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Uncovering a missing demographic in trauma registries: epidemiology of trauma among American Indians and Alaska Natives in Washington State

Megan J Hoopes[1], **Jenine Dankovchik**[1], **Thomas Weiser**[2], **Tabitha Cheng**[3], **Kristyn Bigback**[1], **Elizabeth S Knaster**[4], and **David E Sugerman**[5]

[1]Northwest Tribal Epidemiology Center, Northwest Portland Area Indian Health Board, Portland, Oregon, USA

[2]Portland Area Indian Health Service and Northwest Tribal Epidemiology Center, Northwest Portland Area Indian Health Board, Portland, Oregon, USA

[3]Division of Scientific Education and Professional Development, National Center of Injury Prevention and Control, Centers for Disease Control and Prevention, Atlanta, Georgia, USA

[4]Urban Indian Health Institute, Seattle Indian Health Board, Seattle, Washington, USA

[5]National Center of Injury Prevention and Control, Centers for Disease Control and Prevention, Atlanta, Georgia, USA

Abstract

Background—The objectives of this study were to evaluate racial misclassification in a statewide trauma registry and to describe the epidemiology of trauma among the Washington American Indian and Alaska Native (AI/AN) population.

Correspondence to: Jenine Dankovchik, Northwest Tribal Epidemiology Center, Northwest Portland Area, Indian Health Board, 2121 SW, Broadway, Suite 300, Portland, OR 97201, USA; jdankovchik@npaihb.org.

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Disclaimer: The findings and conclusions in this report are those of the authors and do not represent the official views of the US Department of Health and Human Services (DHHS), the Centers for Disease Control and Prevention (CDC) or the Indian Health Service (IHS). The inclusion of individuals, programmes or organisations in this article does not constitute endorsement by the US federal government, DHHS, CDC or IHS. The results of this study were presented at the 2013 Conference of the Council of State and Territorial Epidemiologists.

Competing interests: None declared.

Patient consent: A waiver of signed consent was granted for this study.

Ethics approval: The study protocol was approved by the Institutional Review Boards of the Portland Area Indian Health Service and Washington State Department of Health. The manuscript was also approved by the Portland Area Indian Health Service Institutional Review Board.

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Methods—We performed probabilistic record linkage between the Washington Trauma Registry (2005–2009) and Northwest Tribal Registry, a dataset of known AI/AN. AI/AN patients were compared with caucasians on demographic, injury and clinical outcome factors. A multivariable model estimated odds of mortality.

Results—Record linkage increased ascertainment of AI/AN cases in the trauma registry 71%, from 1777 to 3039 cases. Compared with caucasians, AI/AN trauma patients were younger (mean age=36 vs 47 years, p<0.001) and more commonly male (66.5% vs 61.2%, p<0.001). AI/AN experienced more intentional injuries (suicide or homicide: 20.1% vs 6.7%, p<0.001), a higher proportion of severe traumatic brain injury (20.7% vs 16.8%, p=0.004) and were less likely than caucasians to use safety equipment such as seat belts/airbags (53.9% vs 76.7%, p<0.001). ISSs were similar (ISS >15: 21.4% vs 20.5%, p=0.63), and no difference was observed in mortality after adjustment for covariates (p=0.58).

Conclusions—Linkage to a state trauma registry improved data quality by correcting racial misclassification, allowing for a comprehensive description of injury patterns for the AI/AN population. AI/AN sustained more severe injuries with similar postinjury outcomes to caucasians. Future efforts should focus on primary prevention for this population, including increased use of seat belts and child safety seats and reduction of interpersonal violence and suicide.

BACKGROUND

Unintentional injuries are the third leading cause of death among American Indians and Alaska Natives (AI/AN) in the USA, and the leading cause among those ages 1–44.[1] Mortality rates from unintentional injuries are approximately 2–3 times higher in this population compared with the general US population.[2] 3 Statistics from Washington State largely mirror national data, with unintentional injuries leading all causes of AI/AN deaths among ages 1–54.[4] Suicide rates are 1.7 times higher than the general population, and homicide rates are 3.7 times higher.[5] To date, most AI/AN injury data have come from death records,[12] and reports are frequently available only at national or regional levels.[2367] The relatively small size of the AI/AN population and inaccurate race coding in public health data systems contribute to widespread unavailability of reliable state-level or local-level data.[89] Thus, little is known about injury risks, causes, mechanisms and non-fatal outcomes for this high-risk population. Complete and accurate data are important in the design and evaluation of injury prevention strategies in Indian Country. Statewide trauma registries present a promising source of data to complete such an assessment if the reliability of race information for AI/AN can be assured.

Racial misclassification of AI/AN has been well documented in cancer registries[1011] and death certificates.[1213] Within these registries, misclassification of AI/AN as another race is significantly more frequent than misclassification of other races as AI/AN, leading to systematic underestimation of AI/AN morbidity and mortality.[14] Trauma registries have been established to collect standardised data on all trauma events in a given region, and generally determine race based on information in the medical record. Thus, these systems are likely subject to similar racial misclassification. A study in Oregon found that 65% of known AI/AN patients were classified as non-AI/AN in a state injury registry, leading to substantially underestimated injury rates.[15]

Administrative records from the Indian health system provide a mechanism to validate AI/AN race in external data sources such as trauma registries since enrolment in a federally recognised tribe or proof of descent from an enrolled member is required for Indian Health Service (IHS) eligibility. Linkages between such AI/AN patient records and surveillance systems have successfully improved AI/AN representation in other settings.[1116–19]

The objectives of this study were to (1) link the Washington Trauma Registry (WTR) to a large dataset of AI/AN patients in the northwest to improve race information, and (2) use the corrected data to provide a more accurate description of injury patterns, risk factors and outcomes (length of hospital stay, intensive care unit (ICU) admission, discharge disposition and death) among Washington AI/AN, comparing the AI/AN population's trauma experience to that of the majority caucasian population.

METHODS

We completed a retrospective cross-sectional analysis of trauma cases from the WTR, 2005–2009, linked to the Northwest Tribal Registry (NTR).

Data sources

The WTR is a mature statewide trauma registry that collects data from 80 trauma-designated hospitals in Washington State. Data are reported for all patients who are discharged with an International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) diagnosis of 800–904, 910–959, 994.1, 994.7 or 994.8 and meet one or more of the following criteria: activated the Trauma Resuscitation Team, dead on arrival (DOA) or died in facility, transferred into or out of the facility by emergency medical services (EMS), transported by air from the scene, paediatric trauma patients (ages 0–14) or adults with length of stay in the reporting facility >48 h.[20] Among the hospitals reporting to the WTR, four provide paediatric and rehabilitation care, and one is a level I trauma centre. The WTR does not represent the entire population of trauma cases in the state as the registry excludes injured patients who do not meet eligibility criteria or who present to a hospital that does not report to the WTR. For the present study, we obtained all WTR trauma cases from 2005 and 2009, the most current 5-year data period available at the time of the linkage (N=111 701 records).

The NTR is an enumeration of the AI/AN population in Idaho, Oregon and Washington who have accessed services from federally operated, tribal or urban Indian healthcare facilities in this three-state area. Source data for the NTR were compiled from two patient registration files: the Portland Area IHS and the Seattle Indian Health Board (SIHB). The Portland Area IHS is the federal health service administrative office for all federally recognised tribes in Idaho, Oregon and Washington; the SIHB is a non-profit, multiservice community health centre serving urban AI/AN in the Puget Sound region of Washington. The patient registry used for this study included all patients who accessed care through the IHS (including tribally run clinics) from 1986 to 2012 or the SIHB from 2007 to 2010, the most recent data years available at the time of the study. Race information for IHS patients was administratively collected (eg, proof of tribal enrolment or descent presented at registration); SIHB collects self-identified race for all patients at visits. Patient records from the two

sources were combined and probabilistically de-duplicated, then restricted to those of AI/AN race. The final linkage file contained 208 134 unique AI/AN records.

Linkage

We used the probabilistic linkage software Link Plus (V.2.0; Atlanta, Georgia, USA) to compare the NTR with the WTR using a combination of personal identifiers contained in both datasets: date of birth, last four digits of social security number, last name, first name, middle initial and gender. Probabilistic methods allow the identification of individuals with high sensitivity across different datasets by comparing agreement and disagreement across multiple variables, even when those variables differ slightly or contain missing information.[21] Clerical review was conducted by four individuals on the study team, including representatives from the SIHB and the WTR; uncertain pairs were assigned match status by consensus. Linkage methods have been described in more detail elsewhere.[16]

Data coding and analysis

Cases were selected for analysis following a national standard: principal ICD-9-CM codes 800.0–959.9, excluding 905–909.9, 910–924.9 and 930–939.9.[22] Mechanism and intent of injury were coded according to the ICD-9-CM external cause-of-injury matrix.[23] Body region and nature of injury were coded using the Barrell Injury Diagnosis Matrix.[23] ISS was calculated in the Collector Database (Dicorp, Forest Hill, Maryland, USA), and ranged from 1 to 75, representing minor injury to death. The Glasgow Coma Score (GCS) was calculated for patients with a diagnosed traumatic brain injury (TBI) as the sum of three sub-score elements (eye, verbal and motor response). GCS scores were obtained in the emergency department (ED) and ranged from 3 (severe) to 15 (mild). All matched cases, as well as all non-matched records coded as AI/AN in the WTR, were considered AI/AN for analyses. We used race information from the WTR to identify the comparison population.

We calculated descriptive and comparative statistics, comparing AI/AN patients with caucasians (regardless of ethnicity); p values are from χ^2 tests for categorical variables and t tests for continuous variables. Because the WTR includes two records for patients who were transferred, analyses were restricted to pre-transfer records for prehospital and ED variables and post-transfer records for outcome variables. Patients who were never transferred were included in all analyses. Logistic regression was used to examine the outcome of death by race, controlling demographic, injury, prehospital and hospital factors. The logistic regression model was restricted to cases never transferred (N=42 549). Death was defined as DOA, death in ED or death in hospital. No significant interaction terms or evidence of multicollinearity were found in the logistic regression models. Data management and statistical analyses were conducted using SAS software (V.9.2; SAS Institute, Cary, North Carolina, USA).

RESULTS

Linkage results

The WTR contained 111 701 cases, representing all eligible ED, hospitalisation and DOA records from 2005 to 2009 (figure 1). Linkage with the NTR identified 2251 matched

records, of which 1262 (56.1%) were misclassified in the WTR (figure 1). These misclassified cases were most commonly coded as caucasian (64.7%) or unknown race (29.2%). Adding misclassified cases to WTR-coded AI/AN, we identified a total of 3039 AI/AN trauma cases. The result was a misclassification prevalence of 41.5% (1262 of 3039 records), and 71.0% increased ascertainment of known AI/AN cases (from 1777 to 3039 records).

Restricting cases to the ICD-9 code range for analysis left 2707 AI/AN (89.1% of total AI/AN records) and 69 440 caucasian cases (88.9% of total caucasian records). Within this dataset AI/AN accounted for 2.8% of the traumatic injuries collected by WTR, while caucasians accounted for 70.6%. For comparison, AI/AN comprise 2.9% of the Washington population, while caucasians account for 79%.[24]

Demographic characteristics

AI/AN trauma patients were younger than caucasians, averaging 36 years vs 47 (table 1). The sex distribution was similar between the two groups with more traumatic injuries occurring among male than female; the gender gap was slightly larger for AI/AN than caucasians. Compared to caucasians, AI/ANs were more likely to be injured in rural counties and to be treated at hospitals in the North Central, South Central and East regions of the state, corresponding to the locations of the two largest Washington tribes (figure 2). All demographic differences between the two groups were statistically significant (table 1).

Injury characteristics

AI/AN trauma patients had significantly higher percentages of penetrating injuries than caucasians (13.5% vs 6.4%), and their injuries were more commonly caused by firearms, motor vehicle crashes (MVCs) and injuries resulting from being struck by a human or non-machine object (table 1). As a proportion of total injuries, falls were less common among AI/AN (27.7% vs 45.4%). AI/AN trauma patients were more likely than caucasians to sustain injuries to the head and neck (42.1% vs 37.0%). Intentional injuries—homicide/assault and suicide/self-harm—were more common (20.1% vs 6.7%, table 1).

Pre-hospital and clinical characteristics

Table 2 presents prehospital and clinical characteristics for both race groups. There was no difference observed between AI/AN and caucasians treated at level I or II trauma centres, though significantly more AI/AN patients were seen at level IV hospitals and hospitals without a trauma-level designation. AI/AN patients were slightly more likely to have arrived at the hospital via helicopter (6.1% vs 4.8%). Although ISSs were similar between the groups, AI/AN patients who had suffered a TBI were significantly more likely to have a severe TBI (GCS ≤8: 20.7% vs 16.8%). There was no difference in the proportion deceased upon arrival at the trauma facility. AI/AN use of seat belts and airbags was significantly lower than caucasians (53.9% vs 76.7%), as was appropriate child safety seat use (37.0% vs 54.6%) and helmet use among motorcycle riders and children under 16 injured while riding bicycles (59.6% vs 83.3%).

Injury outcomes

Median length of hospital stay was identical between the two groups (3 days; table 3). ICU admission was significantly more common for AI/AN than caucasian patients (29.9% vs 25.6%). AI/AN patients were more frequently discharged to home (58.6% vs 52.0%) and fewer were discharged to a rehabilitation or care facility (7.6% vs 8.2%). Combined mortality was slightly lower for AI/AN than caucasians (2.8% vs 3.6%); however, the odds of death did not differ between AI/AN and caucasians in an unadjusted model nor after adjusting for demographic, severity, preclinical and clinical characteristics (adjusted OR=1.11, 95% CI 0.77 to 1.61; table 4).

DISCUSSION

Disparities in injury incidence and mortality are well recognised in Indian Country, leading to expanded injury prevention efforts in recent years.[25] This study presents the most comprehensive injury data for the Washington AI/AN population available to date, confirming many of the disparities seen in mortality data, and adding the context of prehospital, hospital and risk characteristics. Our linkage with a large tribal registry greatly improved the representation of AI/AN cases in the WTR. Without correction for race misclassification, data from the WTR alone would have underestimated qualifying injuries in this population by over 70%. Inaccurate race data may result in inappropriate decisions regarding the allocation of resources or the monitoring of intervention programmes.[26]

The rate of misclassification in this statewide trauma registry is similar to that from a neighbouring state reported over 20 years ago[15] and on par with hospital discharge systems (authors' unpublished data). Although recent decades have seen significant declines in overall mortality[327] and unintentional injury death rates,[28] substantial disparities persist between AI/AN and caucasian populations. Current findings suggest that there has been little progress in improving either misclassification of race in trauma registries or disparities in injury for this underserved population. Recent efforts to improve the quality of race/ethnicity data in hospital data have resulted in a number of recommendations that may be extended to trauma registries.[29]

Mirroring statewide census data,[24] AI/AN trauma patients were younger than caucasians. Falls were less common among AI/AN in the trauma registry; as falls are strongly associated with advanced age, this finding correlates with lower AI/AN life expectancies. This is consistent with northwest mortality statistics: falls account for 28% of unintentional injury deaths among caucasians, but only 8% among AI/AN.[5] Although the proportion of injuries from falls is small, they still present a significant public health burden, particularly for older AI/AN who experience excess comorbidities [30] and increased risk of TBI [3132] compared with the general population.

AI/AN were less likely to have used seat belts, child safety seats, helmets and vehicle airbags where appropriate. Lack of seat belt and child safety seat use in this population has been reported previously. A 2009 study among northwest tribal communities found that, while proper restraint of children in motor vehicles had improved in recent years, 51% of children in surveyed vehicles were still improperly restrained.[33] These findings are also

consistent with death certificate data that demonstrate a threefold higher disparity in MVC mortality among AI/AN compared with caucasians.[5] Policy and programme implementation on tribal lands such as restraint use laws, enhanced enforcement strategies, media and targeted education campaigns have the potential to significantly reduce MVC morbidity and mortality in tribal communities.[33–35]

Another concerning finding is the high proportion of intentional injuries, including homicide/assault and suicide/self-harm among AI/AN relative to caucasians. Although we report a lower disparity than earlier reports,[36] this difference is substantial and underscores the need for effective interpersonal violence and suicide prevention strategies. Additional research is needed to determine the extent to which existing evidence-based violence and suicide prevention strategies meet the specific needs of the AI/AN population in Washington and elsewhere. Such programmes are likely to have the greatest impact when they are designed, developed and tested in meaningful collaboration with the AI/AN communities they target.[3337]

Overall mortality (DOA, death in ED or death in hospital) was uncommon for both race groups, and our results did not reveal an increased risk of death for AI/AN after adjusting for patient and injury characteristics. By contrast, a prior analysis of race-corrected death certificate data showed Washington AI/AN mortality rates due to injury were significantly higher than those of caucasians in the state.[5] This discrepancy suggests that AI/AN experience similar in-hospital mortality as caucasians after adjustment for injury severity, but are at greater risk for more lethal injuries, which may not meet criteria for inclusion in the WTR (eg, deaths occurring at the scene of the injury). For those patients included in the WTR, the similar rates of treatment at level I/II trauma centres, interfacility transfer and care by Advanced or Intermediate Life Support crews suggest equal access to quality trauma care. Further studies combining trauma registry data with an analysis of death records should be undertaken to explore this finding.

LIMITATIONS

We estimate that the AI/AN registry used for linkage represents 81% of the Washington AI/AN census population;[38] therefore, some racial misclassification may remain unidentified and our results may underestimate the true burden of traumatic injuries. The NTR does not include AI/AN people who have never received care at an IHS, tribal or urban clinic; many of these individuals may self-identify as AI/AN but may not be members of a federally recognised tribe. Additionally, AI/AN living in urban areas are more likely to be misclassified than those living in rural areas.[131439] It is not possible to determine from our data whether the source of inconsistent coding is related to differential racial self-identification by persons across healthcare settings or at different points in time, or due to discrepancies between patient self-identification and racial designation by observers in the healthcare system. Conversely, we are unable to validate the racial coding of unmatched AI/AN patients in the WTR.

The WTR does not contain data on individuals declared dead at the scene or those who died without medical attention. In published reports, out-of-hospital deaths can account for up to

22% of trauma mortality,[40] a figure potentially higher among AI/AN who are more likely to be injured in rural counties where both prehospital and hospital trauma services are scarce. Because the WTR is not a population-based registry of all injuries in the state, conclusions regarding variation in mortality should be interpreted with caution. These results may be better interpreted in conjunction with linked data from population-based hospital discharge and death registries.[5] Additionally, data on EMS transportation time from the scene were missing for 69% of AI/AN patients and 73% of caucasian patients, which excluded this important measure from our analyses. A slightly higher proportion of AI/AN cases were transferred out to another facility (20.6% vs 18.9% for caucasians), thus more severe AI/AN injuries were disproportionately excluded from the logistic regression model and results may underestimate injury severity. Efforts to improve the completeness of data collection by the WTR should be focused on key missing variables such as geographic location of injury occurrence, transport time and transport type.

CONCLUSION

We present one of the first reports based on linked data between a state trauma registry and an AI/AN registry, and demonstrate how data linkage can increase the quality of injury data for the AI/AN population. We identified some notable differences in trauma patterns between AI/AN and caucasians, highlighting opportunities for further analysis to better understand injury risk factors and ultimately improve outcomes for AI/AN trauma patients.

Efforts to improve race classification and reporting of injury morbidity and mortality in AI/AN populations should continue. The described linkage methods could improve data quality in trauma registries in other regions and nationwide. Our findings support the need for improved primary injury prevention among AI/AN to reduce these disparities, including campaigns to improve the use of seat belts, helmets, and child safety seats and programmes to reduce interpersonal violence and suicide.

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What is already known on the subject

- American Indian/Alaska Native (AI/AN) populations experience excess mortality from both unintentional and intentional (suicide/homicide) injuries.
- Racial misclassification in health surveillance systems hinders the ability to completely and accurately describe patterns of injury for AI/AN.

What this study adds

- Using linkage to correct for inaccurate and missing race data in a state trauma registry, we provide one of the most comprehensive epidemiological descriptions of injury causes, mechanisms, contributing factors and outcomes for a statewide AI/AN population available to date.
- Compared with caucasians, AI/AN experienced more severe injuries and were less likely to have used safety equipment; postinjury outcomes were similar between race groups.
- Linkage-corrected injury data are needed for AI/AN communities to more effectively plan, implement and evaluate injury prevention programmes.

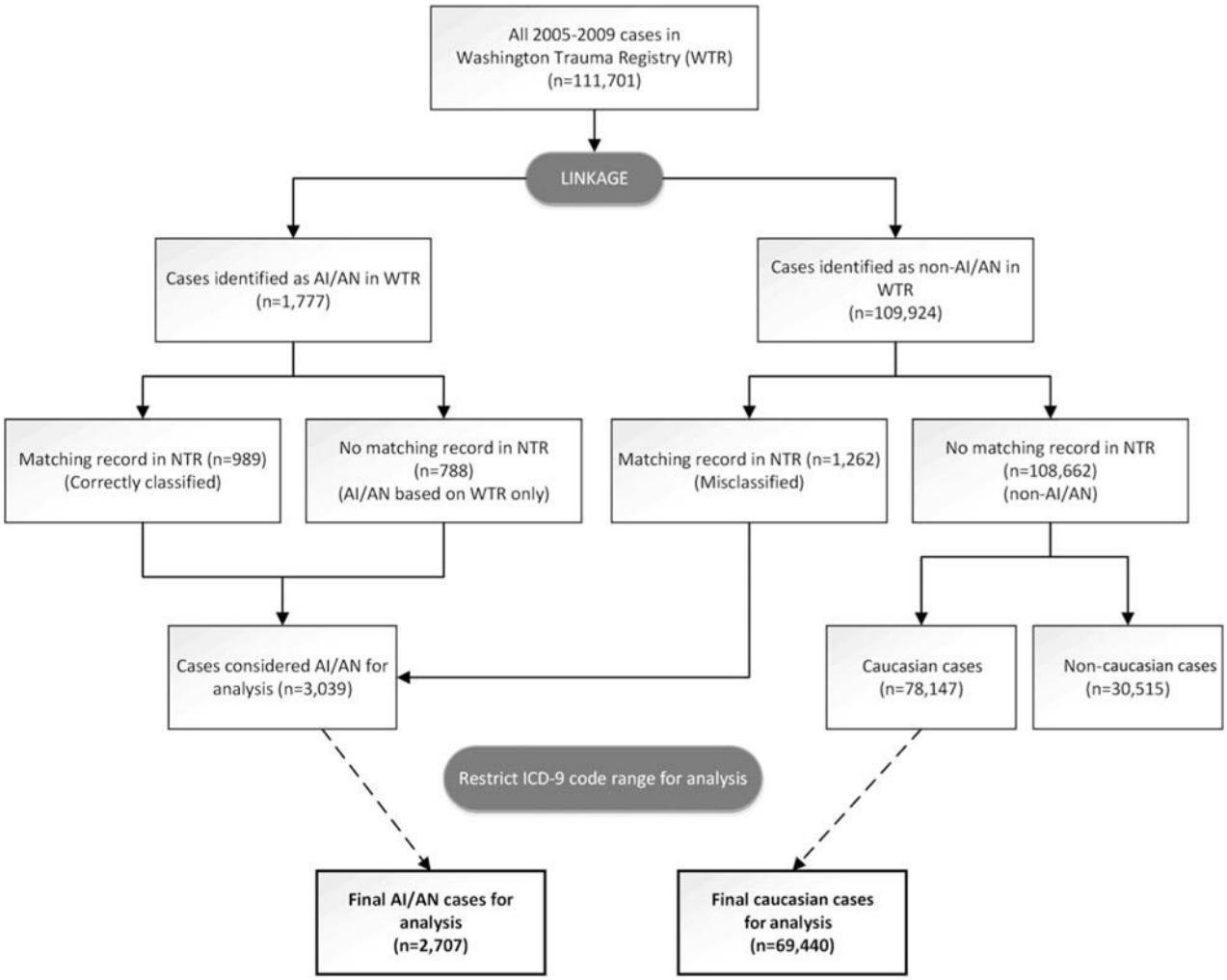

Figure 1.

Data linkage and derivation of American Indian/Alaska Native trauma cases. AI/AN, American Indian/Alaska Native; ICD-9, International Classification of Diseases, 9th Revision; NTR, Northwest Tribal Registry.

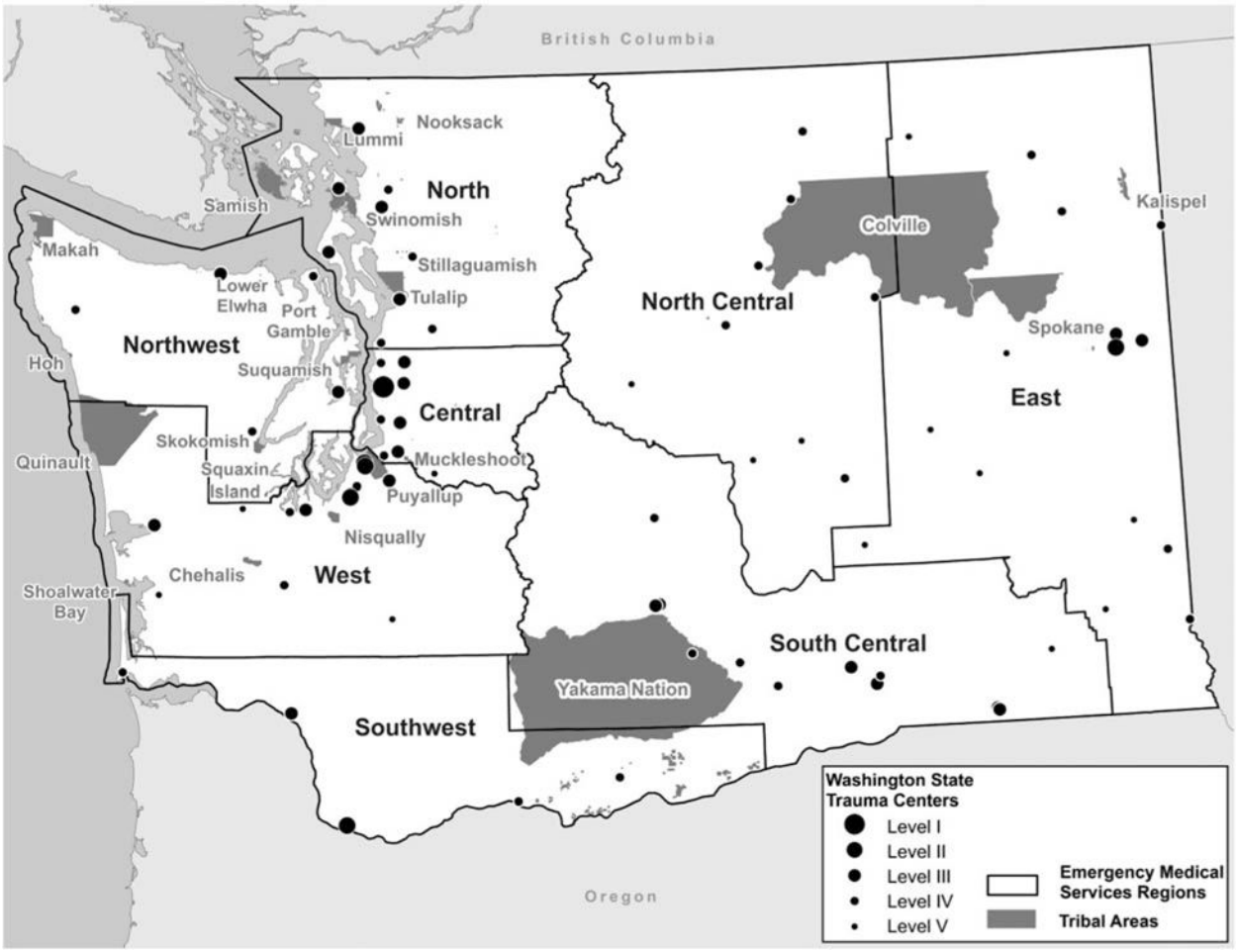

Figure 2.
Tribal lands and trauma centres in Washington State as of 2012.

Table 1

Demographic and injury characteristics of Washington trauma patients, 2005–2009

	AI/AN n (%)	Caucasian n (%)	p Value
Mean age, years (SE) *	35.9 (0.43)	46.9 (0.11)	<0.0001
Age group *			<0.0001
0–18	422 (19.6)	9278 (16.5)	
19–39	848 (39.5)	14 048 (24.9)	
40–59	611 (28.4)	14 330 (25.4)	
≥60	268 (12.8)	18 685 (33.2)	
Missing data	0 (0.0)	5 (0.0)	
Sex *			<0.0001
Female	720 (33.5)	21 860 (38.8)	
Male	1429 (66.5)	34 486 (61.2)	
County type of injury *			<0.0001
Metropolitan	1484 (69.1)	42 747 (75.9)	
Non-metropolitan	440 (20.5)	8565 (15.2)	
Missing data	225 (10.5)	5034 (8.9)	
Hospital region *†			<0.0001
North	211 (5.1)	5485 (9.7)	
Northwest	81 (3.8)	2617 (4.6)	
Central	750 (34.9)	22 155 (39.3)	
West	307 (14.3)	8273 (14.7)	
Southwest	52 (2.4)	3980 (7.1)	
North Central	110 (5.1)	2168 (3.9)	
South Central	263 (12.2)	3164 (5.6)	
East	375 (17.5)	8504 (15.1)	
Injury type *			<0.0001
Blunt	1769 (82.3)	50 357 (89.4)	
Penetrating	289 (13.5)	3626 (6.4)	
Other/unspecified	91 (4.2)	2363 (4.2)	
Mechanism of injury *			<0.0001
Falls	595 (27.7)	25 606 (45.4)	
Firearms	72 (3.4)	1025 (1.8)	
Motor vehicles	711 (33.1)	14 085 (25.0)	
Struck by/against	215 (10.0)	3288 (5.8)	
Other/unspecified	556 (25.9)	12 342 (21.9)	
Site of injury *			<0.0001
Head and neck	905 (42.1)	25 715 (37.0)	
Spine and back	190 (8.8)	7092 (10.2)	
Torso	320 (14.9)	10 650 (15.3)	

	AI/AN n (%)	Caucasian n (%)	p Value
Extremities	651 (30.3)	22 846 (32.9)	
Unclassifiable/unspecified	83 (3.9)	3137 (4.5)	
Missing data	0 (0.0)	11 (0.0)	
Intent of injury *			<0.0001
Unintentional	1696 (78.9)	52 124 (92.5)	
Suicide/self-harm	50 (2.3)	960 (1.7)	
Homicide/assault	383 (17.8)	2838 (5.0)	
Other/unspecified	20 (0.9)	424 (0.8)	

* Excludes those who were transferred in from another facility. N=2149 for AI/AN, N=56 346 for caucasian.

† See figure 2.

AI/AN, American Indian and Alaska Native.

Table 2

Prehospital and clinical characteristics of Washington trauma patients, 2005–2009

	AI/AN (N=2707) n (%)	Caucasian (N=69 440) n (%)	p Value
Transportation mode *			0.0117
Ground ambulance	1428 (68.3)	36 700 (68.4)	
Helicopter	127 (6.1)	2574 (4.8)	
Private vehicle	510 (24.4)	13 708 (25.6)	
Other/unknown	27 (1.3)	660 (1.2)	
EMS crew member level *†			<0.0001
Advanced life support	1103 (70.9)	27 113 (69.0)	
Intermediate life support	27 (1.7)	257 (0.7)	
Basic life support	333 (21.4)	9702 (24.7)	
Missing data	92 (5.9)	2202 (5.6)	
Adult—seat belt/airbag use *‡			<0.0001
Yes	224 (53.9)	5932 (76.7)	
No	192 (46.2)	1804 (23.3)	
Child safety seat use *§			0.0078
Appropriate safety seat used	10 (37.0)	83 (54.6)	
Some safety equipment used, but not appropriate for child	4 (14.8)	37 (24.3)	
No safety equipment used	11 (40.7)	24 (15.8)	
Missing data	2 (7.4)	8 (5.3)	
Helmet use *¶			<0.0001
Yes	28 (59.6)	2268 (83.3)	
No	14 (29.8)	313 (23.3)	
Missing data	5 (10.6)	142 (5.2)	
Trauma centre level **			0.0003
I	680 (31.6)	17 169 (30.5)	
II	317 (14.8)	8446 (15.0)	
III	771 (35.9)	23 535 (41.8)	
IV	179 (8.3)	3979 (7.1)	
V	7 (0.3)	308 (0.6)	
No designation	195 (9.1)	2909 (5.2)	
ISS *			0.6296
≤15	1637 (78.3)	42 480 (79.2)	
16–24	261 (12.5)	6497 (12.1)	
≥25	186 (8.9)	4528 (8.4)	
Missing data	8 (0.4)	137 (0.3)	
GCS in ED *,††			0.0044
Mild (13–15)	472 (67.2)	12 453 (74.1)	
Moderate (9–12)	38 (5.4)	804 (4.8)	

	AI/AN (N=2707) n (%)	Caucasian (N=69 440) n (%)	p Value
Severe (3–8)	145 (20.7)	2813 (16.8)	
Missing data	47 (6.7)	727 (4.3)	
Dead on arrival[‡‡]			0.5440
Yes	1 (0.04)	47 (0.07)	
No	2685 (99.2)	68 977 (99.3)	
Missing data	21 (0.78)	416 (0.6)	

[*] Excludes those who were transferred to another facility. N=2092 for AI/AN, N=53 642 for caucasian.

[†] Among those transferred by emergency medical technicians. N=1555 for AI/AN, N=39 274 for caucasian.

[‡] Among patients over age 8 years who were injured while occupant of a motor vehicle. N=416 for AI/AN, N=7736 for caucasian.

[§] Among children who were injured while occupant of a motor vehicle. Ages included are under 6 years (prior to July 2007) or under 8 years (July 2007 and later), reflecting a change in Washington state law. N=27 for AI/AN, N=152 for caucasian.

[¶] Among drivers or passengers on motorcycles, or children under 16 on pedal bicycle. N=47 for AI/AN, N=2723 for caucasian.

[**] Excludes those who were transferred in from another facility. N=2149 for AI/AN, N=56 346 for caucasian.

[††] Among patients with traumatic brain injuries. N=702 for AI/AN, N=16 797 for caucasian.

[‡‡] Among all patients. N=2707 for AI/AN, N=69 440 for caucasian.

AI/AN, American Indian/Alaska Native; ED, emergency department; EMS, emergency medical services; GCS, Glasgow Coma Score.

Table 3

Outcomes of Washington trauma patients, 2005–2009

	AI/AN (N=2149) n (%)	Caucasian (N=56 346) n (%)	p Value
Mean hospital stay, days (SE)	5.9 (0.19)	5.2 (0.03)	<0.0001
Median hospital stay, days	3.0	3.0	
ICU admission			<0.0001
Yes	642 (29.9)	14 441 (25.6)	
No	1258 (58.5)	35 261 (62.6)	
Missing data	249 (11.6)	6644 (11.8)	
Hospital discharge disposition			<0.0001
Home	1587 (58.6)	36 083 (52.0)	
Rehab facility or home with rehab/outside care	206 (7.6)	5712 (8.2)	
Skilled nursing facility	211 (7.8)	10 496 (15.1)	
Died	77 (2.8)	2507 (3.6)	
Other*	68 (2.5)	1540 (2.2)	
Missing data	0 (0.0)	8 (0.0)	
Death†			0.0345
No	2630 (97.2)	66 933 (96.4)	
Yes	77 (2.8)	2507 (3.6)	

*Includes psychiatric care, jail/police custody, other and unspecified.

†Includes dead on arrival, death in emergency department and death in hospital.

AI/AN, American Indian/Alaska Native; ICU, intensive care unit.

Table 4

Crude and adjusted odds of death among Washington trauma patients, 2005–2009

	Crude OR (95% CI)	p Value	Adjusted OR (95% CI)	p Value
Race *		0.0558		0.5831
Caucasian	1.0 (reference)		1.0 (reference)	
AI/AN	0.80 (0.63 to 1.01)		1.11 (0.77 to 1.61)	
Age, years (continuous) *	1.02 (1.02 to 1.03)	<0.0001	1.05 (1.05 to 1.06)	<0.0001
Sex *		<0.0001		<0.0001
Female	1.0 (reference)		1.0 (reference)	
Male	1.29 (1.18 to 1.40)		1.43 (1.24 to 1.64)	
$ISSlog_{10}$ (continuous) †‡	5.72 (5.34 to 6.13)	<0.0001	2.95 (2.73 to 3.17)	<0.0001
Days in hospital (continuous)	1.01 (1.00 to 1.02)	0.0098	0.90 (0.89 to 0.91)	<0.0001
GCS in ED †§		<0.0001		<0.0001
Mild	1.0 (reference)		1.0 (reference)	
Moderate	5.20 (3.85 to 7.01)		5.39 (3.79 to 7.67)	
Severe	27.86 (23.62 to 32.88)		32.09 (25.54 to 40.32)	
Mechanism of injury *		<0.0001		<0.0001
Struck by/against	1.0 (reference)		1.0 (reference)	
Motor vehicle	3.25 (2.45 to 4.32)		3.25 (1.98 to 5.35)	
Falls	3.27 (2.47 to 4.32)		3.31 (2.03 to 5.40)	
Firearms	20.93 (15.40 to 28.45)		8.13 (4.15 to 15.95)	
Other	1.77 (1.32 to 2.38)		2.20 (1.30 to 3.70)	
Type of injury *		<0.0001		0.0019
Blunt	1.0 (reference)		1.0 (reference)	
Penetrating	1.13 (0.93 to 1.38)		1.79 (1.09 to 2.96)	
Other	2.17 (1.93 to 2.45)		3.69 (1.58 to 8.60)	
Site of injury *		<0.0001		0.0004
Extremities	1.0 (reference)		1.0 (reference)	
Head and neck	4.71 (4.18 to 5.30)		1.12 (0.86 to 1.46)	
Spine and back	1.41 (1.15 to 1.72)		0.75 (0.57 to 0.99)	
Torso	2.58 (2.22 to 2.99)		1.32 (1.09 to 1.60)	
Intent of injury *				0.0024
Suicide/self-harm	1.0 (reference)		1.0 (reference)	
Homicide/assault	0.19 (0.15 to 0.23)		0.70 (0.46 to 1.06)	
Unintentional	0.17 (0.14 to 0.20)		0.46 (0.30 to 0.71)	
Transportation mode †		<0.0001		<0.0001
Helicopter ambulance	1.0 (reference)		1.0 (reference)	
Ground ambulance	0.46 (0.40 to 0.53)		1.33 (1.06 to 1.67)	
Private vehicle	0.05 (0.04 to 0.07)		0.49 (0.30 to 0.79)	
Other	0.35 (0.19 to 0.63)			

	Crude OR (95% CI)	p Value	Adjusted OR (95% CI)	p Value
Emergency life support levels †		<0.0001		0.0020
Basic life support	1.0 (reference)		1.0 (reference)	
Intermediate life support	2.66 (1.49 to 4.73)		1.96 (0.84 to 4.59)	
Advanced life support	3.25 (2.77 to 3.80)		1.43 (1.17 to 1.76)	
Work related †		<0.0001		
Yes	1.0 (reference)		Not significant	
No	1.82 (1.40 to 2.35)			
Safety equipment used †		<0.0001		0.0002
Yes	1.0 (reference)		1.0 (reference)	
No	1.52 (1.34 to 1.74)		1.56 (1.26 to 1.93)	
County type *		0.0145		
Metropolitan	1.0 (reference)		not Significant	
Non-metropolitan	1.14 (1.03 to 1.27)			
Region †¶		<0.0001		<0.0001
Does not include large tribe	1.0 (reference)		1.0 (reference)	
Includes large tribe (E, NC, SC)	1.37 (1.24 to 1.51)		2.51 (2.15 to 2.94)	
Trauma centre level *				0.0278
I	1.0 (reference)	<.0001	1.0 (reference)	
II	0.75 (0.67 to 0.85)		1.07 (0.84 to 1.36)	
III	0.61 (0.55 to 0.66)		1.15 (0.92 to 1.43)	
IV–V/no designation	0.64 (0.56 to 0.73)		1.42 (1.11 to 1.81)	
ICU admission		<0.0001		<0.0001
No	1.0 (reference)		1.0 (reference)	
Yes	8.41 (7.58 to 9.32)		4.29 (3.59 to 5.11)	

*Excluding those who were transferred to another facility (keep only last facility records).

†Excluding those who were transferred in from another facility (keep only first facility records).

‡A $\log_{10}$ transformation was made of ISS code to correct for skew, thus the reported OR is associated with a tenfold increase in ISS.

§Among patients with a traumatic brain injury.

¶See figure 2.

AI/AN, American Indian/Alaska Native; E, East; ED, emergency department; GCS, Glasgow Coma Score; ICU, intensive care unit; NC, North Central; SC, South Central.