Original Article

Demographics in the context of health-care delivery for C1 and C2 fractures

ABSTRACT

Introduction: Atlas and axis fractures are the most severe cervical fractures which may result in complete paralysis or death. The purpose of the current study is to identify disparities regarding length of stay (LOS), mortality, and demographic factors in patients with the most serious cervical spine fractures utilizing a nationally representative database.

Materials and Methods: The Nationwide Emergency Department Sample was utilized to provide a representative sample for patients with a primary diagnosis of C1 or C2 fracture presenting to emergency departments in years from October 2015 to December 2019. A multivariable logistic regression model was used to estimate LOS for different patient demographics, including gender, race, and age.

Results: A weighted sample of 7,262,791 patients presented to emergency rooms in the United States between 2015 and 2019. The mean age at admission was 76 years old, 52.6% of patients were female, and 83.0% identified as white. Patients between 45 and 65 and patients over 65 were significantly more likely to have an increased LOS. Women were less likely to have an increased LOS than men. Patients identifying as Black were significantly more likely to have increased LOS over white patients. In addition, patients who had an increased LOS were more likely to die in the hospital than patients with a shorter LOS.

Conclusion: This study provides patient characteristics that help providers determine patient risk factors for increased hospital LOS and in-hospital mortality for those suffering from C1 and C2 fractures. Clinicians should be made aware of these disparities to allow equitable delivery of care.

Keywords: Cervical fracture, demographics, spine

INTRODUCTION

In the United States, axis (C1) fractures are found to have an incidence rate of 13 per million while atlas (C2) fractures are estimated to have an incidence rate of 60 per million.[1,2] C1 vertebral fractures account for up to 13% of cervical spine injuries while C2 vertebral fractures account for approximately 18% of cervical spine injuries.[3,4] Moreover, 41%–44% of C2 fractures are concurrent with C1 fractures.[5] The length of stay (LOS) of each patient presenting to the emergency department (ED) varies greatly and has been previously found to be influenced by patient characteristics such as age and sex.[6] However, there is currently a paucity of data regarding which patient or hospital characteristics significantly predict the LOS of patient with a C1/C2 fracture.

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The risk of mortality in patients with C1/C2 fractures is also influenced by patient-level factors including comorbidities and patient age, as was found in a multicenter study of French hospitals.[7] However, given the diversity of patient characteristics and hospital systems, these findings may not be applicable to hospitals in the United States. Furthermore, the yearly incidence and economic burden, estimated to be more than $1.3 billion for inpatient cervical fracture patients, is continuing to grow.[8,9] This underlines the need for further study of how patient-level and hospital-level factors influence hospital burden, patient LOS, and patient outcomes.

Given this need, the aim of the current study is to assess how patient-level factors and hospital factors influence patient LOS and mortality for patients with C1/C2 fractures. This analysis was performed utilizing the context of patient sex, race, age, income, payer, mechanism of injury, and hospital type and region.

MATERIALS AND METHODS

The Healthcare Cost and Utilization Project (HCUP) Nationwide Emergency Department Sample (NEDS) database was used to gather information on patients presenting to the ED with C1 and C2 fractures from October 2015 to December 2019. The NEDS database represents approximately 20% of US EDs and was created by the HCUP to provide publicly available data regarding longitudinal healthcare in the United States.[10] As the largest ED database in the US, it provides unweighted data from over 20 million ED visits per year and 123 million weighted ED visits per year. This study was exempt from institutional review board approval due to the use of publicly available and anonymized patient data.

All patients were eligible for inclusion in this analysis with a diagnosis meeting the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) code for a primary fracture of the C1 or C2 vertebrae. Patient demographic data were reported, including age, sex, race (white, Black, Hispanic, Asian or Pacific Islander, Native American, and other), primary insurance status (Medicare, Medicaid, private insurance, self-pay, no charge, and other), and the quartile of median household income based on patient zip code. Age categories were separated into five groups for analysis: children (0–10 years old), adolescents (11–20 years old), young adults (21–44 years old), adults (45–65 years old), and elderly (>65 years old). At the time of this analysis, national income quartiles were reported as 1st Quartile from $1 to 47,999, 2nd Quartile from $48,000 to 58,999, 3rd Quartile from $61,000 to 81,999, and 4th Quartile from $82,000+. Hospitals represented in this study were categorized based on region (Northeast, Midwest, South, and West), teaching status (metropolitan nonteaching, metropolitan teaching, and nonmetropolitan), and trauma center designation (nontrauma, trauma level I, trauma level II, and trauma level III).

All analyses were calculated using STATA (17.0, StataCorp LLC, College Station, TX) and utilized weighted data provided in the NEDS sample database.[10] Weighted frequencies were reported for all demographic variables. An increased LOS was determined to be the 75th percentile for the number of days a patient remained in the hospital for their visit, which was calculated to be 7 days. A multivariable-adjusted logistic regression model was utilized to calculate odds ratios (ORs) for increased patient LOS and inpatient mortality. 95% confidence intervals (CIs) were reported for each OR. A $P = 0.05$ was considered to be statistically significant. Confounding factors were limited due to the large size of the representative sample provided by the NEDS database, ensuring limited interference in the analysis. Any missing data, such as the absence of patient race records during their visit, were disregarded and not included in the subsequent tables.

RESULTS

Demographics

A weighted sample of 7,262,791 patients presented to emergency rooms in the United States between October 2015 and December 2019 with primary C1 or C2 fracture. The median age at admission was 76 years old, and the mean age was 70 years old. 52.6% of patients were female, yet males composed 62.7% of patients under 65 years old [Table 1]. 83.0% of patients identified as white, followed by 7.5% Black, 5.4% Hispanic, 1.6% Asian or Pacific Islander, 0.4% Native American, and 2.2% identified as another race. The majority of patients had Medicare as their primary insurance type (63.3%), followed by private insurance (20.9%), Medicaid (6.9%), self-pay (5.0%), no charge (0.5%), and other insurance types (2.2%). The most common median household income quartile for patients with C1 and C2 fractures was the first quartile with an income under $48,000 per year. Patients were also more often presenting to hospitals in the South (38.4%), metropolitan teaching hospitals (69.6%), and hospitals with no designated trauma center (34.0%).

Increased length of stay

Within the weighted sample of patients presenting with C1 and C2 fractures, 6,155,192 patients had an LOS of 7 days or under, while 1,107,601 patients had an increased LOS over 7 days. Patients in the adult category (between ages 45 and 65) and

Table 1: Demographics of patients with primary C1 and C2 fractures

Characteristic	Children (0–10 years), *n* (%)	Adolescents (11–20 years), *n* (%)	Young adults (21–44 years), *n* (%)	Adults (45–65 years), *n* (%)	Elderly (65 years+), *n* (%)	Total, *n* (%)
Sex						
Male	165 (51.9)	780 (58.1)	4728 (65.4)	7509 (61.8)	20,032 (40.9)	33,213 (47.4)
Female	152 (48.1)	563 (41.9)	2502 (34.6)	4637 (38.2)	29,000 (59.1)	36,855 (52.6)
Race						
White	70 (66.8)	303 (58.4)	1880 (61.1)	3838 (75.4)	20,074 (88.3)	26,165 (83)
Black	11 (10.6)	123 (23.7)	591 (19.2)	634 (12.5)	1007 (4.4)	2366 (7.5)
Hispanic	11 (10.4)	78 (15)	399 (13)	373 (7.3)	844 (3.7)	1705 (5.4)
Asian or Pacific Islander	4 (4.3)	0	61 (2)	81 (1.6)	348 (1.5)	494 (1.6)
Native American	4 (3.9)	0	30 (1)	43 (0.8)	44 (0.2)	121 (0.4)
Other	4 (4.1)	15 (2.9)	118 (3.8)	122 (2.4)	428 (1.9)	688 (2.2)
Primary insurance						
Medicare	0	6 (0.5)	253 (3.5)	2275 (18.9)	41,689 (85.2)	44,223 (63.3)
Medicaid	174 (54.7)	401 (29.8)	1715 (23.8)	2266 (18.8)	268 (0.5)	4823 (6.9)
Private insurance	106 (33.5)	725 (54)	3058 (42.5)	5213 (43.2)	5461 (11.2)	14,564 (20.9)
Self-pay	32 (10.1)	144 (10.7)	1505 (20.9)	1327 (11)	449 (0.9)	3457 (5)
No charge	0	0	40 (0.6)	86 (0.7)	5 (0)	132 (0.2)
Other	5 (1.7)	68 (5)	619 (8.6)	895 (7.4)	1053 (2.2)	2640 (3.8)
Median household income (national quartile for patient zip code)						
1st quartile ($1–47,999)	124 (39.4)	498 (37.6)	2622 (37.4)	3973 (33.6)	11,728 (24.3)	18,945 (27.6)
2nd quartile ($48,000–58,999)	94 (29.9)	315 (23.7)	1881 (26.9)	3107 (26.3)	13,075 (27.1)	18,471 (26.9)
3rd quartile ($61,000–81,999)	66 (21.2)	256 (19.3)	1478 (21.1)	2584 (21.9)	11,838 (24.5)	16,222 (23.6)
4th quartile ($82,000+)	30 (9.4)	257 (19.4)	1024 (14.6)	2144 (18.2)	11,636 (24.1)	15,091 (22)
Hospital region						
Northeast	33 (10.4)	199 (14.8)	929 (12.9)	1991 (16.4)	9065 (18.5)	12,218 (17.4)
Midwest	76 (24)	364 (27.1)	1603 (22.2)	2919 (24)	13,380 (27.3)	18,342 (26.2)
South	195 (61.4)	549 (40.9)	3368 (46.6)	5005 (41.2)	17,785 (36.3)	26,902 (38.4)
West	13 (4.2)	230 (17.1)	1330 (18.4)	2231 (18.4)	8807 (18)	12,611 (18)
Hospital teaching status						
Metropolitan nonteaching	38 (11.8)	162 (12)	1009 (14)	1970 (16.2)	9370 (19.1)	12,548 (17.9)
Metropolitan teaching	235 (73.9)	979 (72.9)	5334 (73.8)	8706 (71.7)	33,525 (68.4)	48,779 (69.6)
Nonmetropolitan	45 (14.3)	202 (15.1)	888 (12.3)	1470 (12.1)	6142 (12.5)	8747 (12.5)
Hospital trauma level designation						
Nontrauma	102 (32)	332 (24.7)	1807 (25)	3475 (28.6)	18,074 (36.9)	23,790 (34)
1	157 (49.5)	569 (42.3)	2845 (39.3)	4315 (35.5)	13,306 (27.1)	21,191 (30.2)
2	33 (10.4)	289 (21.5)	1729 (23.9)	2771 (22.8)	10,957 (22.3)	15,779 (22.5)
3	26 (8.1)	141 (10.5)	734 (10.2)	1421 (11.7)	5874 (12)	8196 (11.7)

elderly patients (over age 65) were significantly more likely to have an increased LOS than patients between ages 21 and 45 (OR: 1.62, 95% CI = [1.11–2.35], $P = 0.012$), (OR: 1.61, 95% CI = [1.08–2.42], $P = 0.020$), respectively [Table 2]. Women were less likely to have an increased LOS compared to men (OR: 0.66, 95% CI = [0.55–0.78], $P < 0.001$). Patients identifying as Black were significantly more likely to have increased LOS over patients identifying as white (OR: 1.46, 95% CI = [1.09–1.95], $P = 0.011$). Patients of the other race category were less likely to have an increased LOS compared to white patients (OR: 0.48, 95% CI = [0.27–0.87], $P = 0.015$).

Those with a primary insurance type of Medicaid were also significantly more likely to have an increased LOS >7 days compared to patients with Medicare (OR: 1.73, 95% CI = [1.06–2.82], $P = 0.028$). Patients with other insurance types were not found to be more likely to have an increased LOS. Patients with a median income in the 3rd quartile had an increased LOS compared to those of the 1st quartile (OR: 0.76, 95% CI = [0.6–0.97], $P = 0.028$). Hospital region had no determinants on the likelihood for a patient to have an increased LOS, yet patients presenting to a hospital with a level I trauma center were more likely to have an increased LOS than those at hospitals with no trauma center (OR: 1.56, 95% CI = [1.08–2.24], $P = 0.017$). In addition, patients who died in the hospital were more likely to have an increased LOS than surviving patients (OR: 2.28, 95% CI = [1.44–3.60], $P < 0.0001$).

Table 2: Association of C1 and C2 fractures with increased inpatient stay

Characteristic	OR (95% CI)	*P*
Age (years)		
0–10	-	-
11–20	0.96 (0.42–2.17)	0.913
21–45	Reference	-
46–65	1.62 (1.11–2.35)	0.012*
>65	1.61 (1.08–2.42)	0.02*
Race		
White	Reference	-
Black	1.46 (1.09–1.95)	0.011*
Hispanic	1.05 (0.73–1.51)	0.786
Asian or Pacific Islander	1.13 (0.55–2.34)	0.735
Native American	-	-
Other	0.48 (0.27–0.87)	0.015*
Sex		
Male	Reference	-
Female	0.66 (0.55–0.78)	<0.0001*
Primary insurance		
Medicare	Reference	-
Medicaid	1.73 (1.06–2.82)	0.028*
Private insurance	1.07 (0.81–1.43)	0.616
Self-pay	0.83 (0.52–1.31)	0.415
No charge	1.78 (0.5–6.37)	0.378
Other	1.19 (0.76–1.87)	0.455
Median household income (national quartile for patient zip code)		
1st quartile ($1–47,999)	Reference	-
2nd quartile ($48,000–58,999)	0.84 (0.66–1.07)	0.166
3rd quartile ($61,000–81,999)	0.76 (0.6–0.97)	0.028*
4th quartile ($82,000+)	0.84 (0.65–1.09)	0.195
Hospital region		
Northeast	Reference	-
Midwest	0.84 (0.58–1.2)	0.336
South	1.03 (0.76–1.41)	0.831
West	0.81 (0.57–1.15)	0.235
Hospital teaching status		
Metropolitan nonteaching	Reference	-
Metropolitan teaching	0.87 (0.6–1.27)	0.482
Nonmetropolitan	1.09 (0.55–2.13)	0.808
Hospital trauma level designation		
Nontrauma	Reference	-
1	1.56 (1.08–2.24)	0.017*
2	1.33 (0.93–1.9)	0.119
3	0.81 (0.52–1.25)	0.336
Died during visit		
No	Reference	-
Yes	2.28 (1.44–3.60)	<0.0001*

*$P<0.05$. OR - Odds ratio; CI - Confidence interval

Increased inpatient mortality

279,617, or 3.85% of patients in the weighted sample of 7,262,791 patients, experienced inpatient mortality. With respect to inpatient mortality, adults and elderly patients were more likely to die in the hospital compared to young adult patients (OR: 2.12, 95% CI = [1.06–4.46], $P = 0.035$), (OR: 5.65, 95% CI = [2.78–11.49], $P < 0.0001$), respectively [Table 3]. Women were also significantly less likely to die in the hospital compared to men (OR: 0.64, 95% CI = [0.52–0.79], $P < 0.0001$). In opposition to an increased likelihood for an increased LOS, Black patients were less likely to die in the hospital compared to white patients (OR: 0.35, 95% CI = [0.13–0.95], $P = 0.040$), and patients of other race were more likely to die in the hospital compared to white patients (OR: 3.12, 95% CI = [1.55–6.28], $P = 0.001$).

In addition, patients of all insurance types were less likely to die in the hospital compared to patients with Medicare [Table 3]. Median household income and hospital teaching status were found to have no significant relationship with inpatient mortality. Moreover, patients presenting to hospitals in the South were less likely to die in the hospital than patients in the Northeast (OR: 0.65, 95% CI = [0.02–0.45], $P = 0.020$). Furthermore, patients with C1 or C2 fractures presenting to EDs with a certified trauma center were significantly more likely to die in the hospital than patients presenting at hospitals with no trauma center. Similarly, patients who had an increased LOS were more likely to die in the hospital than patients with a shorter LOS (OR: 1.45, 95% CI = [1.07–1.96], $P = 0.014$).

DISCUSSION

Vertebral injuries, particularly those of the cervical spine, are usually the result of trauma and are accountable for between 19% and 51% of spinal trauma cases annually.[11] These patients are considered high-risk and are linked to the highest reported mortality rates in the realm of traumatic spinal injuries. Consequently, it is imperative to identify factors outside of the primary insult contributing to the appropriate and equitable treatment and management of such grave injuries.

Thus, in this nationally representative study, a weighted sample of patients who presented to US EDs with primary C1 or C2 fractures was statistically analyzed using a multivariable logistic regression model. Although related studies have been conducted using international patient data such as from the Swedish National Patient Registry or French multicenter patient cohorts, this review extrapolated its findings from the NEDS database.[7,12] Moreover, unlike the recent work of Lyons– which describes incidence rates, injury characteristics, and surface-level demographics of atlas fractures reported in the National Electronic Injury Surveillance System database – this investigation is aimed at identifying disparities regarding the LOS and mortality statistics in an analogs patient populace.[2] Accordingly, as the first report of its kind to assess patient-level and hospital-level factors in the US regarding

Table 3: Association of C1 and C2 fractures with inpatient mortality

Characteristic	OR (95% CI)	*P*
Age (years)		
0–10	1	-
11–20	2.21 (0.57–8.47)	0.246
21–45	Reference	-
46–65	2.12 (1.06–4.46)	0.035*
>65	5.65 (2.78–11.49)	<0.0001*
Race		
White	Reference	-
Black	0.35 (0.13–0.95)	0.040*
Hispanic	0.61 (0.22–1.65)	0.327
Asian or Pacific Islander	1.81 (0.62–5.36)	0.280
Native American	1	-
Other	3.12 (1.55–6.28)	0.001*
Sex		
Male	Reference	-
Female	0.64 (0.52–0.79)	<0.0001*
Primary insurance		
Medicare	Reference	-
Medicaid	0.48 (0.01–0.27)	0.014*
Private insurance	0.5 (0–0.36)	<0.0001*
Self-pay	0.44 (0.02–0.23)	0.017
No charge	-	-
Other	0.39 (0.02–0.18)	0.018
Median household income (national quartile for patient zip code)		
1st quartile ($1–47,999)	Reference	-
2nd quartile ($48,000–58,999)	1.23 (0.23–0.88)	0.229
3rd quartile ($61,000–81,999)	1.27 (0.18–0.9)	0.178
4th quartile ($82,000+)	1.13 (0.53–0.77)	0.526
Hospital region		
Northeast	Reference	-
Midwest	0.69 (0.06–0.47)	0.061
South	0.65 (0.02–0.45)	0.02*
West	0.89 (0.58–0.59)	0.58
Hospital teaching status		
Metropolitan nonteaching		
Metropolitan teaching	1.15 (0.5–0.76)	0.503
Nonmetropolitan	1.12 (0.77–0.51)	0.77
Hospital trauma level designation		
Nontrauma	Reference	-
1	2.45 (1.57–3.84)	<0.0001*
2	3.23 (2.09–4.99)	<0.0001*
3	2.02 (1.26–3.24)	0.003*
LOS (days)		
≤0	Reference	-
>7	1.45 (1.07–1.96)	0.014*

*$P<0.05$. LOS - Length of stay; OR - Odds ratio; CI - Confidence interval

ICD-10-CM coded vertebral fractures, the proceeding discussion will detail impactful findings in the context of patient demographics, inpatient stay, and mortality trends.

Key findings

In this investigation, patients who presented to the ED with either atlas or axis fractures were 52.6% female as compared to 47.4% male, as shown in Table 1, which is consistent with the most recent epidemiological evaluation of atlas fractures in the US reporting 54% and 46% occurrence in females and males, respectively.[2] Interestingly, however, males accounted for 62.7% of patients under the age of 65 years old. This age-related discrepancy in the context of gender can be attributed to the mechanism of cervical spine injury, namely trauma from sports-related injuries, motor vehicle accidents, and penetrating/blunt trauma for males between the ages of 15–65 years of age, and nontraumatic injuries such as osteoporosis, osteoarthritis, and metabolic diseases for females 65 years and older.[13] Further, most of these patients were comprised of non-Hispanic, whites (83%) followed by Black (7.5%) and Hispanic (5.4%) ethnic minorities, which correlates well with the current demographic composition of the US. A final related pair of patient-level characteristics is notably the intersection between patient primary insurance type, being Medicare (63.3%), and median household income, being the 1st quartile ($1–47,999). According to Roberts *et al.*, the eligible Medicare population is projected to grow by 30%, with half of these individuals expected to have an income of <$322,000.[14] Consequently, this forecasted rise in prospective Medicaid beneficiaries with low income may have implications such as underinsurance and high out-of-pocket costs for patients in the setting of traumatic injury if cost and enrollment rules are not expanded. At the system level, a majority (38.4%) of patients with C1 or C2 fractures presented in the South and within the metropolitan teaching setting (69.6%), with the presentation at metropolitan nonteaching (17.9%) and nonmetropolitan (12.5%) hospitals accounting for a significantly smaller proportion of total cases. These data suggest a potential geographical correlation between spinal cord injury (SCI) tendency in the Southern population, as well as the decision for patient care at large, regional metropolitan teaching hospitals for acute treatment of SCIs. Another study prorupted geography to be a significant determinant of health in SCI populations, suggesting individuals from rural areas use medical care less frequently as compared to those living within urban areas.[15] Although the analyzed data from this manuscript supports said assertions, more research is necessitated before making firm conclusions on geography's impact as a social determinant of health in SCI patients.

When looking at the previously discussed patient demographics in the context of their potential effects on inpatient stay length, there are a few notable trends that warrant further attention and dialogue which can be found in Table 2. At the patient level, individuals between 46–65 and 65+ years old were significantly more likely to have an increased LOS as compared to patients between the

ages of 21 and 45 years old. As previously discussed, the 46–65 years of age group was comprised of a majority male (61.8%), while the 65+ years of age group was a majority female (59.1%). Further, with regard to sex, women had a 34% decrease in the odds of an extended inpatient stay compared to men. Together, these data suggest although female sex confers a statistically significant protective benefit regarding LOS as compared to men following C1 or C2 fractures, age – specifically of elderly age (65 + years old) – is an important predictive factor in increased length of inpatient stay regardless of sex status. A second set of notable characteristics associated with increased LOS include patients who identified as Black when compared to those who identified as white, as well as individuals covered under Medicaid over Medicare. Intriguingly, one study evaluating policy aimed at managing the quality and costs of national health care identified hospitals within the South that provide low-quality, high-cost care for a disproportionately higher number of elderly, Black, and Medicare patients.[16] Thus, this fact may aid in explaining the increased likelihood of prolonged inpatient stays in these groups. Moreover, since many patients (38.4%) who presented with either type of cervical spine fracture did so at EDs within Southern regions, the disparities mentioned above are important considerations when looking to optimize patient outcomes.

Finally, when interpreting the data in association with inpatient mortality, there are a number of patterns that run parallel with the associations with increased inpatient stay as found in Table 3. Namely, individuals between 46–65 and 65+ years old were significantly more likely to experience a fatality as compared to patients between the ages of 21–45 years old. Specifically, elderly age was associated with an up to five-fold increase in the odds of a fatal event. Similarly, patients who were covered under Medicaid or private insurance experienced a statistically significant decrease in the odds of an associated fatal event compared to Medicare beneficiaries, who are generally 65 years or older. Again, female sex was associated with decreased odds of an adverse event, a fatality in this instance, when compared to male counterparts. In contrast to the association with longer inpatient stays described above, patients who identified as Black were less likely to experience a fatal event compared to white patients. Although these data may appear to run counter to inpatient stay length, these associations are well explained by Kahn *et al*. in their study on hospital effects and quality care.[17] Particularly, this system-level conundrum can be attributed to the offsetting effect of Black patients typically receiving care in urban teaching hospitals, which have been shown to provide overall better life-preserving care ($P < 0.5$).[17] Finally, patients who had an increased LOS were more likely to experience a fatal event than patients with a shorter LOS. Taken altogether, while the data may suggest a protective effect regarding Black ethnic minorities in association with decreased odds of mortality, it is crucial to keep in mind older, Black, and male patients were more likely to have an increased LOS, which is associated with an increased odds of mortality in and of itself.

Strengths and limitations

While we are confident this study aptly compares demographics among the populations of C1 and C2 fractures, it is not without limitations. To begin, this analysis is constrained by the variables available in the NEDS. More so, with the use of information provided in these large data inputted from different hospitals, there is inherently going to be heterogeneity within the population sample.[18] While increasing sample size allows for generalizability to the population overall, this can limit the insight from hospitals and lead to difficulties with identifying confounding variables. With the confounding variables in mind, further research at a single intuition would be valuable as the data could include a greater amount of information specific to the patient's previous experience and background information. It is also important to consider information incorporated into the dataset which can be variable when considering the difficulty of diagnosing upper cervical fractures on X-ray.[5]

The strengths of this study lie in the immense amount of data collected in the NEDS database. While there are the previously mentioned limitations with the use of databases such as NEDS, the authors feel the data collected are reliable and provides a representative sample size. With the large sample size, the authors feel confident any findings are truly significant and not found in error.

CONCLUSIONS

This study provides patient characteristics that help providers predict patient populations suffering from C1 to C2 vertebral factors and determine patient risk factors for increased hospital LOS and in-hospital mortality. This information may help providers decide the appropriate aggression of patient treatment, level of patient monitoring, and level of hospital service to admit to (e.g., intensive care unit vs. lower-level unit). These characteristics, in addition to radiographic and comorbid prognostic indicators, may also guide providers when discussing patient and family expectations and goals of care, critical facets of patient care when treating potentially fatal injuries. Furthermore, our data display the potential effects of social determinants – Black patients and patients with Medicaid had higher rates of prolonged hospital LOS. Thus, our study highlights the importance of continued national efforts to increase the equity of emergency healthcare.

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Conflicts of interest

There are no conflicts of interest.

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