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Trends in Motor Vehicle Crashes: Wind River Indian Reservation 1994-2009

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By

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Abstract

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By Anne F. Kenney

Introduction: Motor vehicle crashes are the leading cause of unintentional injury death for American Indians and Alaska Natives (AI/AN) age 1-44 in the United States, with Wyoming being the state with the highest motor vehicle-related death rate among AI/AN between 2003-2007 (1). No specific data exists on crashes occurring within Wyoming's Wind River Indian Reservation boundaries. The overall objective of this study is to describe characteristics of motor vehicle crashes occurring on Wind River Indian Reservation.

Methods: We analyzed data from the Wyoming Department of Transportation (WDOT) using SAS 9.2 and ARCGIS to describe characteristics of motor vehicle crashes occurring within Wind River Indian Reservation boundaries.

Results: Between the years of 1994-2009 WDOT reported 4,848 motor vehicle crashes involving 11,696 individuals within the Wind River Indian Reservation boundaries. Similar numbers of males and females were involved, with 40.8% all crashes occurring with drivers less than age 26. The annual number of motor vehicle crashes did not vary significantly by year. 75.3% of crashes occurred during daylight, with 71.0% on dry roads. Individuals not wearing seatbelts exhibit a higher fatality risk (OR= 10.0, 95% CI= 3.8- 26.48¹)

Conclusion: Better driver education for youth and consistent use of seatbelts, may lead to fewer motor vehicle crashes resulting in injury and fatality on Wind River Indian Reservation.

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Chapter 1: Introduction

Injuries related to motor vehicle crashes (MVCs) are the eight leading cause of death worldwide, and the leading cause of death among those ages 5-34 in the United States (2). MVCs may result in morbidity, mortality, and impose large financial burden on health care systems. In 2005, the cost of health care and loss of productivity associated with MVCs exceeded 99 billion dollars in the US (3).

MVCs are the leading cause of unintentional injury death for American Indian and Alaska Natives (AI/AN) in the US (4). MVC mortality rates are highest in AI/AN than in any other ethnic group in the US (5). Motor vehicle crashes were responsible for approximately 7% of AI/AN deaths, compared to less than 2% of blacks and whites (2). The overall age-adjusted motor vehicle death rate for AI/AN was 29.1 per 100,000 population, compared to 15.0 per 100,000 for whites (6).

Currently, no published information describing reservation specific trends in MVCs exists. This information is important to understand due to differences in reservation composition and culture. Trends in MVC at the reservation level will provide information to help design reservation specific interventions.

Using data obtained from the Wyoming Department of Transportation, this project will describe trends in MVCs on Wind River Indian Reservation. Wind River Indian Reservation occupies 2,268,000 acres of land and is home to both the Eastern Shoshone and Northern Arapahoe tribes (7). The project will focus on describing trends in person, place, time, and event relating to MVCs.

This is the first study to describe trends and characteristics of motor vehicle crashes on Wind River Indian Reservation. The results will provide information that may be used in the

design of interventions to reduce the morbidity, mortality, and the economic impact that may be caused by MVCs. Importantly, action should be taken to help reduce the disparities in MVC death rates that exist between AI/AN populations compared to the entire US population.

Chapter 2: Literature Review

PubMed was used to review current literature on MVCs in AI. Only 7 published articles appeared when searching for articles containing the following words; “American Indian”, with “Car Crash”, or “Motor Vehicle Crashes”. Articles focused on disparities in MVC death rates among AI/AN populations, the role of alcohol in MVCs, and low seat belt use among AI/AN. Additional information was found using the Indian Health Service website, CDC website, and NHTSA website.

Disparities

Various studies document disparities in MVC mortality rates among American Indians and Alaska Natives (AI/AN), as compared to other ethnic groups in the United States (5). The overall age-adjusted motor vehicle death rate for AI/AN was 29.1 per 100,000 population, compared to 15.0 per 100,000 for whites (6). In all races/ethnicities, males had higher motor vehicle death rates than females. Among males, AI/AN had the highest annual motor vehicle death rate of 23 per 100,00 population (6). Motor vehicle crashes are the leading cause of unintentional injury/death for American Indians and Alaska Natives (AI/AN) age 1-44 in the United States (1).

Safety Restraints Use

In 2006, AI/AN was the ethnic group with the highest percentage of unrestrained passengers killed in motor vehicle crashes. 75% of AI/AN killed in MVCs were not wearing seatbelts (8). A retrospective cohort study identifying predictors of seat belt use among AI in Phoenix, Arizona found that AI had the lowest seat belt use rates compared to all other races. The study also found that AIs living on a reservation were more likely to use seat belts than AIs

living off reservation. 25.9% of AI living on a reservation wore seat belts compared to 42.7% of AI who lived off reservation (8). Analysis of collected data revealed low seat belt use was associated with alcohol use (9).

Seat belts are effective in reducing both fatalities and injuries. When used correctly, lap/shoulder belts reduce risk of fatal injury to front-seat occupants by 45 percent and risk of moderate-to-critical injury by 50 percent (10). In 2009, seatbelts saved approximately 12,713 lives in the United States (11). The National Occupant Protection Use Survey conducted by the National Highway Traffic Safety Administration (NHTSA) in 2009 found that seat belt use was lowest among those aged 16-24, in males compared to females, in drivers driving alone, and in passengers riding in the backseat (12).

Child safety seats (CSS) have shown to significantly reduce the risk of fatal injury in young children. CSS reduce the risk of fatal injury by 80 percent compared to those unrestrained (13). However, a 2002 study revealed that CSS use rates are lower in AI/AN communities than in non-native communities. To address this problem and to promote awareness among AI/AN communities of the importance of CSS, the IHS developed a program called *Ride Safe*. This program provides resources for Tribal Head Start Staff to participate in NHTSA Child Passenger Safety (CPS) technician training, provides CPS training for Head Start Staff who are assisting with Ride Safe activities, educates parents and care givers on importance of using appropriate child restraints, distributes CSS to each child attending Head Start. Follow-up visits to the homes of all families receiving CSS occurs 2-3 months after CSS distribution. The visits consist of head start staff checking to see if CSS are still installed, educating parents and providing additional information on the proper way to install CSS, and to gathering data for program evaluation (14). An evaluation of the Ride Safe program revealed that between 2003-2006 the

program reached approximately 3,500 children in six states, educating over 1,700 caregivers. 2,916 CSS were distributed and CPS training was provided to 78 Tribal Staff Members (15).

Alcohol Related MVC's

Alcohol related crashes cost the US approximately 51 billion dollars each year (16). Alcohol also contributes to a large number of motor vehicle fatalities. Nearly one third of all motor vehicle crash fatalities in the US occur in alcohol related crashes (17). In attempt to reduce the number of impaired drivers some states have expanded the number of sobriety checkpoints in their states, have made it illegal for individuals under the age of 21 to have an elevated BAC, and some states require that all individuals who have been caught driving while intoxicated to have breathalyzer devices in their vehicle (18).

A national study conducted between 2001-2002 revealed AI had significantly ($p < 0.01$) higher rates of driving while under the influence of alcohol than all other races (19). AI's also had the highest percentage of fatalities occurring in alcohol related MVCs compared to all other races. Of all AI's killed in MVCs, 48% of fatalities occurred in alcohol related crashes (8). A study evaluating factors contributing to high motor vehicle crash mortality rates among AI in Arizona found that excess mortality associated with alcohol ranged from 36.8% to 66.7%, and the percentage associated with pedestrian deaths ranged from 27.2% to 55.4% (20). The study recommended that action be taken to prevent pedestrian and alcohol-related fatalities.

Interventions

The CDC's Injury Center provided funding to 4 American Indian tribes between 2004-2009 to address large disparities in motor vehicle mortality rates between AI/AN population and all other populations in the US. The pilot programs increased both seat belt and child safety seat

use, and decreased alcohol-impaired driving. The Tohono Nation passed a primary seat belt law and launched a media campaign promoting seatbelt use. This resulted in a 15% increase in seat belt use between 2005-2008 (21). The Ho-Chunk Nation increased seat belt use 38% and increased child safety use 94% after implementing a media campaign, educating police officers, and forming partnerships with local county police departments (21). The White Mountain Apache Tribe increased seat belt and decreased alcohol related crashes by introducing a media campaign, enhancing enforcement, and using DUI sobriety checkpoints. In 2008, 13,408 vehicles were stopped at DUI Sobriety Checkpoints on White Mountain Apache Reservation (21). The San Carlos Apache Tribe was able to increase DUI arrests by 52% and seat belt use by 46% by using media campaigns, sobriety checkpoints, enhanced police enforcements, and local community event (21).

Currently, CDC's injury center is providing 8 additional tribes with funding to implement interventions to reduce the number and severity of motor vehicle crashes. The following tribes have been selected to receive funding: Caddo Nation of Oklahoma, California Rural Indian Health Board, Colorado River Indian Tribes, Hopi Tribe of Arizona, Oglala Sioux Tribe of South Dakota, Rosebud Sioux Tribe of South Dakota, Sisseton-Wahpeton Oyate of the Lake Traverse Reservation, and Southeast Alaska Regional Health Consortium. In 2014, all interventions will be evaluated and best practice/lessons learned manual will be published (21)

Gaps in Research

Very few published studies exist regarding MVC's in AI/AN populations. Most studies look at AI/AN as one group and do not discuss reservation or regionally specific data. Heterogeneity among tribal cultures is often not considered in research because the necessary data is not available (22). AI/AN populations are unique and can be difficult to research. Cultural

and geographic diversity in the 562 federally recognized tribes, and low response rates among AI/AN in surveys and censuses, make conducting research to improve the health of AI/AN especially challenging (23). Large growth in AI/AN population combined with the unique legal and political status of tribes require additional and more in depth research of this population (22).

Chapter 3: Manuscript

***Trends in Reported Motor Vehicle Crashes: Wind River Indian Reservation
1994-2009***

Contribution of Student:

This manuscript was prepared by Anne Kenney with assistance from Roger Rochat, MD. Anne independently cleaned and analyzed data. Dr. Rochat assisted Anne in selecting important information to be included in the manuscript, and provided guidance on effective ways to present the material. The manuscript was written by Anne and edited by Dr. Rochat.

Abstract

Introduction: Motor vehicle crashes are the leading cause of unintentional injury death for American Indians and Alaska Natives (AI/AN) age 1-44 in the United States, with Wyoming being the state with the highest motor vehicle-related death rate among AI/AN between 2003-2007 (1). No specific data exists on crashes occurring within Wyoming's Wind River Indian Reservation boundaries. The overall objective of this study is to describe characteristics of motor vehicle crashes occurring on Wind River Indian Reservation.

Methods: We analyzed data from the Wyoming Department of Transportation (WDOT) to describe trends and characteristics of motor vehicle crashes occurring within Wind River Indian Reservation boundaries.

Results: Between the years of 1994-2009 WDOT reported 4,848 motor vehicle crashes involving 11,696 individuals within the Wind River Indian Reservation boundaries. Similar numbers of males and females were involved, with 40.8% all crashes occurring in drivers less than age 26. The annual number of motor vehicle crashes did not vary significantly by year. 75.3% of crashes occurred during daylight, with 71.0% on dry roads. Individuals not wearing seatbelts exhibit a higher fatality risk (OR= 10.0, 95% CI= 3.8- 26.48¹)

Conclusion: Better driver education for youth and consistent use of seatbelts, may lead to fewer motor vehicle crashes resulting in injury and fatality on Wind River Indian Reservation.

Introduction

In 2007, motor vehicle crashes (MVC) caused about 44,000 fatalities, with large disparities across racial/ethnic groups. MVCs were responsible for approximately 7% of AI/AN deaths, compared to less than 2% of blacks and whites (2). The overall age-adjusted motor vehicle death rate for AI/AN was 29.1 per 100,000 population, compared to 15.0 per 100,000 for whites (3). MVCs are the leading cause of unintentional injury/death for American Indians and Alaska Natives (AI/AN) age 1-44 in the United States, with Wyoming being the state with the highest motor vehicle-related death rate among AI/AN between 2003-2007 (1,4).

Despite well documented disparities in injury death rates between the general U.S. Population and AI/AN populations, no reservation specific information is available describing characteristics of motor vehicle crashes. Although these data are limited and difficult to locate, reservation specific data should be analyzed due to diverse ecological zones, genetic lineages, historical experiences, lifestyles, laws, customs, and traditions that differ on each reservation (5). These differences can influence numbers of crashes, characteristics of crashes, as well as other behaviors such as seat belt use and alcohol consumption. The National Highway Traffic Safety Administration (NHTSA), reports that seat belt use on Indian Reservations in the United States ranges from 8.8% to 84.8% (6).

Wind River Indian Reservation, Wyoming's only Indian Reservation, is located in central Wyoming. The reservation covers over 2.2 million acres and has a total population of 23,250 (7). Both the Northern Arapahoe and Eastern Shoshone tribes share the reservation, which is the 7th largest Indian Reservation in the United States. About 3,900 Eastern Shoshone and 8,600 Northern Arapahoe tribal members share Wind River (8). Although the state of Wyoming had the highest motor vehicle-related death rate among AI/AN between 2003-2007 (4), no published

information details characteristics and trends in MVCs occurring on Wyoming's only federally recognized Indian Reservation.

Analysis will inform us of reservation specific trends and characteristics of MVCs. Information will also assist tribal leaders in the creation and administration of comprehensive safety guidelines. This is the first study to describe reservation specific trends and characteristics of motor vehicle crashes. Its goal is to provide vital information for the design of reservation specific interventions.

Methods

We utilized data obtained from Wyoming Department of Transportation (WDOT) of all reported motor vehicle crashes occurring within the Wind River Indian Reservation boundaries between 1994-2009. The data is a compilation of all crash reports sent to WDOT by both state law enforcement and Wind River Tribe Law Enforcement Services. The data included information on 4,848 motor vehicle crashes involving 11,696 individuals aged 1–98 years. The data were cleaned and analyzed using SAS 9.2. The univariate and frequency procedures were used to describe trends and give a descriptive overview of motor vehicle crash characteristics on the Wind River Indian Reservation. Using latitude and longitude measurements for each crash, we will use ArcGis to examine the spatial distribution of the crashes. Due to the large number of crashes overall, we will only be displaying crashes resulting in fatality and injury.

Results

Event

Between the years of 1994-2009, 4,848 motor vehicle crashes were reported within the Wind River Indian Reservation boundaries with 32(0.7%) crashes resulting in at least one fatality, and 1,352(27.9%) resulting in at least 1 injury. 1,158 (23.9%) crashes involved a single vehicle, 3435 (71.1%) involved 2 vehicles, and 240 (5.0%) involved 3 or more vehicles.

Of the 2,871 (59.2%) crashes where manner of collision was reported, collision occurred at an angled direction in 1,109 (38.6%) crashes, rear collision in 1,003 (34.9%), head on in 173 (6.0%), sideswipe in 439 (15.3%), and non-collision in 147 (5.1%).

“First harmful event” as described by WDOT responsible for greater than 3% of crashes were: motor vehicles in transport 2,939 (60.8%) , parked motor vehicle 638 (13.2%), fencing 213 (4.4%) , large animals 210(4.3%) and overturn/rollover 154 (3.2%).

Person

A total of 12,376 individual ages 1-98 years were involved in the crashes with a mean age of 30.8 (SD=19.2) and a median age of 24. Of the 11, 842 (95.7%) involved individuals with reported sex, 6,245 (52.7%) were male and 5,597 (47.3%) female. Of all persons involved in motor vehicle crashes, 7,934 (63.61%) were drivers, 4,005 (32.11%) passengers, 455 (3.65%) with an unknown status, 5 (0.04%) pedacyclists, and 2(0.02%) pedestrians. The age of drivers ranged from 4-98, with a mean age of 35.6 (SD=18.1) and a median age of 31. 40.75% all crashes occurred to drivers less than age 26 (figure 1).

Varying employment statuses existed among involved individuals. Of the 6,155 (52.8%) individuals with known employment status, 3,616 (58.7%) were employed, 1,497 (24.3%)

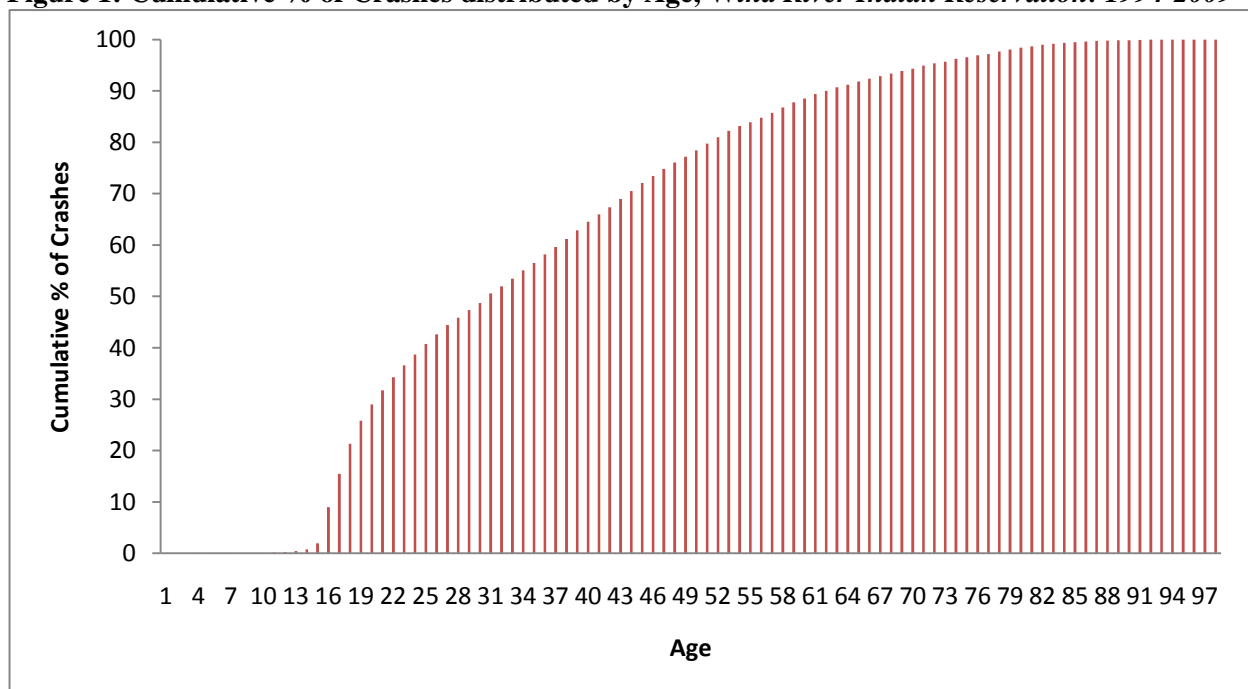
students, 541 (8.8%) retired, 370 (6.0%) unemployed, and 131 (2.1%) household/domestic.

Nearly 3/4th of involved individuals lived within the reservation boundaries.

5,701(71.6%) lived in the city where the crash occurred, 602 (7.6%) lived less than 25 miles from the crash scene, 602 (7.6%) lived greater than 25 miles but within Wyoming, 480 (6.0%) did not live in Wyoming or had an unknown residence.

Seat belts were used by 7,243 (58.2%), not used by 3,204 (25.7%) , and unknown for 1,636 (13.2%) . Other types of safety equipment used included helmets by 19 (0.2%), and child restraints for 337 (2.7%). Those not wearing seatbelts exhibit a higher fatality risk (OR= 10.0, 95% CI= 3.8- 26.48¹). Use of alcohol prior to the crash was suspected in 418 (3.5%) individuals, not suspected in 11,256 (93.6%), and unknown for 349 (2.9%).

Figure 1: Cumulative % of Crashes distributed by Age, Wind River Indian Reservation: 1994-2009



Time

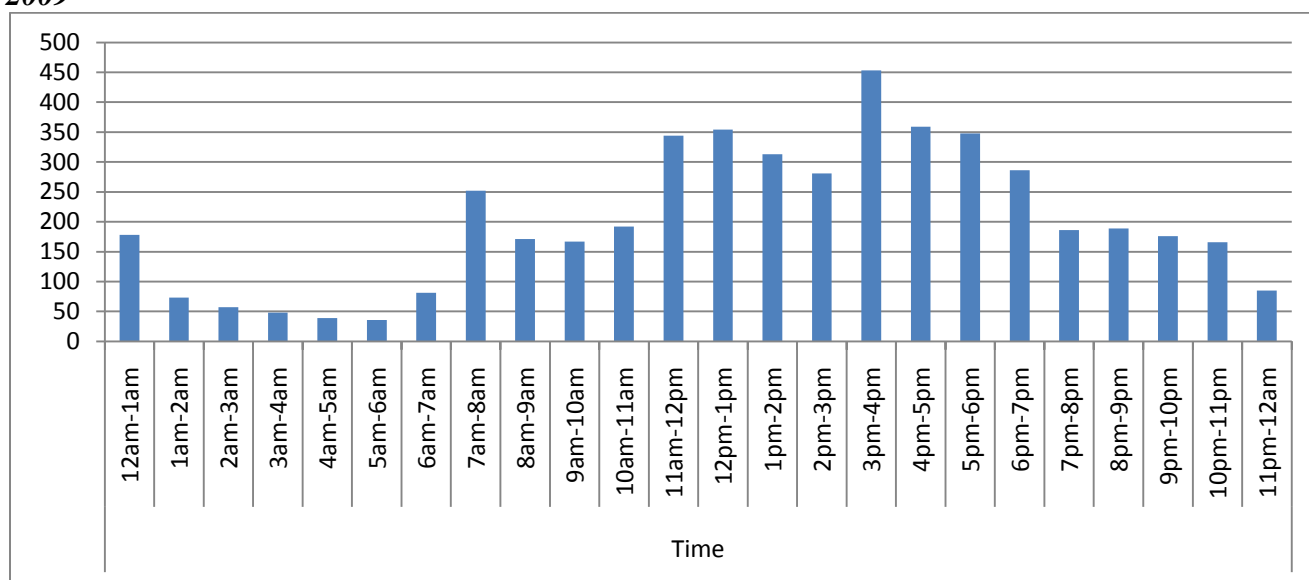
No observable trend or pattern occurred in number of crashes occurring each year. The numbers of crashes occurring each year averaged 302, with the fewest in 2004 and the most in 2007. 250 (5.2%) crashes occurred in 2004, compared to 345(7.1%) in 2007. Number of reported crashes was within 2 standard deviations of the mean for all years.

The number of reported crashes was within 2 standard deviations of the mean for all months except December. The number of crashes reported each month averaged 392 with the fewest in April and the most in December. Fewest crashes 314(6.5%) occurred in April and the highest number in December 559 (11.6%).

Number of crashes was within 2 standard deviations of the mean for each day of the week. The most crashes occurred on Friday and the fewest number on Sunday. A total of 862 (18.4%) crashes occurred on Fridays compared to 416 (8.9%) crashes occurring on Sundays.

Variation existed in number of motor vehicle crashes occurring during each hour of the day (figure 2). The highest number of crashes occurred between 11am-7pm, with the highest number occurring during the 3 o'clock afternoon hour.

Figure 2: Hourly distribution of MVCS occurrences, Wind River Indian Reservation: 1994-2009

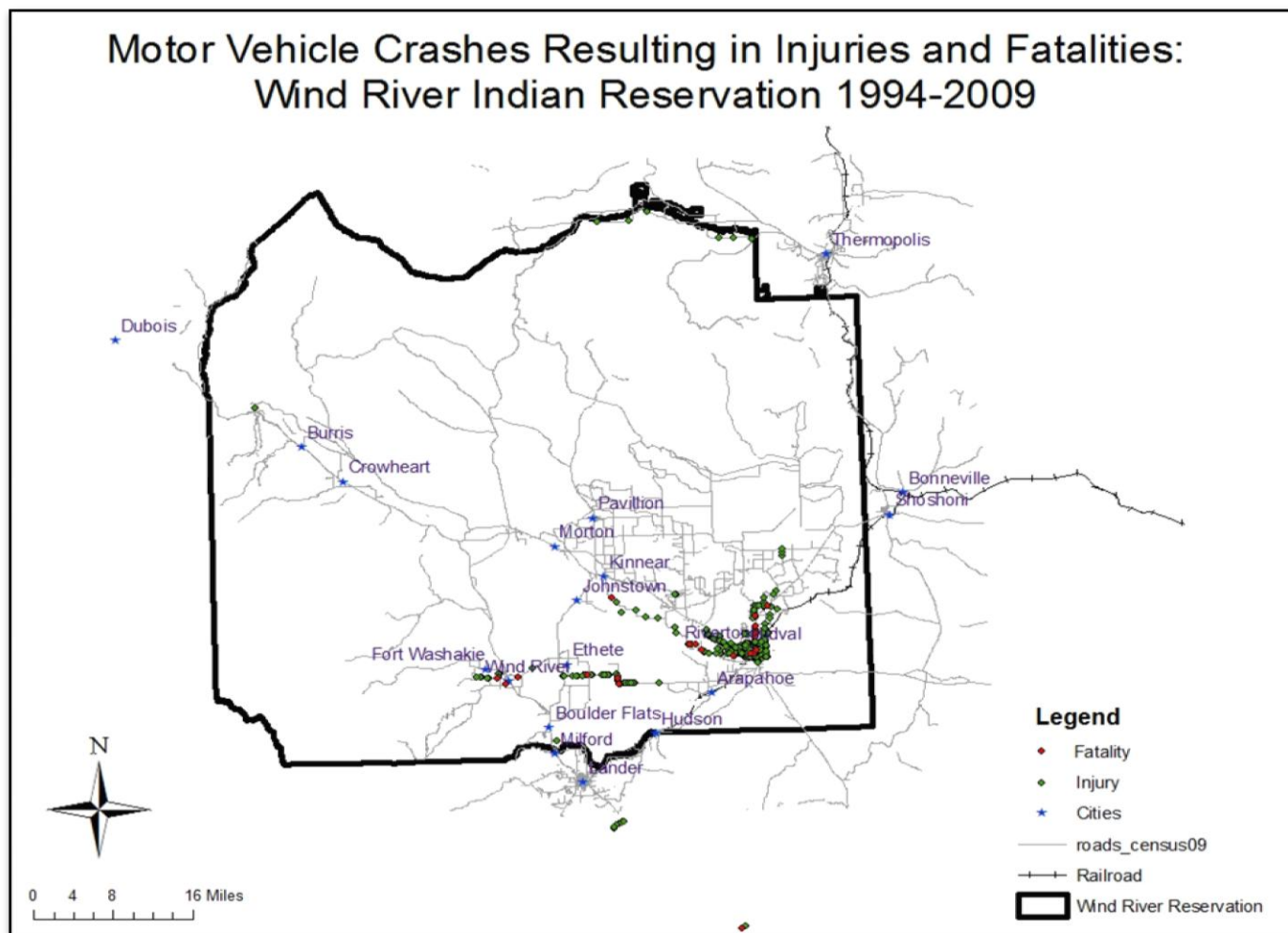


Place

Figure 4 shows the spatial distribution of all crashes resulting in fatality and/or injury. Crashes resulting in one or more fatality are represented by a red dot, and those resulting in one or more injury are represented with a green dot. The majority of crashes occur on Fed/Hwy 789, the reservations busiest road. Few crashes resulting in fatality and/or injury occurred on rural reservation roads. 2,290 (47.9%) of all crashes occurred directly at or were related to an intersection. Of the crashes occurring at intersection 1,514 (42.6%) crashes occurred at a 4-way intersection, 640 (18.0%) at a T intersection, and 63 (1.7%) at a Y intersection.

A total of 3,641(75.3%) crashes occurred on dry roads, 881 (18.2%) crashes on snowy/icy roads, 262 (5.4%) crashes on wet roads, and 50 (1.03%) crashes occurring on unknown road conditions.

Crashes occurred during a variety of different lighting conditions 3,452 (71.0%) crashes took place in the daylight, 119 (2.5%) during dusk, 50 (1.03%) during dawn, and 1,177 (24.3%) during times of darkness.



Discussion

No significant reduction in number of crashes occurred within reservation boundaries between 1994 and 2009. 40.75% all crashes occurring in drivers less than age 26, with seat belts only used by 7,243 (58.2%) individuals. Those not wearing seatbelts exhibit a higher fatality risk (OR= 10.0, 95% CI= 3.8- 26.48¹) It is recommended better driver education for youth and consistent use of seatbelts be enforced on Wind River Indian Reservation.

In the United States, teen drivers are 4 times more likely than adults to be involved in a motor vehicle crash (9). As with the rest of United States' population, crashes on Wind River Indian Reservation are most frequent in teenagers, with less involvement in young children and those ages 26 and older. Many factors that contribute to motor vehicle crashes and injuries among teens including: inexperience, distractions, night time driving, and not using safety restraints (9).

The high proportion of crashes among teens on Wind River Indian Reservation, suggests the need for drivers training programs for teenagers. Currently, no law mandates residents of the reservation to have a driver's license to operate a motor vehicle. Reducing the number of young unskilled drivers on the road might be achieved by passing and enforcing a minimum driving age law and implementing a graduated driver licensing (GDL) program. This 3 stage program requires young drivers to display responsible driving prior to receiving a complete driver's license (10). Among 16 year olds, GDL programs have been associated with a 38 %reduction in fatal crashes and 40% reduction in crashes resulting in injury (9).

Low seat belt use existed, with only 7,243 (58.2%) individuals reporting use. Currently no seat belt laws or punishments are given to individuals not wearing seat belts on Wind River

reservation. Tribal leaders and law enforcement should encourage reservation resident to use seatbelts when traveling in a vehicle. Tribal leaders could potentially reduce death by as much as a third or more if safe driving and seat belt use were encouraged, while drunk driving was further discouraged (5).

One way to address seat belt use is by passing a primary seat belt law. This safety intervention has shown positive results on many Indian Reservations throughout the country. The Tohono O'odham Nation located in southeastern Arizona saw a 47% increase in seat belt use by drivers and a 62% increase in seat belt use among passengers just 3 years after implementing a primary seat belt law on the reservation. Both media campaigning and enforcement by tribal police were used to enforce the law (9).

This study has several limitations. The information utilized was obtained from the WDOT, and contained a large amount of unknown and missing data. Due to incomplete data we could not use advance statistical methods in our analysis. We could only report general characteristics and trends of motor vehicle crashes. We also relied on existing data that had been collected by WDOT. We were not able to evaluate accuracy in data collection.

Potential information bias is present in the data. Occupation, age of passengers, seat-belt use, and alcohol use, were all self-reported. Data reflects information collected at the crash scene by the investigating officer.

The creation of a motor vehicle crash surveillance system would be helpful on Wind River Indian Reservation. Crash reports given to WDOT contain missing data that restrict the use of advance statistical methods in analyses. Various organizations such as Indian Health Service,

Tribal Leaders Counsel, and Tribal Law enforcement should collaborate to develop reporting systems that increase the completeness of data on crashes.

This study gained a better understanding of MVC characteristics on Wind River Indian Reservation. The high proportion of teenagers involved in crashes, and low seat belt use on the reservation should be addressed by the tribal council and reservation law enforcement. Two interventions that have yielded positive results in these areas are primary seat belts laws and GDL. Steps should be taken to reduce the disparities in motor vehicle death and injury rates that exist between AI/AN populations and the U.S. population.

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Chapter 4: Conclusion and Recommendations:

Action should be taken to reduce disparities in motor vehicle death and injury rates that exist between AI/AN populations and the U.S. population. With interventions designed specifically to address a reservations needs, it is possible to reduce motor vehicle injury and death rates. This was made apparent in programs introduced to 4 tribes by the CDC's Injury Center. The CDC's injury prevention center successfully increased both seat belt and child safety seat use, and decreased alcohol-impaired driving on Tohono Nation, Ho-Chunk Nation, White Mountain Apache Tribe, and San Carlos Apache Tribe (16).

It is necessary to look at each reservation independently when identifying appropriate interventions to be implemented. This is important due to varying access to technology, laws, geography, age distribution, and cultural beliefs between reservations in the US. I would recommended trends in MVCs be evaluated at the reservation level before implementing programs targeting prevention of injury related to MVC. This information will assist tribal leaders and IHS in adapting interventions that best fit the need of the population.

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Appendix A: IRB Exemption Letter



EMORY
UNIVERSITY

Institutional Review Board

March 7, 2011

Anne Kenney
Rollins School of Public Health
Emory University

RE: Determination: No IRB Review Required
Examining Motor Vehicle Crashes: Wind River Indian Reservation 1994-2009
PI: Anne Kenney

Dear Ms. Kenney,

Thank you for requesting a determination from our office about the above-referenced project. Based on our review of the materials you provided, we have determined that it does not require IRB review because it does not meet the definition of research involving "human subjects" or the definition of "clinical investigation" as set forth in Emory policies and procedures and federal rules.

Specifically, in this project, you will be using a dataset provided by the Indian Health Service (IHS) to examine the impact of motor vehicles crashes on the indigenous population and to identify possible interventions to address excess morbidity and mortality resulting from those crashes. As the dataset does not contain identifiable information, this research does not involve human subjects as defined in 45 CFR 46.102(f)(1)(2).

This determination could be affected by substantive changes in the study design. If the project changes in any substantive way, please contact our office for clarification.

Thank you for consulting the IRB.

Sincerely,

Sean Kiskel
Research Protocol Analyst
Emory University IRB