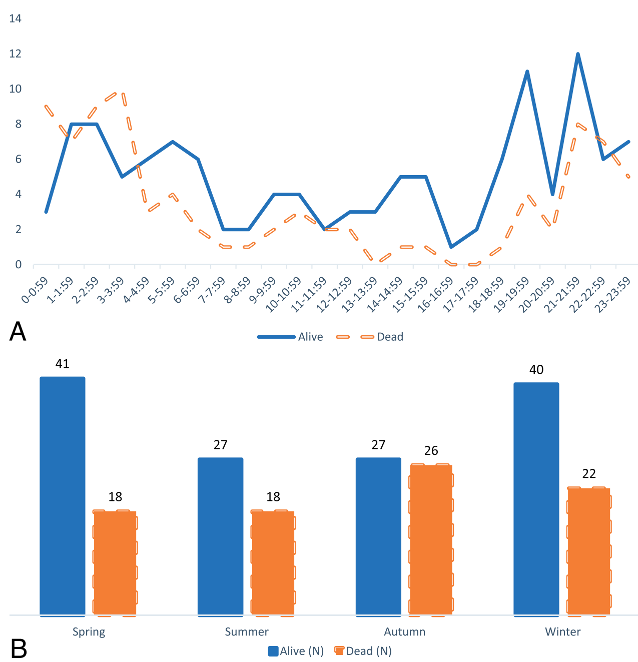

FIGURE 1. (A) Occurrence of collision by hour. (B) Occurrence of collision by season.

not accurately classified by standard trauma coding protocols. Examples are as follows:

- The atlanto-occipital disarticulation AIS score of 2 does not reflect the fact that this injury is rarely identified within the living population as a survivable injury (Hall et al., 2015).
- Within the cranial vault, a complete transverse basilar skull fracture extending through both petrous ridges and the sella turcica or clivus as a continuous open fracture or "hinge fracture" has an AIS of 4, and the complete circumferential foramen magnum fracture or "ring fracture" also has an AIS of 4, which gives an inconsistent severity rating because these two complex injuries are rarely encountered in the clinical setting.
- At autopsy, the identification of spinal cord "softening" without overt hemorrhage/contusion of the spinal cord appears frequently in polytrauma deaths. With a minimal survival interval and no clinical physical examination to confirm a spinal cord injury, no AIS score is designated for this lesion. However, it likely represents a *forme fruste* of a spinal cord contusion and would undoubtedly be a significant injury.
- In a reference to a "pulpified" moniker, the closest analogy would be an AIS score for an avulsed organ, be it liver (AIS = 6), kidney (AIS = 5), brain (AIS = 6), spleen (AIS = 5), or stomach (AIS = 4).

Linking law enforcement incident reports with patients transported to hospitals was difficult and resulted in missing variables. Thus, we were not able to determine the effect on injury or death because of road conditions and roadway type as well as whether warning signals, such as use of emergency hazard lights, warning cones, and hood up, would have made a difference. A simple solution would be for trauma centers to capture the law enforcement case number within their registries.

The demographic significance found in this study is likely an artifact. The stranded motorist incidences noted occurred in a southern, coastal area metropolitan area that has large Black and Hispanic populations. In addition, because of its geographical location, it was not expected that seasonal changes in stranded motorist incidences would be significant. The denominator of stranded motorists who are not injured or who are injured but do not seek medical attention or seek care outside the two participating hospitals is not captured in the current findings.

Forensic Nursing Implications

Forensic nurses in death investigation roles must be aware of the unique circumstance of stranded motorists and to appropriately track these deaths and to document external injuries and injury patterns. Forensic nurses in the hospital setting have a role in documenting patient injuries in nonfatal cases. Forensic nurses have a vital responsibility to work within their communities to help implement preventive and public awareness initiatives. This includes developing a solid collaboration between trauma systems and medicolegal death investigation agencies and ensuring ongoing open communication. This collaboration enables accurate identification and tracking of both fatal and nonfatal cases. Identification and tracking permits forensic nurses to present an accurate picture of the scope of preventable injuries and to provide informed input to various governmental agencies involved in transportation planning and law enforcement. Ultimately, injury prevention strategies always rest on a foundation of complete understanding of the scope and nature of the injuries and deaths.

In Harris County, the collaboration between trauma centers and the medical examiner's office has provided crucial data to the regional transportation safety authorities, which has culminated in a public service campaign dubbed "It's Only a White Line." Several initiatives have come from that campaign, including a 32-second video public service announcement (Texas Transtar, 2021), which highlights the risk of stopping on a highway. Other initiatives include bolstering public awareness and enforcement of the "Move Over" law that requires vehicles to either move over one lane or slow down while passing a stopped emergency, highway maintenance, or tow truck vehicle.

An implication of study findings for first responders and trauma personnel is the high risk of spinal, chest, and abdominal injuries, which must be considered when responding to and transporting individuals not pronounced dead at the scene. For motorist and pedestrian safety reasons, it is apparent that if a driver must stop the car on a public road/shoulder, vehicle occupants should remove themselves from the vicinity of possible impact or, if this is not possible, remain in the vehicle with seat belts on. This finding has implications for highway safety programs. If you cannot distance yourself physically from the stopped vehicle, your chances of survival are increased if you remain seat-belted within the stopped vehicle. Some states have implemented laws that specify disabled vehicles should be visible to oncoming traffic at a distance of 200 feet. Options to increase visibility include the use of emergency hazard lights or placing a bright cloth from the window or car antenna. For all purposes, data findings will be useful in devising highway safety programs or policy that maximizes survival.

Conclusion

Outcomes of this study illustrated the success of the interprofessional collaboration between two trauma centers and a medicolegal death investigation agency. The establishment of a prospective system to distinguish stranded motorist incidents from other types of vehicular injuries and fatalities led to identification of over 200 incidents within a 5-year period. Essentially, this averaged to 3.7 incidents a month that resulted in hospitalization or death. Ultimately, research findings allow better understanding of factors involved in stranded motorist incidences that could lead to educational and policy programs to reduce the incidence of death or injury and promote higher survival rates.

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