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ORIGINAL ARTICLE

An investigation of social determinants of health and outcomes in pediatric nonaccidental trauma

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Abstract

Objectives Nonaccidental trauma (NAT) is a leading cause of pediatric mortality and disability. We examined our institution's experience with NAT to determine if socioeconomic status is correlated with patient outcomes.

Methods NAT cases were reviewed retrospectively. Socioeconomic determinants included insurance status and race; outcomes included mortality, discharge disability and disposition. Correlations were identified using *t* test, Fisher's exact test, and logistic regression.

Results The cohort comprised of 337 patients, with an overall uninsured rate of 5.6%. This rate was achieved by insuring 64.7% of the cohort after admission. Non-survivors were more likely to have no insurance coverage (14.8% versus 4.8%, $p = 0.041$). Regression revealed that uninsured had 8 times (95% CI 1.7–38.7, $p = 0.008$) higher in-hospital mortality than those with insurance when controlling for injury severity. Additionally, injury severity score ≥ 15, transfer from outside hospital, need for ICU or operative treatment were predictive of mortality. Adjusted risk factors for severe disability at discharge did not include insurance status or race, while ISS ≥ 15 and ICU stay were predictive.

Conclusions There are significant associations of insurance status with pediatric NAT outcomes, highlighting that determinants other than disease severity may influence mortality and morbidity. High-risk patients should be identified to develop strategies to improve outcomes.

Keywords Non-accidental trauma · Pediatrics · Insurance status · Socioeconomic status

Introduction

Non-accidental trauma (NAT), or child abuse, is a leading cause of death and disability in children [1]. These injuries are on the rise, with a 3.8% increase in NAT incidence between 2011 and 2015 [2]. NAT is a malignant disease state and confers mortality risk beyond what is observed from similar injuries in accidental trauma [3]. It is estimated that the cost for the hospitalization of abused children approximates 73.8 million USD every year in the United States [4], and maltreated children require approximately $2600 more in Medicaid dollars when compared to non-abused counterparts. Roughly, 9% of all Medicaid expenditures cover the hospitalization and care of patients injured due to NAT [5].

Children at risk for NAT injury include those that are less than 5 years of age, those whose parents are unemployed, those living in a rural setting, and with lower socioeconomic status [6, 7]. After NAT, patients are at risk for increased rates of anxiety, depression, social withdrawal, and decreased educational level [6, 8, 9]. Recently, national databases have been analyzed to determine if socioeconomic factors are associated with mortality after NAT, uncovering alarming trends in which uninsured children are 2–3 times more likely to suffer mortality [10, 11]. Unlike race, ethnicity, or age, payor status is a modifiable factor

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that may change over time. Adult studies have shown that trauma morbidity may be associated with loss of coverage or increased rates of public insurance [12]. Since public insurance programs are more available to children as compared to adults [13, 14], dynamic alterations in insurance coverage may play a role in pediatric NAT outcomes differently that in adult disease states.

To study socioeconomic correlations with outcomes in NAT patients on a granular level, we examined insurance status, race and outcomes in patients admitted for NAT at our Level I pediatric trauma center. We hypothesized that patients with key economic and social risk factors, including lack of insurance coverage and nonwhite race, would experience greater rates of morbidity and mortality.

Methods

Database and case identification

This is a retrospective single-institution observational study aimed at identifying possible associations between patient social and economic factors and outcomes after NAT. Children's Medical Center Dallas is an American College of Surgeons verified Level I Pediatric Trauma Center, which admits 1400–1500 trauma patients annually. In accordance with National Trauma Data Bank (NTDB) guidelines, data are collected on all children admitted to the hospital for acute injury as well as children who are dead on arrival or die in the emergency department. A trained registrar completes a collection form for each patient, which includes a field to indicate history of child abuse. After institutional review board approval, our hospital's trauma registry was queried to identify all cases of NAT. All patients with suspected NAT are admitted after injury for protection and social work services, and there were no NAT patients who were discharged home from the emergency department post-injury. The institutional review board (IRB) reviewed and approved this study (IRB# STU 012,017-083). Given the retrospective nature of the study, the requirement for informed consent was waived by the IRB.

Variables and outcomes

Data were available for the years 2011–2014. Patient characteristics were extracted from our trauma registry, including age at time of admission, sex, race, insurance coverage, incoming transfer status, and illness severity score. Race was considered a social determinant of health and insurance status was considered an economic determinant of health for the purpose of this study. Insurance coverage was defined as commercial, public [Medicaid or Children's Health Insurance Program (CHIP)], or none. For the purposes of this study, ethnicity and race groupings were considered together and will henceforth be referred to as race groupings. These included Caucasian, African American, Hispanic, and other. Transfer status reflected whether or not the patient presented as a transfer from an outside hospital versus direct presentation through the emergency department. ISS was collected as a numerical variable and also grouped into a binary variable by separating children with ISS < 15 or ≥ 15.

The primary outcome measure for this study was in-hospital mortality, and secondary outcome measures included need for ICU stay, operative management, length of hospital stay (LOS), discharge disposition and presence of post-trauma disability. LOS was calculated as days from time of admission to time of discharge (or time of death for non-survivors). Operative management encompassed any surgery including neurologic, orthopedic and general surgery cases. Interventional radiology procedures were not considered. Discharge disposition separated surviving patients into those who were discharged home versus to foster care or custodial care. Disability groupings consisted of surviving patients with full to moderate recovery versus severely disabled. To be categorized in the moderate recovery group, the patient is defined as independent with respect to daily life and able to participate in activities indicating self-sufficiency beyond dressing and minimal self-care. For the severely disabled category, the patient could be conscious and at least somewhat responsive, but dependent for daily support. Some patients were discharged to rehabilitation or acute nursing centers first prior to final discharge home versus to foster care. These patients were excluded from analyses of discharge disposition and disability, since their final disposition and disability status were unknown.

Statistical analyses

Descriptive calculations included frequencies for categorical variables and means and standard deviation for numerical variables. Unadjusted comparisons were completed with t test and χ^2 test (or Fisher's exact test in the case of small group sizes). Multivariate modeling was achieved with binomial logistic regression to control for illness severity and demographics and detect a possible association of socioeconomic status with patient outcomes. Model significance was determined using the omnibus test with a significance level of $p < 0.05$. Model strength is reflected with Nagelkerke R square and percent of predictions made correctly. Significant variables within the model were identified with $p < 0.05$ and the adjusted odds ratio and 95% confidence interval were presented. All statistical analyses were completed with SPSS 25 (IBM, Armonk, NY).

Results

337 patients were identified who presented with NAT during the study period (2011–2014). All patients were victims of blunt trauma and not penetrating trauma. Demographic information for all patients, survivors and non-survivors is presented in Table 1. The median age of patients was 14.2 months, and 62.3% were males. About one-third of the patients were Caucasian, one-third were African American, and one-third were Hispanic, with a few children listed as "other" race. Over half of the patients presented as transfers from outside facilities (55.5%). The mean ISS upon presentation was 13.3, with 35.6% of patients presenting with ISS greater or equal to 15. Interestingly, 70.3% of patients presented to our hospital with no insurance coverage. With the help of social work and case management, 92.0% of these patients were insured by the time of discharge, leaving a final uninsured rate of 5.6%. Upon discharge, 81.0% of children were covered with public insurance, and 13.4% had commercial insurance. No child who presented with insurance lost coverage during the study.

Briefly, insurance obtainment during hospitalization is a dynamic and individualized process carried out by skilled social workers and case managers at our institution. The final outcome of achieving insurance coverage during admission depends on each patient's particular situation. For example, uninsured patients who qualify for Medicaid or CHIP are identified and assisted in completing their application to receive this coverage. This application occurs at the state level and may be expedited when medically necessary. Some patients lack coverage upon admission, because they present without verified identification. Once accurate patient identity is confirmed, insurance coverage is subsequently determined. Alternatively, patients who are undocumented and present with emergency conditions are covered by emergency Medicaid funding. These are the major mechanisms by which uninsured patients receive coverage prior to discharge at our institution.

Mortality occurred in 27 patients (8.0%). Univariate comparisons between survivors and non-survivors revealed no significant differences in demographic variables such as age, gender, and race ($p > 0.05$). Cause of death was from neurologic trauma in all but two patients, who died due to cardiac arrest after blunt thoracic and abdominal injury. Patients who died were significantly more likely to have been transferred from outside hospitals when compared to those who survived (74.1% versus 53.9%, $p = 0.046$). To understand this finding, we compared the mean ISS for transfer and non-transferred patients, which was not significantly different ($p = 0.717$). The mean ISS for non-survivors was

Table 1 Patient characteristics and morality after NAT

	All	Survivors	Non-survivors	*p*
Number of patients	337	310	27	
Age, mean months ± std dev[a]	14.2 ± 23.3	14.1 ± 23.8	15.7 ± 17.7	0.728
Males, *n* (%)	210 (62.3)	193 (62.3)	17 (63.0)	0.942
Race, *n* (%)				0.569
Caucasian	114 (33.8)	107 (34.5)	7 (25.9)	
African American	94 (27.9)	87 (28.1)	7 (25.9)	
Hispanic	108 (32.0)	96 (31.0)	12 (44.4)	
Other	21 (6.2)	20 (6.5)	1 (3.7)	
Transferred from OSH[b], *n* (%)	187 (55.5)	167 (53.9)	20 (74.1)	0.046
Length of stay, mean days ± std dev[a]	11.2 ± 99.6	11.6 ± 103.7	5.8 ± 12.5	0.771
Injury severity score, mean ± std dev[a]	13.4 ± 10.0	12.3 ± 9.2	25.1 ± 11.3	< 0.0001
ISS[c] ≥ 15, *n* (%)	120 (35.6)	100 (32.3)	20 (74.1)	< 0.0001
Insurance status on arrival, *n* (%)				0.756
None	237 (70.3)	216 (69.7)	21 (77.8)	
Public	81 (24.0)	76 (24.5)	5 (18.5)	
Commercial	19 (5.7)	18 (5.8)	1 (3.7)	
Final insurance status, *n* (%)				0.041
None	19 (5.6)	15 (4.8)	4 (14.8)	
Public	273 (81.0)	252 (81.3)	21 (77.8)	
Commercial	45 (13.4)	43 (13.9)	2 (7.4)	

[a] *Std dev* standard deviation

[b] *OSH* outside hospital

[c] *ISS* injury severity score

approximately 25, compared to 12 in survivors ($p < 0.0001$). Likewise, a significantly greater proportion of mortalities had an ISS greater or equal to 15 when compared to survivors (74.1% versus 32.3%, $p < 0.0001$). Insurance coverage upon presentation was similar between the two groups, though non-survivors had an insignificantly higher rate of uninsured patients ($p = 0.756$). At discharge, however, significant differences in insurance coverage were discovered. While 14.8% of non-survivors had no insurance coverage at discharge (death), only 4.8% of survivors had no insurance coverage at discharge ($p = 0.041$). To further understand this finding, we evaluated rates of successful obtainment of coverage post-admission in survivors and non-survivors, and found 64.8% of survivors and 63.0% of non-survivors were insured between admission and discharge ($p = 0.105$). Therefore, survivors and non-survivors had similar rates of insurance obtainment post-admission. However, the rate of uninsured patients was higher at discharge in non-survivors, because their initial rate of being uninsured upon admission was also higher (77.8% in non-survivors versus 69.7% in survivors were uninsured upon arrival).

Given that NAT non-survivors were more likely to remain uninsured after admission, we next aimed to assess if differences in insurance coverage were related to length of stay. Specifically, we wanted to rule out the possibility that non-survivors were less likely to be insured, because they died prior to establishment of coverage post-admission. To investigate this, we compared mean hospital LOS between groups based upon mortality and insurance status. When comparing LOS of patients who died during their hospital stay, LOS was not significantly different between survivors and non-survivors (Table 1, $p = 0.771$). Likewise, comparing the LOS of non-survivors based upon insurance status did not reveal any significant differences, both at presentation ($p = 0.769$) or discharge ($p = 0.711$). Finally, comparing patients who obtained insurance by discharge versus those who remained uninsured, there was no difference in mean hospital LOS (Table 2, $p = 0.773$).

We examined the injury severity and outcomes of our cohort by final insurance status with univariate analyses, which are presented in Table 2. The ISS was not significantly different between insured and uninsured, nor were presentation transfer rates ($p > 0.05$). The mean hospital LOS for the entire cohort was 11.2 days, and although uninsured patients appeared to have a much shorter LOS at 4.5 days, this difference was not statistically significant ($p = 0.763$). There was a trend towards an increased mortality rate when comparing the uninsured versus insured (21.1% versus 7.2%, $p = 0.055$). There was no difference in rates of ICU stay or operative intervention in either group. Disability and disposition outcomes were analyzed in surviving patients. With regard to disability post-trauma, there were no significant differences in rates of severe disability in insured and uninsured patients ($p = 1.000$). The discharge disposition was likewise similar in insured and uninsured patients ($p = 0.697$). For patients who were not discharged home, none were transferred to other inpatient hospitals, rather, they went to skilled nursing or rehabilitation facilities.

Table 2 Patient outcomes after NAT by final insurance coverage status

	All	Insured	Uninsured	*p*
Number of patients	337	318	19	
Injury severity score, mean ± std dev[a]	13.4 ± 10.0	13.3 ± 10.0	13.8 ± 10.4	0.831
Transferred from OSH[b], *n* (%)	187 (55.5)	177 (55.7)	10 (52.6)	0.816
Length of stay, mean days ± std dev[a]	11.2 ± 99.5	11.6 ± 102.5	4.5 ± 5.7	0.763
Mortality, *n* (%)	27 (8.0)	23 (7.2)	4 (21.1)	0.055
ICU[c] stay, *n* (%)	124 (36.8)	119 (37.4)	5 (26.3)	0.464
Operative intervention, *n* (%)	55 (16.3)	51 (16.0)	4 (21.1)	0.528
Surviving patients only ($n = 310$)				
Number of patients	310	295	15	
Recovery, *n* (%)				1.000
Moderate to full recovery	266 (85.8)	252 (85.4)	14 (93.3)	
Severe disability	26 (8.4)	25 (8.5)	1 (6.7)	
Transfer (unknown)	18 (5.8)	18 (6.1)	0 (0)	
Disposition, *n* (%)				0.697
Home	114 (36.8)	223 (75.6)	13 (86.7)	
Foster or custodial care	178 (57.4)	54 (18.3)	2 (13.3)	
Transfer (unknown)	18 (5.8)	18 (6.1)	0 (0.0)	

[a] *Std dev* standard deviation

[b] *OSH* outside hospital

[c] *ICU* intensive care unit

Univariate comparisons were made to determine significant associations between race, injury severity, and outcomes, which are presented in Table 3. The ISS was not significantly different across race groups ($p = 0.932$). However, presentation via transfer was more common for Caucasian patients and those of "other" race as compared to African American and Hispanic patients ($p < 0.0001$). The mean LOS was similar between race groups ($p = 0.631$). While mortality rates were similar in Caucasian and African American patients at 8.0% and 6.1%, respectively, the mortality rate was higher in Hispanic children at 11.1% and lower in children of "other" race at 4.8%. However, these differences did not reach statistical significance ($p = 0.569$). With regard to the cause of death, all mortalities were related to neurologic injury, except in two patients, one of whom was Caucasian, and the other was African American. There was no difference in rates of ICU stay between races, but African American and patients of other race were more likely to undergo surgery ($p = 0.009$). Disability and disposition outcomes were analyzed in surviving patients. With regard to disability post-trauma, rates of severe disability were similar across race groups ($p = 0.564$). The discharge disposition was likewise similar in various races ($p = 0.449$).

To further characterize mortality in pediatric NAT, logistic regression modeling was performed to adjust for patient factors and determine significant predictors of mortality. Variables included in the model were age in months, gender, transfer status upon arrival, ISS ≥ 15, ICU or operative management, race, and final insurance status. Binomial logistic regression revealed that together, these variables explain 37.4% of the variation in mortality in pediatric NAT ($p < 0.0001$). This model can correctly predict mortality in 92.3% of cases. Significant predictors and other variables modeled are shown in Table 4. Significant predictors include presentation by transfer from outside hospital which conferred 3.6 times the mortality ($p = 0.017$). Need for ICU stay and operative management lead to 14.1 and 8.6 times the mortality, respectively ($p < 0.0001$, $p = 0.013$). ISS ≥ 15 was associated with 3.8 times greater mortality ($p = 0.015$). Hispanic race trended towards significance compared to Caucasian race in conferring a 2.9 times greater mortality ($p = 0.066$). Significantly, lack of insurance coverage at discharge led to 8.2 times the mortality when compared to children who were insured with public or private insurance upon discharge ($p = 0.008$).

Binomial logistic regression was performed to determine adjusted predictors of severe disability and discharge disposition. To characterize predictors of severe disability versus moderate to normal recovery, the variables in Table 5 were included in a regression model. This model was statistically significant in accounting for 43.1% of the variance in disability level, with the ability to correctly predict disability level in 92% of cases ($p < 0.0001$). Significant predictors included ISS ≥ 15, which conferred a 3.6 times greater risk for severe disability ($p = 0.024$). ICU stay was the most significant predictor of increased disability, with patients who

Table 3 Patient outcomes after NAT by race

	All	Caucasian	African American	Hispanic	Other	*p*
Number of patients	337	114	94	108	21	
Injury severity score, mean ± std dev[a]	13.4 ± 10.0	13.4 ± 9.1	13.6 ± 11.3	12.9 ± 10.2	14.2 ± 8.7	0.932
Transferred from OSH[b], *n* (%)	187 (55.5)	86 (75.4)	45 (47.9)	44 (40.7)	12 (57.1)	< 0.0001
Length of stay, mean days ± std dev[a]	11.2 ± 99.5	5.8 ± 8.6	5.9 ± 8.0	21.4 ± 175.5	14.8 ± 3.2	0.631
Mortality (*n*, %)	27 (8.0)	7 (6.1)	7 (7.4)	12 (11.1)	1 (4.8)	0.569
ICU[c] stay (*n*, %)	124 (36.8)	45 (39.5)	36 (38.3)	34 (31.5)	9 (42.9)	0.555
Operative intervention (*n*, %)	55 (16.3)	17 (14.9)	19 (20.2)	11 (10.2)	8 (38.1)	0.009
Surviving patients only (*n* = 310)						
Number of patients	310	107	87	96	20	
Recovery (*n*, %)						0.564
Moderate to full	266 (85.8)	90 (84.1)	76 (87.4)	83 (86.5)	17 (85.0)	
Recovery severe disability	26 (8.4)	10 (9.3)	4 (4.6)	10 (10.4)	2 (10.0)	
Transfer (unknown)	18 (5.8)	7 (6.5)	7 (8.0)	3 (3.1)	1 (5.0)	
Disposition (*n*, %)						0.449
Home	114 (36.8)	77 (72.0)	69 (79.3)	76 (79.2)	14 (70.0)	
Foster or custodial care	178 (57.4)	23 (21.5)	11 (12.6)	17 (17.7)	5 (25.0)	
Transfer (unknown)	18 (5.8)	7 (6.5)	7 (8.0)	3 (3.1)	1 (5.0)	

[a] *Std dev* standard deviation

[b] *OSH* outside hospital

[c] *ICU* intensive care unit

Table 4 Adjusted predictors of mortality after pediatric NAT

	Adjusted odds Ratio	Confidence interval (95%)	*p*
Age	1.1	0.994–1.035	0.164
Male sex	1.4	0.517–3.712	0.517
Transfer from outside hospital	3.6	1.254–10.183	0.017
ISS[a] ≥ 15	3.8	1.293–10.968	0.015
ICU[b] stay	14.1	3.904–51.057	< 0.0001
Operative management	8.6	1.573–47.421	0.013
Race			0.209
Caucasian	Reference	Reference	Reference
African American	1.5	0.436–5.228	0.515
Hispanic	2.9	0.930–9.145	0.066
Other	0.476	0.040–5.742	0.559
Lack of insurance upon discharge	8.16	1.724–38.651	0.008

[a] *ISS* injury severity score

[b] *ICU* intensive care unit

Table 5 Adjusted predictors for severe disability after NAT

	Adjusted odds ratio	Confidence interval (95%)	*p*
Age	0.986	0.944–1.029	0.507
Male sex	1.1	0.391–3.055	0.864
Transfer from outside hospital	1.4	0.481–3.804	0.566
ISS[a] ≥ 15	3.6	1.181–10.669	0.024
ICU[b] stay	26.4	5.507–126.156	< 0.0001
Operative management	1.5	0.457–4.640	0.525
Race			0.181
Caucasian	Reference	Reference	Reference
African American	1.4	0.201–9.454	0.744
Hispanic	0.5	0.059–3.556	0.455
Other	2.2	0.306–15.764	0.433
Lack of insurance upon discharge	1.6	0.056–7.291	0.726

[a] *ISS* injury severity score

[b] *ICU* intensive care unit

required ICU stay 26.4 times more likely to develop severe disability ($p = 0.0001$). Race and final insurance status did not significantly predict disability outcomes in this model. Finally, upon modeling discharge disposition, no combination of variables significantly predicted the variance between discharge to home versus discharge to foster or custodial care ($p = 0.132$).

Discussion

We examined the associations between sociodemographic characteristics of victims of NAT and outcomes at a large single-institution Level I pediatric trauma center. Our study demonstrated that being uninsured was correlated with eight times greater mortality in NAT when controlling for injury severity. Interestingly, we discovered that insurance coverage was dynamic in our cohort. While 70.3% of patients presented with no insurance coverage, this number was reduced to 5.6% after admission. Overall, race identity was not associated significantly with mortality, though there was a trend towards increased mortality in Hispanic children, and two minority groups (African American and "other") were more likely to undergo surgery. We also examined post-trauma outcomes including disability level and discharge disposition and found that insurance status and race were not associated with significantly increased rates of disability or discharge to foster or custodial care.

The interplay between insurance coverage and outcomes has been established across a wide array of disease states with uninsured status associated with inferior outcomes in both adult and pediatric patients [15–18]. Uninsured children have higher overall morality, and that this risk extends into adulthood and even transmits to future generations [13]. Moreover, patients from underrepresented minorities are known to suffer increased mortality and complications in a variety of clinical settings [19, 20]. Underlying causes of this phenomenon could include lack of resources or education in these groups, leading to delayed presentation for care and/or impaired treatment [3, 16, 18, 20–23]. Compromised healthcare quality may stem from implicit bias or poor communication between healthcare workers and disenfranchised patients [16, 24]. Increased rates of child maltreatment are perceived to be associated with low socioeconomic status by pediatricians [25]. Recently, the problem of depressed outcomes in uninsured patients and minorities has been confirmed specifically in NAT via the examination of large national databases [10, 11]. Our study agrees with these national findings, showing correlations between insurance status and mortality independent of disease severity. Importantly, ISS and insurance status were not correlated in our study, reflecting similar disease severity across coverage groups, which would imply that factors other than disease severity are responsible for increased mortality in uninsured children. Though determining the underpinnings of this finding is beyond the scope of this study, we suspect that factors such as education level, healthcare literacy, access to care, and biases in the healthcare system may be underlying mechanisms, as mentioned above.

In addition to the association we discovered between insurance coverage and mortality, our study also uncovered higher rates of mortality in patients who presented to our hospital via transfer from outside facilities. Again, this difference cannot be explained by higher disease severity in transfer patients given that ISS was not significantly different between transfer and non-transfer patients. Existing studies have shown that children with less favorable insurance status (self-pay or Medicaid) are more likely to be transferred to tertiary centers for NAT, general trauma and other emergent conditions [17, 26]. However, insurance coverage was not associated with transfer status in our study. Interestingly, we have examined payor status in patients transferred to our institution for appendectomy in a previous study and demonstrated no correlation between transfer status and disease severity or insurance status [27]. Trends from our NAT cohort agree with these appendectomy data, since NAT patients who presented via transfer had similar insurance coverage and ISS to those who presented directly. Our collective data thus suggest that mechanisms not related to insurance coverage are responsible for the association between transfer status and increased NAT mortality at our institution. For example, the distance traveled or potential delays in care could impact transfer patients negatively, but our database does not contain such information. Adult data has shown no difference in mortality in patients transferred to a Level I trauma center from a non-designated center [28]. However, pediatric data shows that transfer delays can lead to increased mortality in NAT, which may be due to non-trauma centers inability to identify severely injured children or abused children when compared to pediatric trauma centers [29, 30]. Though not correlated with insurance coverage, our data do show association of transfer status with ethnicity, with transfer patients more likely to be Caucasian than other ethnicities. We attribute this finding to the socioeconomic makeup of the zip codes immediately surrounding our hospital, which contain more minority and uninsured patients [31]. It thus appears that the physical location of our institution in an area inhabited by underrepresented groups may improve these patients' access to our services.

Another interesting aspect of these data include the finding that 70.3% of our patient population were uninsured upon initial presentation, but the vast majority were able to obtain insurance shortly after presentation due to the social work infrastructure of our institution, with a final uninsured percentage of 5.6%. Between social work and case management strategies, this demonstrates the ability for acute care facilities to secure coverage in high-risk pediatric groups. A significant question that arises from these findings regards whether or not lack of insurance coverage and mortality are related due to survival bias; patients who suffer mortality may not live long enough to obtain coverage as compared to their surviving counterparts, which would artificially correlate insurance status and mortality. However, LOS was not significantly shorter where coverage was not obtained, lessening the possibility that early mortalities with lack of time to obtain coverage can explain this effect. Unfortunately, the same trends are not seen in adult trauma patients, who frequently lose insurance coverage with multiple trauma admissions [12]. Overall, there is some degree of instability in pediatric coverage, especially those with Medicaid [14], and gaps in coverage are associated with delayed presentation for care [32]. Presently, little data are available in the pediatric population to determine how trauma or other surgical admissions may impact obtainment or loss of insurance coverage in this group.

Our study also examines relationships between socioeconomic factors and discharge outcomes including level of disability and disposition. Previous studies in adults and children have demonstrated associations between insurance status, race, and level of function after traumatic brain injury [33–35]. However, our data did not show any correlations between socioeconomic determinants and disability level at discharge from hospital. Instead, we show correlations between disease severity and disability, with a high odds ratio of 26 for ICU stay and presence of severe disability at discharge. Current research confirms high levels of persistent disability in abused children treated in the intensive care unit [36, 37].

The limitations of our study include the use of retrospective data and inclusion of patients from a single center. Patients seen in the emergency department and discharged home are not included in the trauma registry, so it remains unknown if socioeconomic factors correlate with post-trauma outcomes in these children. We also lacked meaningful follow-up with our cohort, which decreases the impact of our findings for long-term outcomes such as the level of disability and final disposition location. Additionally, the disposition of some patients included transfer to skilled nursing or rehabilitation facilities. These patients were excluded from specific analyses of final disposition, since their final statuses were unknown, which may introduce bias. Our models could not explain the variance in discharge disposition, suggesting that factors other than those presented in this study are the determinants of this outcome, and further studies are needed to establish these. Finally, we did not evaluate specific injury patterns or management approaches, which detracts contextual information from this evaluation of NAT outcomes. While limited in its scope, this study provides a key framework to better understand data obtained from national databases regarding the association between mortality and socioeconomic factors in NAT.

Conclusions

This single center study demonstrates that insurance status associates with outcomes in pediatric NAT, revealing that uninsured patients suffer from eight times the risk of mortality when compared to patients with commercial or public coverage. This risk is pervasive, persisting after successfully achieving coverage for greater than 90% of uninsured patients in this cohort. This study therefore reveals that patients who fail to receive coverage with some type of insurance are at high risk for mortality after NAT. The means and mechanisms to provide coverage to uninsured children should therefore be studied, with the goal of improving coverage to potentially decrease excess mortality in victims of NAT. Overall, identification of high-risk groups may pave the way for implementation of strategies and interventions to improve the lives of children who are victims of NAT.

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Compliance with ethical standards

Conflicts of interest The authors declare no conflicts of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the Children's Health institutional research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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