

**Absence of Tribal Traffic Laws as a Risk Factor for Crash Injury Severity:
A Retrospective Study**

Jordan M. Vandjelovic, MPH

Division of Environmental Health and Engineering
Indian Health Service
2900 4th Ave. N, Suite 407
Billings, MT 59101

Abstract:

American Indian/Alaska Native's (AI/AN) have disproportionately high motor vehicle crash (MVC) rates compared to U.S. All Races. This study estimated the risk for crash-related injuries associated with the absence of 10 types of traffic safety laws on AI/AN Tribal reservations in the Indian Health Service Billings Area of Montana. Crash type categories included: no-injury, injury and fatality for years 2016 through 2018. Age-adjusted rates were calculated. Multinomial logistic regression was used to estimate risk ratios (RR) by crash type. For each traffic law, rates for All Crashes, No-Injury, Injury, and Fatality were 705.8, 411.1, 256.9 and 37.7 respectively. The risk for MVC fatal injury was associated with the absence of each of eight laws. The risk for MVC non-fatal injury was associated with the absence of each of six laws. The traffic laws that produced the largest risk estimates were roadblock/check point, insurance, and under the influence of alcohol laws. When absent, these laws produced more than a three-fold increased risk for fatal crash (RR = 4.48, 4.41, 3.33 respectively), and an elevated risk for non-fatal injury (1.71, 1.74, 1.18). These results suggest that Tribal enactment of traffic safety laws might help prevent MVC injuries and fatalities and promote health equity for the AI/AN population.

Introduction:

Unintentional injuries have been one of the leading causes of death in the United States (US) according to the Centers for Disease Control and Prevention (CDC).¹ In the American Indian and Alaska Native (AI/AN) communities, unintentional injuries are the leading cause of death between the ages of 1 to 44 years, with rates disproportionately higher than the U.S. overall.² Motor vehicle crashes account for 43% of unintentional injury deaths in the AI/AN population, with the Indian Health Service (IHS) Billings Area having the highest age-adjusted motor vehicle crash death rates (65.8 per 100,000) compared to all twelve [12] IHS areas. The Billings Area rate is 5.7 times the 2009 U.S. All Races rate (11.6).²

The Billings Area includes ten [10] federally recognized Tribes, with more than 70,000 AI/AN people on eight [8] reservations in Montana and Wyoming (Appendix A), including: Assiniboine and Sioux, Blackfeet, Chippewa Cree, Crow, Gros Ventre, Little Shell Chippewa, Northern Cheyenne, and Salish and Kootenai, Eastern Shoshone and Northern Arapaho.³ These Tribes are sovereign nations managed by their own Tribal government, possessing the inherent rights to self-govern and act in accordance to their needs and priorities.^{3 4}

Some studies indicate that geography, low population density, per capita income, alcohol intake, and absence of traffic laws and enforcement are risk factors, which contribute to the high burden of motor vehicle crash fatality.^{5 6 7} Road characteristics, travel speed, seat belt use, type of vehicles, and availability of emergency care are also factors which influence crashes and the associated injury and fatality.⁷ Most Native American reservations, including those in the Billings Area, are located in rural areas with inadequate education and disproportionate poverty.^{6 8}

Traffic-related policies, including statutes, ordinances, and regulatory codes, have an impact on the outcome of crashes and crash-related injuries.^{6 9 10 11 12 13 14 15 16 17} Such laws include seatbelt, child restraint, safety seat distribution and child education program, roadblock or checkpoint, license, speeding, under the influence of alcohol, careless or reckless driving, insurance, and reporting crashes.^{6 9 10 11 12 13 14 15 16 17} Because of their sovereign nation status, Tribes and their associated reservations are not subject to

the traffic laws and other civil laws of the surrounding states.^{6,9} Each reservation in Montana and Wyoming has either adopted its state law or enacted its own traffic ordinances, codes and laws. This study estimated the risk for crash-related injuries associated with the absence of 10 types of traffic safety laws on AI/AN Tribal reservations in the Indian Health Service Billings Area of Montana.

Methods:

Crash Data

The study used data obtained from the Montana Department of Transportation (MTDOT). Wyoming Department of Transportation (WYDOT) were requested, but not included in this study due to the lack of a race variable. Both agencies have an open data policy and the data do not include personal information from individuals. The Salish Kootenai College Institutional Review Board provided a review waiver, indicating the research as exempt from review.

Tribes included in the study were required to have reservation land within the state of Montana. Tribal-specific motor vehicle crash data were obtained for years 2016 through 2018 inclusive. The data sets included police-reported traffic crashes by county, reservation, crash type, age, gender, race, injury status, and injury severity. Crashes were included in the study only if the crash occurred on the reservation property and within the county boundary (Appendix A). Crash data only included motor vehicle occupant crash data.

Two injury variables in the original DOT dataset were combined to derive the variable Crash Type with three categories: no injury, injury and fatality (Table 1).

Table 1. Criteria for Derived Variable: Crash Type.

Values for Derived Variable: <i>Crash Type</i>	Criteria for Inclusion of MTDOT variable: <i>Injury Status Type</i>
No-Injury	No injury
Injury	Possible injury; Non-incapacitating injury; Incapacitating injury
Fatal Injury	Fatal injury

Policy Data

Each reservation’s Tribal traffic laws were identified from IndianLaw.mt.gov and specific Tribal government websites (Appendix A). Dates for enactment or amendment of traffic policies ranged from 1996 through 2016; therefore, the most recent policies were used since they would have been enforced during the study timeframe of 2016 through 2018.

Ten types of traffic laws were included as binary variables to reflect the presence or absence of each law on each reservation (Table 2). Three law variables were derived for purposes of the study: Child Restraint System (from Seatbelt laws); Under the Influence of Alcohol; and Careless and Reckless Driving (combining the two separate laws).

Table 2. Traffic Law Description and Status by Reservation.

Traffic Law Type	Description of Legal Code	Status of Traffic Law: Salish and Kootenai	Status of Traffic Law: Blackfeet	Status of Traffic Law: Fort Peck	Status of Traffic Law: Fort Belknap	Status of Traffic Law: Crow	Status of Traffic Law: Northern Cheyenne	Status of Traffic Law: Rocky Boy	% Absent
Careless/ Reckless Driving	A person operating or driving a vehicle of any manner on a road shall drive it in a careful and prudent manner, so as to avoid unduly or unreasonably endangering the life, limb, property or other rights of other persons.	Enacted	Enacted	Absent	Enacted	Absent	Enacted	Absent	43.0%
Child Education Program	Distribution and Education Programs that provide approved child safety seats to parents and caregivers combined with an educational component.	Enacted	Absent	Absent	Absent	Absent	Enacted	Absent	71.4%
Child Restraint System	Laws that require children riding in motor vehicles to be restrained in approved child restraints (for example, car seats and booster seats).	Enacted	Absent	Enacted	Enacted	Absent	Enacted	Absent	43.0%

Traffic Law Type	Description of Legal Code	Status of Traffic Law: Salish and Kootenai	Status of Traffic Law: Blackfeet	Status of Traffic Law: Fort Peck	Status of Traffic Law: Fort Belknap	Status of Traffic Law: Crow	Status of Traffic Law: Northern Cheyenne	Status of Traffic Law: Rocky Boy	% Absent
Insurance Requirements	All vehicles operated on roads must be properly, currently insured with basic liability insurance to protect other drivers and passengers in the amount of no less than Page 10 of Title VII of the Traffic Code \$25,000.00 per person and \$50,000.00 per accident, with proof of such insurance being carried in the vehicle at all times it is being operated.	Enacted	Enacted	Absent	Enacted	Absent	Absent	Absent	57.1%
License	All individuals operating a Motor Vehicle or Motorcycle shall have in their possession a valid, current Driver's License from an authorized issuing agency.	Enacted	Enacted	Enacted	Enacted	Absent	Enacted	Enacted	14.3%
Reporting Accidents (Crashes)	The driver of any vehicle involved in an accident resulting only in damage to a vehicle which is driven or attended by any person shall immediately stop such vehicle at the scene of such accident or as close thereto as possible and shall forthwith return to and in every event shall remain at the scene of such accident. Every stop shall be made without obstructing traffic more than is necessary.	Enacted	Absent	Enacted	Enacted	Enacted	Enacted	Absent	28.6%
Road Block/ Check Points	Programs that involve high visibility enforcement conducted by law enforcement stopping drivers systematically to assess alcohol impairment.	Enacted	Enacted	Absent	Absent	Absent	Absent	Absent	71.4%
Seatbelt law	Laws that require motor vehicle occupants to wear seat belts. Includes both primary and secondary laws.	Enacted	Absent	Enacted	Enacted	Absent	Enacted	Absent	43.0%
Speeding	The operator of any vehicle shall limit the speed of his/her vehicle to the posted speed limit signs or otherwise stated in legislation.	Enacted	Absent	Enacted	Enacted	Enacted	Enacted	Enacted	14.3%

Traffic Law Type	Description of Legal Code	Status of Traffic Law: Salish and Kootenai	Status of Traffic Law: Blackfeet	Status of Traffic Law: Fort Peck	Status of Traffic Law: Fort Belknap	Status of Traffic Law: Crow	Status of Traffic Law: Northern Cheyenne	Status of Traffic Law: Rocky Boy	% Absent
Under Influence of Alcohol	Laws that declare that it is illegal for a driver’s blood alcohol concentration (BAC) to reach exceed 0.05% (0.05 g/dL) for drivers aged 21 years and older.	Enacted	Enacted	Enacted	Enacted	Absent	Enacted	Enacted	14.3%
% Absent	N/A	0%	50%	30%	20%	80%	20%	70%	40.0%

Population Data

For purposes of injury rate estimation, population denominators were obtained from the Centers for Disease Control and Prevention (CDC) WONDER website, including only AI/AN race for counties that corresponded to the study locations (Appendix A).¹⁸

Data Analysis

Ratio and distribution patterns of Crash Type were examined by age group and sex. All injury rates were calculated per 100,000 population. Age-adjusted rates were calculated using fatal motor vehicle crashes for U.S. All Races from the Centers for Disease Control and Prevention's (CDC) Web-based Injury Statistics Query and Reporting System (WISQARS) and 2000 U.S. Census standard population data.

Multinomial logistic regression analysis was used to estimate risk ratios (RR) and 95% confidence intervals (95% CI) for Crash Type by the exposure (i.e., “absence” of the traffic law). Analyses were performed using SAS 9.4 (SAS Institute Inc., Cary, NC, US).

Results:

During the years 2016 through 2018 among the study population in the study locations, there were 1,285 motor vehicle crashes. Overall, 58.3% of the crashes resulted in No-Injury, with Injury accounting for 36.6%, and Fatality 5.1% (Table 3).

Table 3. Frequency and Proportion of Crash Type by Age Group and Sex for Montana Reservations (2016-2018).

Age Group	Sex	Crash Type: All Crashes N (%)	Crash Type: No-Injury N (%)	Crash Type: Injury N (%)	Crash Type: Fatality N (%)
All ages	Total	1,285 (100.0)	749 (58.3)	470 (36.6)	66 (5.1)
All ages	Male	677 (52.7)	382 (29.7)	253 (19.7)	42 (3.3)
All ages	Female	608 (47.3)	367 (28.6)	217 (16.9)	24 (1.9)
0-9 yrs	Total	100 (7.8)	68 (5.3)	29 (2.3)	3 (0.2)
0-9 yrs	Male	56 (4.4)	34 (2.6)	21 (1.6)	1 (0.1)
0-9 yrs	Female	44 (3.4)	34 (2.6)	8 (0.6)	2 (0.2)
10-14 yrs	Total	84 (6.5)	53 (4.1)	26 (2.0)	5 (0.4)
10-14 yrs	Male	40 (3.2)	24 (1.9)	14 (1.1)	2 (0.2)
10-14 yrs	Female	44 (3.4)	29 (2.3)	12 (0.9)	3 (0.2)
15-19 yrs	Total	210 (16.3)	116 (9.0)	88 (6.8)	6 (0.5)
15-19 yrs	Male	90 (7.0)	42 (3.3)	43 (3.3)	5 (0.4)
15-19 yrs	Female	120 (9.3)	74 (5.8)	45 (3.5)	1 (0.1)
20-24 yrs	Total	189 (14.7)	93 (7.2)	83 (6.5)	13 (1.0)
20-24 yrs	Male	105 (8.2)	47 (3.7)	47 (3.7)	11 (0.9)
20-24 yrs	Female	84 (6.5)	46 (3.6)	36 (2.8)	2 (0.2)
25-34 yrs	Total	311 (24.2)	183 (14.2)	111 (8.6)	17 (1.3)
25-34 yrs	Male	177 (13.8)	109 (8.5)	58 (4.5)	10 (0.8)
25-34 yrs	Female	134 (10.4)	74 (5.8)	53 (4.1)	7 (0.5)
35-44 yrs	Total	151 (11.8)	81 (6.3)	60 (4.7)	10 (0.8)
35-44 yrs	Male	73 (5.7)	40 (3.1)	29 (2.3)	4 (0.3)
35-44 yrs	Female	78 (6.1)	41 (3.2)	31 (2.4)	6 (0.5)
45-54 yrs	Total	98 (7.6)	61 (4.7)	30 (2.3)	7 (0.5)
45-54 yrs	Male	51 (4.0)	28 (2.2)	18 (1.4)	5 (0.4)
45-54 yrs	Female	47 (3.7)	33 (2.6)	12 (0.9)	2 (0.2)
55-64 yrs	Total	90 (7.0)	58 (4.5)	29 (2.3)	3 (0.2)
55-64 yrs	Male	55 (4.3)	34 (2.6)	18 (1.4)	3 (0.2)
55-64 yrs	Female	35 (2.7)	24 (1.9)	11 (0.9)	0 (0.0)
65+ yrs	Total	52 (4.0)	36 (2.8)	14 (1.1)	2 (0.2)
65+ yrs	Male	30 (2.3)	24 (1.9)	5 (0.4)	1 (0.1)
65+ yrs	Female	22 (1.7)	12 (0.9)	9 (0.7)	1 (0.1)

In general, males accounted for slightly higher total proportions for all crash types, except for ages 15-19 and 35-44 years. For both sexes, the largest proportions of all crash types occurred at ages 25-34 years (Table 3). For crashes resulting in non-fatal Injury, ages 15-44 years accounted for 72.8% of injuries with an increase from age 15 through 34 years. For fatal crashes, ages 20-44 years accounted for

60.6% of deaths. In general, the proportion of injury and fatality decreased for those 45 years and older, with a large decrease in fatalities for those 55 years and older.

Motor vehicle crashes occurred at a rate of 705.8 crashes per 100,000 population for All Crashes, with rates of 411.1, 256.9 and 37.7 for No-Injury, Injury, and Fatality respectively (Table 4).

Table 4. Age-Adjusted Crash Rates^{a b} by Crash Type, Age Group and Sex for Montana Reservations (2016-2018).

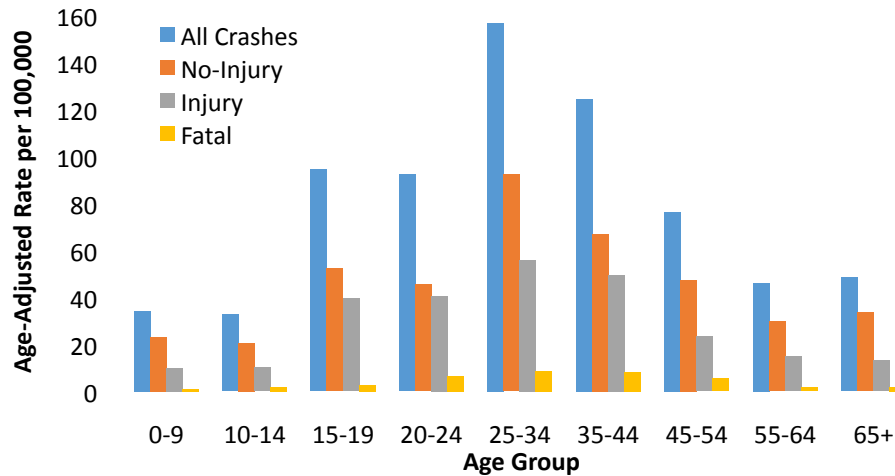
Age Group	Sex	Rate by Crash Type: All Crashes	Rate by Crash Type: No- Injury	Rate by Crash Type: Injury	Rate by Crash Type: Fatality
All ages	Total	705.8	411.1	256.9	37.7
All ages	Male	765.5	439.0	278.3	48.1
All ages	Female	654.0	389.8	236.4	27.9
0-9 yrs	Total	34.1	23.2	9.9	1.0
0-9 yrs	Male	37.5	22.8	14.1	0.7
0-9 yrs	Female	30.6	23.6	5.6	1.4
10-14 yrs	Total	32.6	20.5	10.1	1.9
10-14 yrs	Male	31.0	18.6	10.8	1.5
10-14 yrs	Female	34.2	22.5	9.3	2.3
15-19 yrs	Total	94.5	52.2	39.6	2.7
15-19 yrs	Male	79.5	37.1	38.0	4.4
15-19 yrs	Female	110.1	67.9	41.3	0.9
20-24 yrs	Total	92.4	45.5	40.6	6.4
20-24 yrs	Male	103.5	46.3	46.3	10.8
20-24 yrs	Female	81.5	44.6	34.9	1.9
25-34 yrs	Total	156.8	92.3	56.0	8.6
25-34 yrs	Male	183.1	112.8	60.0	10.3
25-34 yrs	Female	131.8	72.8	52.1	6.9
35-44 yrs	Total	124.6	66.9	49.5	8.3
35-44 yrs	Male	123.6	67.7	49.1	6.8
35-44 yrs	Female	125.7	66.1	49.9	9.7
45-54 yrs	Total	76.3	47.5	23.4	5.5
45-54 yrs	Male	82.8	45.5	29.2	8.1
45-54 yrs	Female	70.3	49.3	17.9	3.0
55-64 yrs	Total	46.2	29.8	14.9	1.5
55-64 yrs	Male	61.2	37.8	20.0	3.3
55-64 yrs	Female	33.4	22.9	10.5	-
65+ yrs	Total	48.4	33.5	13.0	1.9
65+ yrs	Male	63.6	50.9	10.6	2.1
65+ yrs	Female	36.5	19.9	14.9	1.7

^a Age-Adjusted to the U.S. 2000 standard population

^b Rates per 100,000 population

Rates for all crash types increased until age 25-34 years, and then decreased with advancing years (Table 4 and Figure 1). At their peak in the 25-34 year age group, the crash rates were 156.8, 92.3, 56.0 and 8.6 for All Crashes, No-Injury, Injury and Fatality respectively (Table 1 and Figure 1).

Figure 1. Age-Adjusted Crash Rates by Age Group and Crash Type for Montana Reservations (2016-2018).



Males generally had higher rates for all crash type categories, except for ages 15-19 and 35-44 years. For both sexes, the highest rates occurred at ages 25-34 years with males showing rates of 765.5, 439.0, 278.3 and 48.1 for All Crashes, No-Injury, Injury and Fatality respectively, and females showing rates of 654.0, 389.8, 236.4 and 27.9 for the same injury types (Table 4 and Figures 2, 3, 4 and 5).

Figure 2. Age-Adjusted All Crash Rates by Age Group and Sex for Montana Reservations (2016-2018).

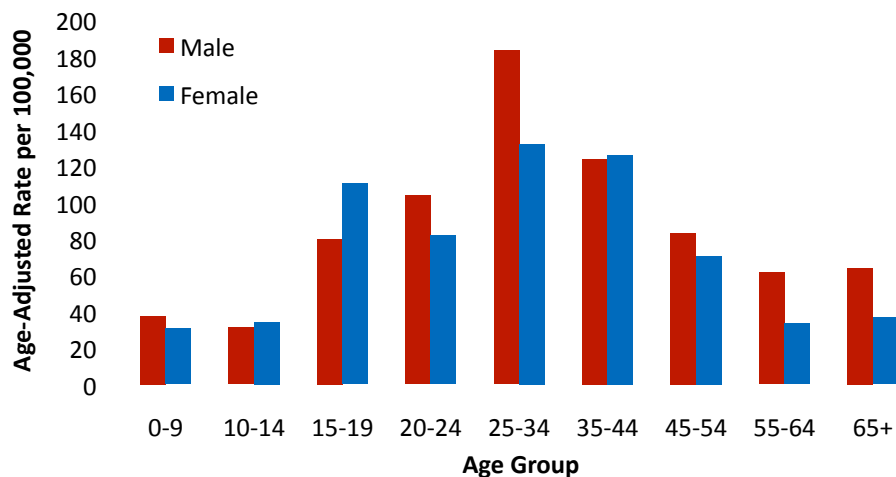


Figure 3. Age-Adjusted No-Injury Rates by Age Groups and Sex for Montana Reservations (2016-2018).

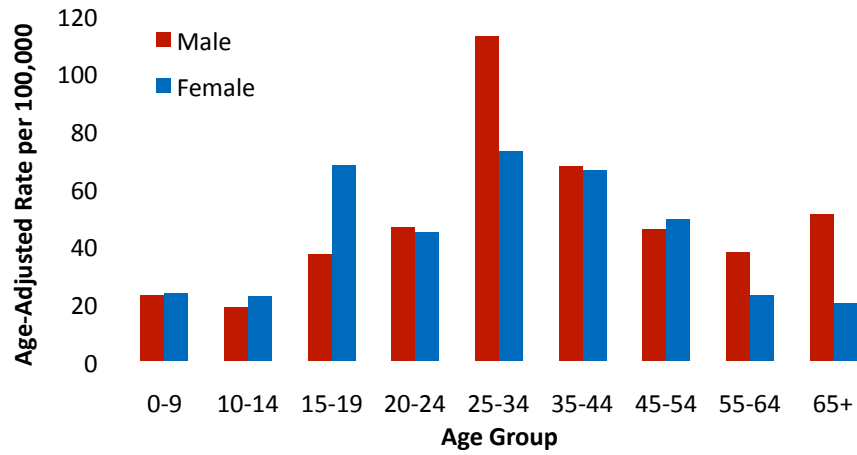


Figure 4. Age-Adjusted Injury Rates by Age Groups and Sex for Montana Reservations (2016-2018).

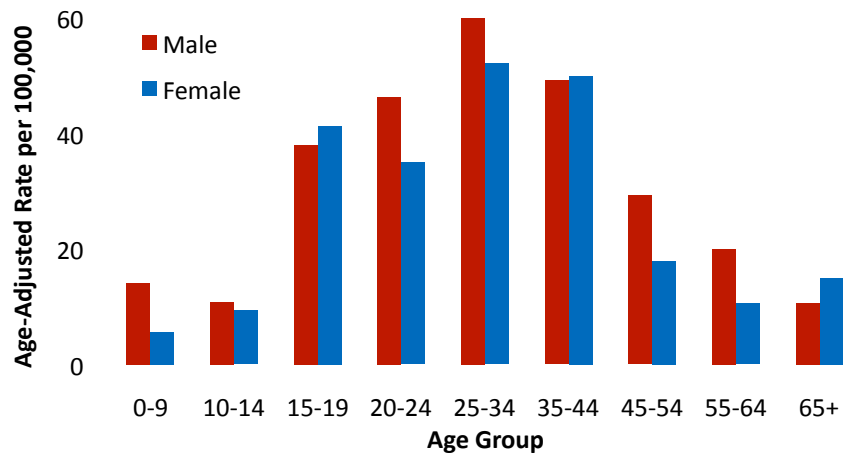
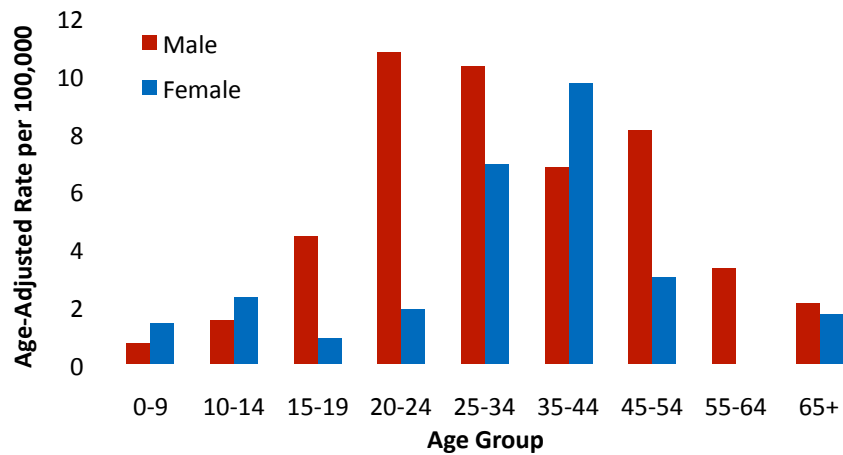


Figure 5. Age-Adjusted Fatality Rates by Age Groups and Sex for Montana Reservations (2016-2018).



Injury rates increased for both males and females starting at 15 years of age, and then decreased after 44 years, with males having higher age-adjusted injury rates except for ages 15-19 and 35-44 years (Table 4 and Figure 4).

In contrast, fatality rates increased starting at age 20 years, but slightly decreased after 45 years of age, ranging from 6.4 to 8.6 fatalities per 100,000 population (Table 4 and Figure 1). Fatality rates for males were approximately 1.7 times those of females (48.1 compared to 27.9 per 100,000 population), with males accounting for higher fatality rates in all age groups except for those 14 years of age and younger and 35-44 years (Tables 4 and Figure 5). Furthermore, male fatality rates increased sharply from ages 15-19 years to 20-24 years (2.7 to 6.4 fatalities per 100,000 respectively) (Table 4 and Figure 5). In general, injury and fatality rates decreased for those 45 years and older, with a larger drop in fatalities for those 55-64 years of age (Figures 4 and 5).

The fatal crash rate for the study population was 3.2 times higher than that of the U.S. All Races (37.7 compared to 11.8 per 100,000 population) (Table 5). Fatality rates were higher in all age groups, except for those 65 years and older which were of equal value (1.9 per 100,000 population), with the greatest rate difference of 13.3 times higher for those 10-14 years of age (Table 5 and Figure 6). Those 20-44 years had rates 4.1 to 5.1 times higher than the U.S. All Races, with females having the greatest rate increase for those 0-9 and 10-14 years of age, being 13.3 and 19.0 times greater (Figures 7 and 8).

Table 5. Age-Adjusted Fatal Crash Rates^{a b} for Montana Reservations and U.S. All Races (2016-2018).

Age Group	Sex	Fatal Crash Rates:	Fatal Crash Rates:	Rate Ratio
		MT Reservations	U.S. All Races	
All ages	Total	37.7	11.8	3.2
All ages	Male	48.1	17.0	2.8
All ages	Female	27.9	6.8	4.1
0-9 yrs	Total	1.0	0.3	3.8
0-9 yrs	Male	0.7	0.2	4.0
0-9 yrs	Female	1.4	0.1	11.4
10-14 yrs	Total	1.9	0.1	13.3
10-14 yrs	Male	1.5	0.2	9.2
10-14 yrs	Female	2.3	0.1	19.0
15-19 yrs	Total	2.7	0.9	3.2

^a Age-Adjusted to the U.S. 2000 standard population

^b Rates per 100,000 population

Age Group	Sex	Fatal Crash Rates: MT Reservations	Fatal Crash Rates: U.S. All Races	Rate Ratio
15-19 yrs	Male	4.4	1.1	4.0
15-19 yrs	Female	0.9	0.6	1.5
20-24 yrs	Total	6.4	1.3	5.1
20-24 yrs	Male	10.8	1.8	6.0
20-24 yrs	Female	1.9	0.7	2.9
25-34 yrs	Total	8.6	2.1	4.1
25-34 yrs	Male	10.3	3.1	3.4
25-34 yrs	Female	6.9	1.1	6.5
35-44 yrs	Total	8.3	2.0	4.1
35-44 yrs	Male	6.8	3.0	2.3
35-44 yrs	Female	9.7	1.1	9.1
45-54 yrs	Total	5.5	1.7	3.1
45-54 yrs	Male	8.1	2.6	3.2
45-54 yrs	Female	3.0	0.9	3.2
55-64 yrs	Total	1.5	1.2	1.3
55-64 yrs	Male	3.3	1.8	1.9
55-64 yrs	Female	0.0	0.6	0.0
65+ yrs	Total	1.9	1.9	1.0
65+ yrs	Male	2.1	2.7	0.8
65+ yrs	Female	1.7	1.2	1.4

Figure 6. Age-Adjusted Fatality Rates by Age Groups Montana Reservations Compared to U.S. All Races (2016-2018).

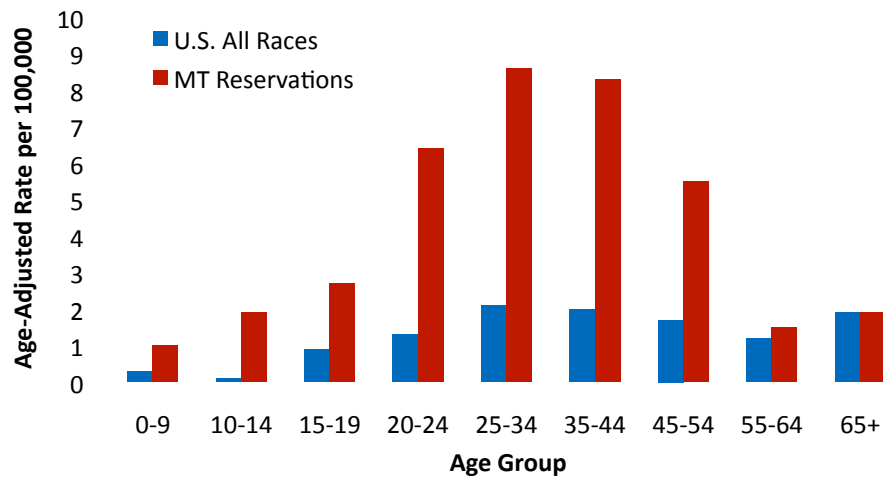
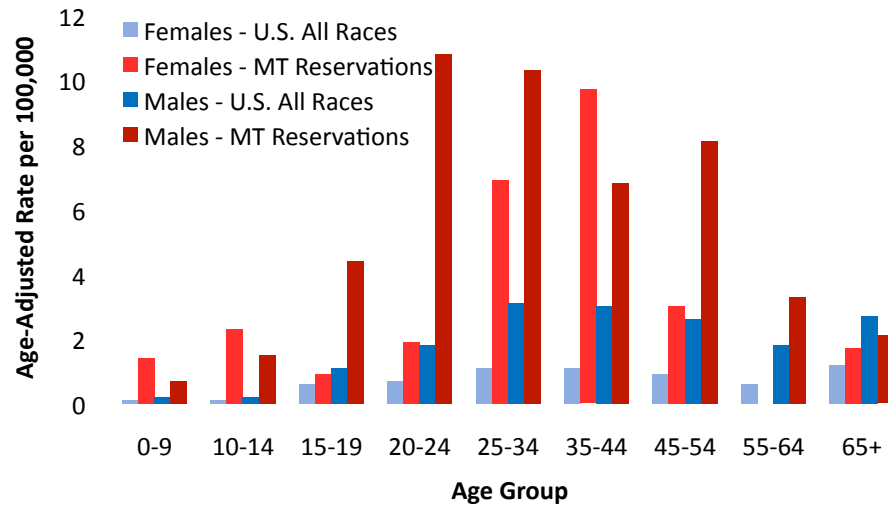


Figure 7. Age-Adjusted Fatality Rates by Age Groups and Sex for Montana Reservations Compared to U.S. All Races (2016-2018).



Eight of the ten traffic safety laws were statistically significant in their association of absence of law with crash type risk (Table 6). Reporting accidents and speeding laws did not significantly influence the risk of any crash type.

The risk for MVC fatal injury was associated with the absence of each of the eight traffic safety laws, and the risk for MVC non-fatal injury was associated with the absence of each of six laws (Table 6). For some laws, when absent (therefore, not protecting the driving population) the risk for an injury outcome increased with the severity of the crash type. For example, without a Careless/Reckless Driving law, the risk for MVC fatal injury was higher (RR=2.27) than the risk for non-fatal injury (RR=1.61) (Table 6).

Table 6. Risk Ratio of Law Compared to Crash Type for Montana Reservations (2016-2018).

Type of Law	Risk Ratio ^e	Crash Type: Injury	Crash Type: Fatality
Roadblock/ Check Points	RR	1.71*	4.48*
Roadblock/ Check Points	<i>Lower</i>	1.55	3.01
Roadblock/ Check Points	<i>Upper</i>	1.89	6.68
Insurance Requirements	RR	1.74*	4.41*
Insurance Requirements	<i>Lower</i>	1.58	2.97
Insurance Requirements	<i>Upper</i>	1.92	6.56
License	RR	1.18*	3.33*
License	<i>Lower</i>	1.01	2.16
License	<i>Upper</i>	1.37	5.14
Under the Influence of Alcohol	RR	1.18*	3.33*

^e Includes upper and lower bounds of 95% confidence interval.

Type of Law	Risk Ratio ^e	Crash Type: Injury	Crash Type: Fatality
Under the Influence of Alcohol	<i>Lower</i>	1.01	2.16
Under the Influence of Alcohol	<i>Upper</i>	1.37	5.14
Child Restraint System	RR	1.13	2.80*
Child Restraint System	<i>Lower</i>	1.00	1.89
Child Restraint System	<i>Upper</i>	1.26	4.14
Seatbelt	RR	1.13	2.80*
Seatbelt	<i>Lower</i>	1.00	1.89
Seatbelt	<i>Upper</i>	1.26	4.14
Careless/Reckless Driving	RR	1.61*	2.27*
Careless/Reckless Driving	<i>Lower</i>	1.45	1.53
Careless/Reckless Driving	<i>Upper</i>	1.79	3.38
Child Education Program	RR	1.50*	2.27*
Child Education Program	<i>Lower</i>	1.36	1.53
Child Education Program	<i>Upper</i>	1.65	3.36
Reporting Accident (Crashes)	RR	1.05	1.51
Reporting Accident (Crashes)	<i>Lower</i>	0.91	0.90
Reporting Accident (Crashes)	<i>Upper</i>	1.22	2.53
Speeding	RR	1.05	1.22
Speeding	<i>Lower</i>	0.90	0.70
Speeding	<i>Upper</i>	1.22	2.14

* Statistically significant risk ratio.

The traffic laws that produced the largest risk estimates were roadblock/check point, insurance, and under the influence of alcohol laws. When absent, these laws produced more than a three-fold increased risk for fatal crash (RR = 4.48, 4.41, 3.33 respectively), and an elevated risk for non-fatal injury (1.71, 1.74, 1.18). For the remaining laws with statistical significance, the risk increased more than two-fold when the law was absent (RR = 2.27 to 2.80).

Discussion:

Due to minimal literature exploring the effect of the presence of a law on the risk of injury and fatality, this study estimated the risk associated with the absence of injury-preventative traffic laws on crash-related injury types within the boundaries of Montana Tribal reservations.^{19 20 21 22 23 24 25} The findings from this study show that the risk of injury and fatality increases with the absence of injury-preventative traffic laws, suggesting that the presence of such laws are protective and might contribute to lower crash injury rates.

In general, roadblock/check point laws were most strongly associated with the risk for all crash types due to their protective effect for reducing injury, and the higher risk ratios for injury and fatality when such laws were absent. This suggests that roadblock/check point laws might be a significant intervention to reduce injuries and fatalities related to motor vehicle crashes.

This study also showed that insurance license and under the influence of alcohol laws were associated with preventing injuries and fatal crashes. This suggests that these laws might reduce the fatality risk more than threefold, while seatbelt and child restraint system laws might also dramatically reduce crash fatalities. Furthermore, several of these laws, if enacted, also seem to reduce the risk of non-fatal injury during a crash.

Limitations to this study include that it did not assess the reliability and inclusion of data for the AI/AN race, with misclassification of AI/AN race mortality being estimated at 6.2% for the Billings Area IHS and limited estimates for morbidity.²⁶ This study also did not evaluate the strength or enforcement of the traffic laws. For example, whether primary seatbelt laws were more effective than secondary seatbelt laws; and whether extensive traffic-law enforcement were associated with effective regulation in the reduction of injury and fatality due to motor vehicle crashes.^{19 20 21 22 23 27 28 29 30} Future research could identify associations between policy strength and risk for injury severity.

The evidence from this study suggests that Tribal traffic laws influence injury outcomes for motor vehicle crashes. To efficiently prevent MVC injury and fatality, and promote health equity for the AI/AN population, concentrated efforts should be made to enact Tribal traffic safety laws, with a priority order to their enactment. In addition to traffic laws, Tribes could develop educational and traffic enforcement programs that focus on adults 25-44 years, with an emphasis on males.

References

- ¹ Xu JQ, Murphy SL, Kochanek KD, et Al. Mortality in the United States, 2017. *NCHS Data Brief*. 2018; 328: 1-8. <https://www.cdc.gov/nchs/data/databriefs/db328-h.pdf>. Accessed January 22, 2020.
- ² Indian Health Service. Indian Health Focus: Injuries 2017 Edition. https://www.ihs.gov/sites/dps/themes/responsive2017/display_objects/documents/Indian_Health_Focus_%20Injuries_2017_Edition_508.pdf. Published October 2017. Accessed January 22, 2020.
- ³ Indian Health Service. Billings Area. <https://www.ihs.gov/billings/>. Accessed January 22, 2020.
- ⁴ Native American Policies. The United States Department of Justice. <https://www.justice.gov/otj/native-american-policies>. Published July 15, 2020. Accessed January 22, 2020.
- ⁵ Campos-Outcalt D, Prybylski D, Watkins AJ, Rothfus G, Dellapenna A. Motor-vehicle crash fatalities among American Indians and non-Indians in Arizona, 1979 through 1988. *Am J Public Health*. 1997;87(2):282-285. doi:10.2105/ajph.87.2.282.
- ⁶ Henning-Smith C, Kozhimannil KB. Rural–Urban Differences in Risk Factors for Motor Vehicle Fatalities. *Health Equity*. 2018;2(1):260-263. doi:10.1089/hec.2018.0006.
- ⁷ Travis LL, Clark DE, Haskins AE, Kilch JA. Mortality in rural locations after severe injuries from motor vehicle crashes. *Journal of Safety Research*. 2012;43(5-6):375-380. doi:10.1016/j.jsr.2012.10.0047. Phelan KJ, Khoury J, Grossman DC, et AL. Pediatric motor vehicle related injuries in the Navajo Nation: the impact of the 1988 child occupant restraint laws. *Inj Prev*. 2002;8(3):216-220. doi:10.1136/ip.8.3.216.
- ⁸ Indian Health Service. Indian Health Service: Indian Health Disparities. https://www.ihs.gov/sites/newsroom/themes/responsive2017/display_objects/documents/factsheets/Disparities.pdf. Published October 2019. Accessed January 22, 2020.
- ⁹ Centers for Disease Control and Prevention. Best Practices Guide: Tribal Motor Vehicle Injury Prevention (TMVIP) Best Practices Guide 2016. Centers for Disease Control and Prevention. Department of Health and Human Services. https://www.cdc.gov/motorvehiclesafety/pdf/native/TMVIP_Best-Practices_Guide_2016-a.pdf. Published November 16, 2016. Accessed January 22, 2020.
- ¹⁰ Insurance Institute for Highway Safety. Low-hanging fruit: Existing countermeasures merit renewed attention. <https://www.iihs.org/news/detail/low-hanging-fruit-existing-countermeasures-merit-renewed-attention>. Published August 18, 2011. Accessed July 07, 2020.
- ¹¹ National Highway Traffic Safety Administration. Traffic Safety Facts: Laws. https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/810888gradriverlicense_0.pdf. Published January 2008. Accessed July 07, 2020.
- ¹² Carpenter CS, Stehr M. The effects of mandatory seatbelt laws on seatbelt use, motor vehicle fatalities, and crash-related injuries among youths. *Journal of Health Economics*. 2008;27(3):642-662. doi:10.1016/j.jhealeco.2007.09.010
- ¹³ Wagenaar AC, Webster DW, Maybee RG. Effects of child restraint laws on traffic fatalities in Eleven States. *Journal of Safety Research*. 1988;19:100-100.
- ¹⁴ Fell JC, Voas RB. The effectiveness of a 0.05 blood alcohol concentration (BAC) limit for driving in the United States. *Addiction*. 2014;109:869-874.
- ¹⁵ Carpenter CS, Stehr M. The effects of mandatory seatbelt laws on seatbelt use, motor vehicle fatalities, and crash-related injuries among youths. *Journal of Health Economics*. 2008;27(3):642-662. doi:10.1016/j.jhealeco.2007.09.010.

- ¹⁶ Pressley JC, Pressley JC, Addison D, et al. Graduated driver license compliant teens involved in fatal motor vehicle crashes. *The journal of trauma and acute care surgery*. 2015;79:S33-S4. doi: 10.1097/TA.0000000000000794.
- ¹⁷ Williams AF. Licensing age and teenage driver crashes: a review of the evidence. *Traffic Inj Prev*. 2009; 10 (1): 9–15. doi: 10.1080/15389580802500546
- ¹⁸ Centers for Disease Control and Prevention. CDC Wonder: Bridged-Race Population Estimates 1990-2018 Request. Centers for Disease Control and Prevention. Department of Health and Human Services. <https://wonder.cdc.gov/Bridged-Race-v2018.HTML>. Published December 12, 2019. Accessed January 22, 2020.
- ¹⁹ Rookey BD. Drunk driving in the United States: An examination of informal and formal factors to explain variation in DUI enforcement across U.S. counties. *Western Criminology Review*. 2012;13:37-52.
- ²⁰ Goodfellow M, Kilgore C. DUI Offenders' Beliefs About DUI Statutes and DUI Law Enforcement: Implications for Deterrence. *Journal of Drug Issues*. 2014;44:269-280. doi: 10.1177/0022042613500052.
- ²¹ Yao Y, Carsten O, Hibberd D. A close examination of speed limit credibility and compliance on UK roads. *IATSS research*. 2019;2020;44:17-29.
- ²² Wali Anwaar Ahmed Shahid Iqbal Arshad Hussain. Effectiveness of enforcement levels of speed limit and drink driving laws and associated factors -Exploratory empirical analysis using a bivariate ordered probit model. *Journal of Traffic and Transactions Engineering (English Edition)*. 2017;4:272-279.
- ²³ Tay R. The effectiveness of enforcement and publicity campaigns on serious crashes involving young male drivers: Are drink driving and speeding similar? *Accident analysis and prevention*. 2005;37:922-929.
- ²⁴ Redelmeier DA, Tibshirani RJ, Evans L. Traffic-law enforcement and risk of death from motor-vehicle crashes: case-crossover study. *The Lancet*. 2003;361:2177-2182.
- ²⁵ Desapriya E, Nobutada I, Guanghong H. Traffic law enforcement and safety. *The Lancet*. 2003;362:833-833.
- ²⁶ Indian Health Service. Adjusting for miscoding of Indian race on state death certificates. https://www.ihs.gov/sites/dps/themes/responsive2017/display_objects/documents/AdjustingForMiscodingOfIndianRaceOnStateDeathCertificates.pdf. Published November 1996. Accessed July 10, 2020.
- ²⁷ Carpenter CS, Stehr M. The effects of mandatory seatbelt laws on seatbelt use, motor vehicle fatalities, and crash-related injuries among youths. *Journal of health economics*. 2008;27:642-662.
- ²⁸ National Highway Traffic Safety Administration. Safety Belts and Teens 2003 Report. U.S. Department of Transportation. <https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/809899.pdf>. Published September 20, 2020. Accessed January 22, 2020.
- ²⁹ Houston DJ, Richardson LE. Reducing traffic fatalities in the American States by upgrading seat belt use laws to primary enforcement. *Journal of Policy Analysis and Management*. 2006;25:645-659. doi: 10.1002/pam.20195.
- ³⁰ Kwak BH, Ro YS, Shin SD, Song KJ, Kim YJ, Jang DB. Preventive effects of seat belt on clinical outcomes for road traffic injuries. *Journal of Korean Medical Science*. 2015;30:1881-1888. doi: 10.3346/jkms.2015.30.12.1881.

Appendix:

Appendix A. Reservations counties by American Indian/Alaska Native populations, years 2016 – 2018.

Reservation	State	County Name ^a	Total AI/AN Population (2016 – 2018)	Tribal law/codes websites
Blackfeet	Montana	Glacier, Pondera	59,448	https://leg.mt.gov/bills/mca_toc/61_13_1.htm
Crow	Montana	Big Horn (3/4), Yellowstone	90,383	http://indianlaw.mt.gov/crow/codes
Flathead	Montana	Flathead, Lake, Missoula, Sanders	78,476	http://www.csktribes.org/title-iv-chapter-3
Fort Belknap	Montana	Blaine, Phillips	11,723	http://indianlaw.mt.gov/fb/codes
Fort Peck	Montana	Daniels, Roosevelt, Sheridan, Valley	46,517	https://fptc.org/comprehensive-code-of-justice-ccoj
Northern Cheyenne	Montana	Big Horn (1/4), Rosebud	35,582	https://narf.org/nill/codes/northern_cheyenne/index.html
Rocky Boy's	Montana	Chouteau, Hill	15,969	http://indianlaw.mt.gov/Portals/127/chippewacree/codes/tribe_ordinances_39_99.pdf
Wind River	Wyoming	Fremont, Hot Springs	28,121	https://www.windrivertribalcourt.com/tribal-codes/ http://northernrapaho.com/wp/tribal-code/

^a Department of Health and Human Services: Public Health Service –Billings Area Indian Health Service Circular No. 89.2