CHARACTERISTICS ASSOCIATED WITH MOTOR VEHICLE RESTRAINT USE IN AMERICAN INDIAN CHILDREN: AN ANALYSIS TO GUIDE MEANINGFUL INTERVENTIONS

by

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CERTIFICATE OF APPROVAL

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ABSTRACT

Objective: To determine child, driver, and vehicle characteristics associated with proper, incorrect, and non-restraint use among Northwest American Indian children traveling in motor vehicles.

Background: Injuries are the leading cause of death for American Indian and Alaska Native (AI/AN) children and adults age 1-44. AI/AN children have the highest motor vehicle injury mortality rate of any race or ethnic group in the United States. AI/AN children are 3.8 times more likely to die from a motor vehicle injury than all races children. There is overwhelming evidence that child safety seats are effective at reducing injury when used properly, however, restraint use among AI/AN children in the Northwest has not been well established.

Methods: This project utilized data from the 2003 Northwest Tribal Child Safety Seat Project, a cross-sectional observational study conducted in six Northwest tribes. Drivers of vehicles with child passengers were observed for driver and child restraint use, and drivers were asked child's age, weight, vehicle characteristics, and their opinions about child safety seat use. Children in the dataset were classified as being properly, incorrectly, or unrestrained based on reported age and weight and according to recommendations from the American Academy of Pediatrics and the National Highway Traffic Safety Administration (NHTSA). Data were analyzed using three binary logistic regression models comparing each child restraint category: properly restrained vs unrestrained, incorrectly restrained vs unrestrained, and properly restrained vs incorrectly restrained. Regression models were adjusted for clustering of children in a vehicle using a generalized estimating equation (GEE) method.

Results: Of 775 children age 1-8 years, 29 percent were properly restrained, 30 percent were incorrectly restrained, and 41 percent were completely unrestrained in the vehicle. The strongest associations with proper child restraint use, rather than no restraint use, were seat eligibility (Odds Ratio [OR] for infant seat vs booster seat: 25.1; OR for child seat vs booster seat: 8.7), driver seat belt use (OR: 6.5), and driver relationship to the child (OR for parents vs non-parents: 3.9). Being subject to a state seat belt law was associated with both proper (OR: 4.4) and incorrect restraint use (OR: 6.6), rather than no restraint use, compared to children riding in areas with no law. Being subject to a tribal seat belt law was also associated with incorrect restraint use (OR: 2.4), rather than no restraint use, compared to children riding in areas with no law. The three factors that were differently associated with proper and incorrect restraint use were the child's seat eligibility (OR for infant seat vs booster seat:15.7; OR for child seat vs booster seat: 7.5), seating position (OR for rear-outboard seated vs front seated: 1.9), and whether or not the child was riding with his or her own parent (OR for parents vs non-parents:2.9).

Conclusions: AI/AN children are at risk for incorrect and non-use of motor vehicle restraints. Understanding barriers and facilitators to the use of child passenger restraint systems in tribal communities can guide prevention efforts for American Indian communities across the United States. Such interventions might include strategies to get all occupants (adults and children) to use proper restraints; stressing importance of regular use, even for short trips; increase availability of proper seats for all vehicles that children ride in regularly; include training on proper use, not only for parents, but all regular caregivers.

BACKGROUND AND SIGNIFICANCE

Health Disparities in Preventable Injuries in American Indian Populations

Injuries are the leading cause of death and years of potential life lost for AI/AN children and adults age 1 – 44 years old. Injuries account for 75 percent of all deaths among American Indian and Alaska Native (AI/AN) children and youth, and AI/ANs have an overall injury-related death rate that is twice the U.S. rate for all racial/ethnic populations [1]. Motor vehicle injuries accounted for 54 percent of unintentional injury deaths among AI/ANs from 1999-2004 [2]. AI/AN children have the highest motor vehicle injury mortality rate of any race or ethnic group in the United States [3]. The Centers for Disease Control and Prevention (CDC) estimates that for AI/AN children age 8 years and younger, death rates from motor vehicle crashes are three times the national average [2]. The Indian Health Service (IHS) estimates the risk to be even higher among its service users, with a motor vehicle death rate of 19.7 per 100,000 for children age 1-4, compared to 5.2 deaths per 100,000 persons for all races children. This translates to a 3.8 fold risk for AI/AN children compared to all races children (see Table 1). The unintentional injury death rate is highest among AI/ANs age 15-24 with an adjusted rate of 86.2 deaths per 100,000 persons. The disparity in unintentional injury deaths persists for AI/ANs of all ages, with the greatest difference in the 45-54 year age group. AI/ANs age 45-54 have an unintentional injury death rate six times higher than the U.S. all races rate for the same age group.

Motor vehicle injuries are also a significant cause of morbidity for AI/ANs. Because injury morbidity data is not uniformly collected across states, it is more difficult to track than fatality data. Some national injury morbidity data are available, but the data are not race specific. In 2004, the National Highway Traffic and Safety Administration estimated that for every traffic fatality, another 65 persons were injured from motor vehicle crashes [4]. If this ratio is true for the AI/AN population, then based on motor vehicle mortality data from the National Center for Health Statistics [2] we estimate that 52,180 AI/ANs were injured in a motor vehicle crash in 2004. One study conducted in Washington State found that AI/ANs have experienced a nearly two-fold higher rate of motor vehicle injury hospitalization compared to all residents of Washington State [5].

Table 1. Age-Adjusted All Unintentional Injuries Death Rates, IHS Areas, 1996-1998

	American Indian & Alaska Native				U.S. All Races	U.S. White	Ratio[1] of AI/AN to:	
	Number		Rate[2]					
	Actual	Adjusted[1]	Actual	Adjusted[1]	Rate	Rate	U.S. All Races	U.S. White
Age 1-4	69	76	17.9	19.7	5.2	4.9	3.8	4
Age 5-14	94	103	10.6	11.7	5.4	5.3	2.2	2.2
Age 15-24	500	629	68.6	86.2	29.5	31.1	2.9	2.8
Age 25-44	746	881	61.2	72.4	17.5	17.3	4.1	4.2
Age 45-54	171	194	52.6	59.6	10	13.6	6	4.4
Age 55-64	95	104	42.5	46.5	14.6	14.4	3.2	3.2
Age 65 +	80	83	34.1	35.4	22.7	22.8	1.6	1.6

Source: Trends in Indian Health, 1998-1999. Indian Health Service, 2001.
[1]Adjusted to compensate for misreporting of American Indian/Alaska Native race on death certificate
[2] Age-adjusted rate per 100,000 population.

Nationwide, great strides have been made in preventing motor vehicle injuries [6]. The motor vehicle occupant fatality rate per 100,000 population declined by 22.7 percent from 1975 to 1992, and decreased by 1.9 percent from 1992 to 2004. The motor vehicle occupant injury rate per 100,000 population declined by 13.6 percent from 1988 to 1992, and decreased by 20.3 percent from 1992 to 2004 [4]. Child passenger fatality rates have fallen from nearly 3,000 child deaths per year in 1990, to 2,604 deaths in children under 15 years of age by 2004 [4]. While these national improvements are encouraging, the decline is not being seen in AI/AN children, resulting in a widening disparity between AI/AN motor vehicle child occupant fatalities and all races fatalities [3]. In fact, occupant mortality among young AI/AN children aged 1 to 4 years showed a tendency toward increased mortality in 2001-2003 compared to the 1999-2001 rates.

Age-appropriate Child Passenger Restraint Systems

The national reduction in child occupant injury is in part attributable to "passive" strategies to make cars and roads safer. Other improvements in car passenger safety have come through "active" measures, requiring an occupant to actively participate in his own safety. Three decades of research into motor vehicle occupant safety have demonstrated that the single most important protective factor is appropriate use of seat restraints. We know seat belts and child car seats work extremely well [7]; appropriate use of restraints can reduce the risk of death in a crash by as much as 62-73 percent [8, 9] as well as reduce hospitalizations among children who are passengers in cars involved in motor vehicle crashes [7].

Despite child safety seat laws present in all 50 states, many children are still inappropriately restrained. Studies have shown that even when child restraint systems are used, 51 percent–82 percent of infant car seats and 30 percent of booster seats are improperly used, including incorrect installation or incompatibility of the seat with the child's physical characteristics (height, weight, and age) [10].

National Highway Traffic Safety Administration (NHTSA) recommendations (see Table 2 on page 5) state that infants from birth to 1 year old who weigh less than 20 pounds should travel in a rear-facing infant-only seat, or a convertible seat used in the rear-facing position. Children age 1 to 4 years weighing at least 20 to approximately 40 pounds should travel in a forward facing child harness seat. Children should use a harness seat until they are 4 years old and weigh more than 40 pounds, although some newer models have upper limits of 60-65 pounds. Belt-positioning booster seats are designed for children who have outgrown harness-type child restraint devices but are still too small to fit well in an adult lap and shoulder belt. Children who are between 4-8 years of age, weigh between 40 and 80 pounds, or with height less than 4'9" do not fit well into an adult seat belt [11, 12]. Data from mechanical sled tests [11, 12], computer crash simulations [13], and the available epidemiological data [14], all suggest that booster seats are protective for children who do not yet fit into seat belts. Yet despite recommendations of safety experts, only 6 to 30 percent of these children are using booster seats [13, 15-19]. Booster seats are the newest of the child passenger restraint technologies. It is likely that early adopters of booster seats have been parents for whom lack of knowledge alone was a barrier to booster use. Most parents likely face multiple barriers to consistent booster seat use, including child resistance, inconvenience, and cost [9, 13].

Incorrect Seat Belt Use

Although seat belts are better than no restraint at all, adult seat belts usually do not fit children properly. For best protection, children should use age and weight-appropriate restraints for every trip, and all children age 12 and under should ride in the back seat of the vehicle. Children who should be in forward facing harness seats or booster seats but are restrained only with adult lap/shoulder belts face a 3.5-fold increased risk for serious injury in the event of a motor vehicle crash [20]. Compared with seat belts, child restraints, when not seriously misused (e.g., unattached restraint, child restraint system harness not used, 2 children restrained with 1 seat belt) are associated with a 28 percent reduction in risk for death (relative risk, 0.72; 95 percent confidence interval, 0.54-0.97) in children aged 2 through 6 years after adjusting for seating position, vehicle type, model year, driver and passenger ages, and driver survival status. When cases of serious misuse were included, the effectiveness estimate was slightly lower (21 percent) (relative risk, 0.79; 95 percent confidence interval, 0.59-1.05). Based on these findings as well as previous epidemiological and biomechanical evidence for child restraint system effectiveness in reducing nonfatal injury risk, efforts should continue to promote use of child restraint systems through improved laws and with education and disbursement programs [21].

Table 2. Recommended Child Passenger Restraint Guidelines

	Buckle Everyone. Seat children age 12 and under in the back seat.		
	Infants (Birth – 1 Year)	**Toddlers (1 – 4 Years)**	**School-Age Children (4 – 8 Years)**
Recommended Weight Requirements	Up to 20 pounds; if an infant is >20 pounds, use a seat that is labeled for rear-facing use up to 30 pounds.	Over 20 pounds and up to 40 pounds; if a toddler is <20 pounds, use a rear-facing child safety seat.	Over 40 pounds and up to 80 pounds, under 4'9"; if a school-age child is <40 pounds, use a forward-facing child safety seat.
Type of Seat	Infant only or rear-facing convertible	Convertible or forward-facing harness seat	Belt positioning booster seat
Seat Position	Rear-facing only	Can be rear-facing until 30 pounds if seat allows; generally forward-facing	Forward-facing
Notes	Children should use rear-facing seat until one year of age **AND** at least 20 pounds. Harness straps should be at or below shoulder level.	Harness straps should be at or above shoulder level. Most seats require harness straps to be in top slots for forward-facing use.	Belt positioning booster seats must be used with **both** lap and shoulder belt. Shield booster seats are not recommended.
Key safety tips	*Never* place an infant in the front seat of a vehicle with a passenger air bag. A rear-facing seat spreads crash forces over an infant's entire body, minimizing injury to the delicate brain and spinal cord.	Children in forward-facing child safety seats should never sit in the front of a vehicle with a passenger air bag. Properly installed forward-facing CSSs minimize the risk of head and brain injury by reducing head movement in a crash.	The purpose of a belt-positioning booster is to position the child so that the adult seat belt will fit optimally across the child's hips and chest. The lap belt must fit low and tight across the hips, and the shoulder belt must fit over the shoulder and snug across the chest to avoid abdominal injuries.

Source: National Highway Traffic Safety Administration, American Academy of Pediatrics.
For current best practice child restraint use guidelines, see AAP recommendations at: http://www.aap.org/policy/re0116.html.

Booster seats with a plastic shield placed in front of the child are not recommended for children of any age. Investigators have reported that compared to children restrained in forward-facing child safety seats, children in shield booster seats suffered more serious injuries, had longer hospital stays, higher acute care charges, and poorer outcomes. Shield booster cases also had a higher frequency of severe injury to the abdomen/pelvic region and to the thoracic cavity [22]. For these reasons, shield boosters are no longer being manufactured, although many shield boosters are still in circulation. Parents and other drivers need to be made aware that shield boosters are not as safe as belt positioning boosters and forward-facing child safety seats.

Passenger Restraint Laws

All 50 states in the U.S. have child passenger restraint laws, and every state except New Hampshire has an adult motor vehicle restraint law [23]. Many states have separate laws for children and drivers, and enforcement may be primary or secondary. Primary enforcement allows a law enforcement officer to stop a vehicle and issue a citation when the officer observes an unbelted driver or passenger. Under secondary enforcement, a citation can be written only after the officer stops the vehicle or cites the offender for another infraction. Passenger restraint laws in the three Northwest states (Idaho, Oregon and Washington) at the time of this publication (2007) are outlined in the following paragraphs.

Idaho's child passenger safety law, specified in Idaho code 49-672, requires that all children 6 years of age or younger be properly restrained in an appropriate child safety restraint. This is a primary law and the fine is $60. The language of the law does not define "appropriate child safety restraint," but the Idaho Transportation Department website specifies that "an appropriate child restraint is a child safety seat for children up to 40 lbs and a belt- positioning booster seat for children 6 years or younger. Lap-belt only seating positions should not be used with a booster seat." [24] The law took effect July 1st, 2005. For older children and adult passengers and drivers, the Idaho law (Idaho code 49-673) is a secondary law with a $10 fine [24]. Before 2005, the Idaho State law did not require booster seat use. The law required child safety seat use for children less than four years old weighing less than 40 pounds.

Oregon law (ORS 811.210 - 811.225) requires that all motor vehicle operators and passengers be properly secured with a safety belt or safety harness. Child passengers must be restrained in approved child safety seats until age four or forty pounds. A child who is at least four years of age and under six years of age or weighs between 40 and 60 pounds must be properly secured with a child safety system that elevates the person so that a safety belt or safety harness properly fits the person. "Proper fit" means the lap belt of the safety belt or safety harness is positioned low across the thighs and the shoulder belt is positioned over the collarbone and away from the neck. The child safety system must be designed for children weighing between 40 and 60 pounds. A child who is at least six years of age and weighs 60 pounds or more must be properly secured with a safety belt or safety harness. Failure to properly use safety belts or child restraints is subject to a $97 fine. Both the adult law and the child passenger restraint law are subject to primary enforcement [25]. The Oregon State law did not require booster seats until September 1, 2005. Prior to that, the law only required children less than age 4 and less than 40 pounds to use a child safety seat.

Effective June 1, 2007, Washington State has implemented a child passenger restraint law (RCW 46.61.687) that closely approximates the recommendations set by NHTSA and the American Academy of Pediatrics (see recommendations in Table 2 on page 5). Infants need to remain rear facing until one year or 20 lbs. Children ages one to four (or 20 - 40 lbs) are required to ride in forward facing child safety seats. A child must be restrained in a child restraint system until the child is eight years old, unless the child is four feet nine inches or taller. Children under age 13 are required to ride in the back seat of a vehicle if practical. All vehicle occupants must be properly restrained in all seating positions. Both the adult and child passenger restraint laws are subject to primary enforcement with a fine of $101 [26]. The previous law, which went into effect July 1, 2002, had the same requirements for children age 0 – 4 years, but booster seats were only required for children up to age six or 60 lbs. The old law did not require children to be seated in the rear of the vehicle. Before July 27, 2003, the fine for not using a seat belt was $86 [26].

Table 3. Child Passenger Restraint Laws in Northwest States in Both 2003 and 2007

	Law in effect in 2003		Law in effect in 2007	
State	**Child Safety Seat Required**	**Max Fine**	**Child Safety Seat Required**	**Max Fine**
Idaho	<4 yrs or <40 lbs	$60	CSS: <4 yrs or <40 lbs Booster: <6 yrs	$60
Oregon	<4 yrs or <40 lbs	$94	CSS: <4 yrs or <40 lbs Booster: <6 yrs OR <60 lbs	$97
Washington	Rear-facing: <1 yr or <20 lbs CSS: 1-4 yrs or 20-40 lbs Booster: <6 yrs or <60 lbs	$101 effective July 2003, previously $86	Rear-facing: <1 yr and <20 lbs CSS: 1-4 yrs or 20-40 lbs Booster: <8 yrs or <4'9" tall Children < 13 must ride in rear seat if practical	$101

Source:NHTSA Motor Vehicle Occupant Protection Facts, Appendix C. Available at: http://www.nhtsa.dot.gov/people/injury/airbags/OccupantProtectionFacts/appendixc.htm. Accessed May 4, 2007.
Idaho Transportation Department Child Safety Seat Information: http://itd.idaho.gov/ohs/ChildSafety/index.html. Accessed May 4, 2007.
Oregon State Department of Transportation Seat belt restraint laws. http://www.oregon.gov/ODOT/TS/safetybelts.shtml#Seatbelt_Child_Restraint_Laws. Accessed May 4, 2007.
Washington State Legislature child passenger restraint. http://apps.leg.wa.gov/RCW/default.aspx?cite=46.61.687 Accessed May 4, 2007.

Passenger Restraint Use by American Indian Children

American Indians (AI) comprise 1.5 percent of the U.S. population, with approximately 45 percent residing on tribal lands and 55 percent in urban areas [27]. Although age-appropriate child passenger restraint systems can substantially reduce the risk of injury when properly used, less is known about child passenger restraint use among AI children, or reasons for non-use or inconsistent use. Given that AI families tend to be economically disadvantaged, with 31.6 percent [28] of AI living below the federal poverty level (compared to 13.1 percent for U.S. all-races), many families face financial barriers to obtaining child safety seats. There may be other unique issues (e.g. cultural, geographical, political, legal) that also hinder child passenger restraint use among AI parents and care providers who reside in tribal communities. For example, in some rural communities, there may be very few retailers that carry safety seats, making access for AI/AN difficult.

The National Highway Traffic Safety Administration (NHTSA) and the Bureau of Indian Affairs (BIA) Indian Highway Safety Program, established the first baseline tribal reservation safety belt use rate (excluding Navajo) in 2004. In the study, the overall safety belt use rate was 55.4 percent, ranging from a low of 8.8 percent to a high of 84.8 percent by reservation. In reservations with a primary safety belt law, 68.6 percent of vehicle occupants were belted, compared to 53.2 percent on reservations with secondary safety belt laws, and only 26.4 percent on reservations with no seat belt law. Seat belt use was higher for drivers (rather than passengers), females, vehicles traveling within towns, and for vans, SUVs, and passenger cars. Seat belt use was lower for males, vehicles driving on rural arterials, and pickup trucks [29].

Phelan, Khoury, Grossman et al documented that enactment and enforcement of child restraint laws is an effective injury prevention effort for Navajo children [30], however, enforcement of laws on reservations is variable, and depends on tribal agreements with state authorities. Tribes can choose to enact their own laws, adopt state laws, or have no laws pertaining to passenger restraints. In addition, tribal or state police may be responsible for enforcing passenger safety laws within reservation boundaries.

In 2002, after the passage of a primary restraint law in Washington State, two Portland Area reservations reported an increase in restraint use. Observational surveys on the Warm Springs Reservation indicated that restraint use increased from 16 percent to 46 percent among drivers and from 12 percent to 36 percent among passengers. The Yakama Nation passed a primary law in 2001. Observational surveys in 2002 indicated that restraint use continued to increase since the law went into effect. Restraint use was reported at 62 percent [31].

Motor vehicle restraint use among AI/AN children in the Northwest has not been well established. The NHTSA and BIA study cited previously [29] included three Northwest tribes, but seat belt use specific to these communities was not reported, and restraint use among children was not evaluated. A community child passenger safety assessment conducted among three Northwest tribes in 2002 illustrated that car seat use among children from birth to 4 years of age ranged from 12 to 21 percent by tribe. Car seat use among infants (71 to 80 percent) exceeded use among children ages 1-4 years (5 to 14 percent) [32]. Restraint use among children age 5 and older was not evaluated and no detailed information about the proper use of seats was provided.

Knowledge of Barriers and Facilitators from Prior Studies

Nationally, demographic characteristics associated with seat belt use include age and income [33]. The American Indian population is both younger and has a higher risk for poverty than the U.S. all races population, contributing to a disproportionate risk for seat belt non-use. According to the 2000 Census, 28.4 percent of individuals and 35.5 percent of children 18 years and under residing on reservations or tribal lands live below the federal poverty level [27]. For the general U.S. population, 12.4 percent of individuals and 16.1 percent of children 18 years and under were living in poverty [15]. In 2000, the

American Indian median age was 29 years, compared with 35 years for the general U.S. population [27].

Previous studies on child safety seat use have reported generally higher percentages of use among infants and toddlers compared to older children [10, 13, 34]. Several factors were related to the frequency of child safety seat use. A positive relationship between driver seat belt use and child safety seat use was reported in several studies [13, 34]. Compared to non-family members, parents or other family members were more likely to use child safety seats for child passengers [34]. Child safety seat use was higher when the seat was infrequently removed from the vehicle [35] and higher for children who traveled frequently in the vehicle compared to children who traveled less than once a week [36].

Many public health campaigns have focused on educating parents about child car safety, yet studies consistently find that even parents who know about car restraints may not use them, or may not use them consistently. Other barriers to use of safety seats include a low perceived risk of injury, parent beliefs about the health locus of control, and parenting style. One of the most powerful predictors of child restraint use is parental restraint use, which is both a proxy for a parental belief structures as well as a critical example for both younger and older children [9, 37]. Non-users view injury as a rare event, believing they can keep their child safe by safe driving. Seat belt users feel that crashes may happen even when they have taken all precautions [38]. For older children, their willingness to engage in other risky behaviors also correlates with low restraint use. The parents of unrestrained children tend to perceive high costs of restraint use, including child resistance and "negotiation"(particularly among booster-age children), inconvenience and delays, installation difficulty, and cost [38-40]. For poor families, removing the barriers of cost has had a substantial impact on car seat use [41]. More research is needed, especially in native populations, to understand the belief structures behind the misuse and non-use of child restraints, focusing on modifiable factors that can be incorporated into educational and public health campaigns.

PRELIMINARY STUDIES

THE NORTHWEST TRIBAL CHILD SAFETY SEAT PROJECT (PI: Francine C. Romero, Co-Investigators: Jodi A. Lapidus, Beth E. Ebel, Nicole H. Smith)

From June through July 2003, we conducted a cross-sectional observational study on infant seat, child safety seat, and booster seat use in six American Indian tribes in the Northwest (two each in Idaho, Oregon, and Washington). The study was funded by the Indian Health Service as part of a Native American Research Centers for Health (NARCH) grant.

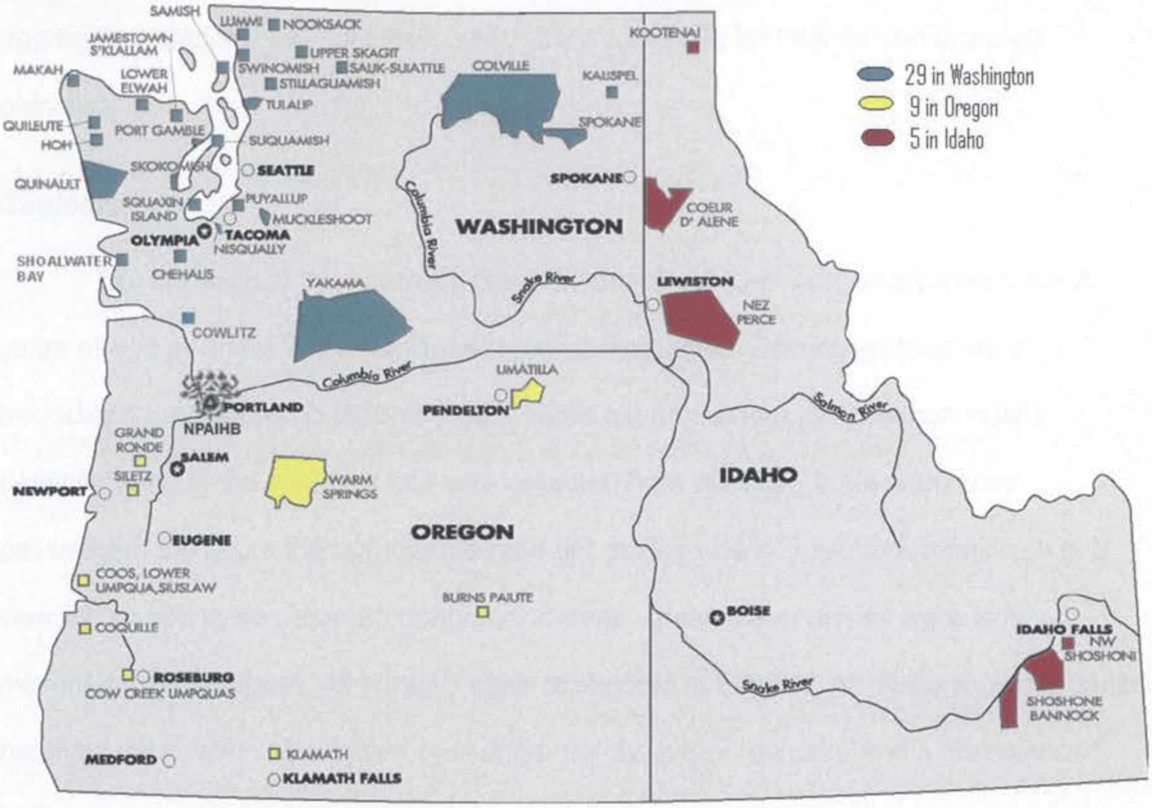
Objectives

The goals of this study were to: 1) estimate the prevalence of appropriate use of child safety seats among American Indian children 8 years and younger in six Northwest tribal communities, 2) determine child, driver and vehicle characteristics associated with appropriate restraint of child passengers, and 3) assess driver knowledge of safety seat guidelines and laws in their communities

Study Population

Two tribes from each of the Northwest Portland Area States (Idaho, Oregon, and Washington) were randomly selected from tribes with >1000 enrolled members. See Figure 1 for a map of the locations of the 43 federally recognized tribes in the Northwest. Four of the six tribes that participated resided on well-defined tribal reservation land, while two tribes did not. The two Oregon tribes were located in small urban clusters within 60 miles of metropolitan areas of the state. Those in Washington and Idaho were rural reservation communities with predominantly American Indian populations. There was significant economic variation among the six tribes; however, all communities had an average per capita income well below the national average, ranging from 47 percent - 87 percent of the U.S. average. Between 12.4 percent and 38.2 percent American Indian households were below the federal poverty level, compared to 12.4 percent of households nationally.

Figure 1. Locations and Names of 43 Federally Recognized Tribes in the Northwest



Tribal and Institutional Approval Processes

Tribal Councils and Health Boards from each participating tribe helped develop study protocols and gave permission to conduct the study on reservation lands. Tribal staff members advised in the choice of observation sites in order to maximize the traffic of vehicles. Since sites included local businesses, elementary schools, and child care centers (5 to 12 sites per tribe), we obtained permission from proprietors or managers at each site to use their parking lots for data collection. Ninety-six percent of businesses and schools contacted gave permission for us to survey drivers entering or leaving their parking lot. Those sites whose owners refused cited perceived dangerous parking situations and prohibitive policy as the reasons for refusal.

Oregon Health & Science University and the Portland Area Indian Health Service (IHS) Institutional Review Boards each independently reviewed and approved this study. Each participating tribe received reports containing their tribe-specific results, plus aggregated data from all six tribes, which they could use for intervention or policy planning.

Subjects

The subjects of this research were drivers of vehicles with child passengers 8 years of age or under in six Northwest tribal communities. Drivers/vehicles were excluded if there were no children age 8 years old or younger of American Indian descent riding in the vehicle. Data was collected from drivers if there were child passengers for whom the appropriate restraint device was difficult to determine (e.g. 9 year old weighing less than 80 pounds); however, these observations were later excluded from analyses. All surveys were conducted in English. All research participants received information about child passenger safety, a free tee shirt, and a Sacajawea dollar after the survey was completed.

Observation Methods

Trained observers approached all vehicles with child occupants as they entered or exited 47 specified sites on 6 reservations, including local businesses, clinics, elementary schools, and child care centers. The sites chosen were ones that most tribal members visited on a regular basis. Observing vehicles at these sites would provide an adequate representation of the community. Observations were conducted during the week (Monday through Friday), usually between 8 a.m. to 6 pm, which is when children in the age range of interest were most likely to be traveling. No identifying information was collected from occupants or vehicles. If the vehicle was entering the parking lot, it was approached before the driver had unfastened his or her seat belt. If the vehicle was leaving the parking lot, it was approached after the driver had the opportunity to secure children and to fasten his or her own seat belt. We attempted to observe every potential vehicle arriving or leaving each site during the observation time frame.

In order to avoid repeat participants and duplicate data in the study we asked each potential participant if they had already been interviewed. We also relied on the familiarity of the tribal project staff members with their community in keeping track of individuals who may have already been interviewed. Once a driver gave verbal consent to participate in the anonymous interview, the goals of the study were explained, and drivers were given a study information sheet. They were asked to confirm their American Indian heritage, and whether there were passenger(s) in the vehicle who were 8 years old or younger. Drivers were asked the age and weight of each child, vehicle model year, and the distance they were from home (in minutes). Trained observers looked into the car to assess seating location and restraint use by the driver and child occupants age 8 years old and younger. Drivers were queried about their reasons for restraint choice and responses were recorded verbatim. Drivers were also asked at what age and weight they felt a child was old or large enough to use an adult seat belt. Drivers' awareness of local child safety seat laws, and interest in attending training on child safety seats were also recorded. For drivers who refused to complete the survey, observers recorded their reason for refusal, gender, and whether the driver was wearing a seat belt.

All responses from the observation and driver survey were recorded on a one-page data collection instrument adapted for this study from previously implemented studies [13, 37]. See Appendix A for a copy of the survey instrument. All observers were systematically trained in proper restraint use for infants and children at Harborview Injury Prevention & Research Center. The principal investigator monitored the quality of the observation process by periodically reviewing observers' technique in the field and providing feedback.

Data Handling

The data was entered into an EpiInfo version 6.4 (Centers for Disease Control and Prevention, Atlanta, GA) database file and then exported into SPSS version 11.5 (SPSS, Inc., Chicago, IL). The data collection forms were returned to the respective tribes for safekeeping in locked filing cabinets. For protection of information, several project procedures were followed: (1) Only project staff members had access to either the filing cabinets or computers; (2) All files on project computers were password protected and accessible only by project staff members; and, (3) All project staff members signed NPAIHB confidentiality statements.

Power

Although child safety seat use in tribal communities may be as low as 30 percent, power calculations were based on a conservative estimate of 50 percent in order to ensure adequate numbers of subjects. At a 95 percent confidence level, we needed to observe 81–88 children to obtain accurate estimates of child safety seat use in a community with 500–1,000 target-age children, allowing for a maximum acceptable difference of +/- 10 percent. To allow for errors in our estimations and to ensure adequate sample size, we observed a minimum of 100 vehicles per tribal community.

RESEARCH DESIGN AND METHODS

This report is a re-analysis of the 2003 Northwest Tribal Child Safety Seat study. The design and methods of the original study are described in the preceding Preliminary Studies section. For more information on the original study, please see the *Northwest Tribal Child Safety Seat Project Final Report* [42], available at http://www.npaihb.org/resources/npaihb_reports/ (accessed April 30, 2007). Also see the journal article entitled *Restraint Use Among Northwest American Indian Children Traveling in Motor Vehicles* published in the American Journal of Public Health, November 2005 [43].

Outcome Variable

Proper restraint status was defined according to the American Academy of Pediatrics and National Highway Transportation Safety Administration (NHTSA) guidelines [44]. A child who should use a rear-facing infant seat was defined as any child <1 year of age (infant seat-eligible). A child between 1-4 years of age and weighing less than 40 pounds was defined as child seat-eligible. A child between 40 and 80 pounds and between 4 to 8 years old was considered booster seat-eligible. Three-year-old children weighing 40 pounds or more were also characterized as being booster seat-eligible, because the majority of child harness seats have a top weight limit of 40 pounds. Children who were over 80 pounds or over 8 years of age were considered to be big enough for the adult lap and shoulder belt and were excluded from this analysis. A child who was using a restraint not recommended for his/her weight and age or was using the recommended restraint incorrectly (shoulder belt behind the arm or back, for example) was classified as incorrectly restrained. A child that was using no restraint device was classified as unrestrained.

Independent Variables

All independent variables in the original data set were included in the preliminary analysis. Additional variables were calculated or recoded from the original data and were also included in the preliminary analysis. All independent variables that were selected for inclusion in the preliminary analysis, with their subcategories and a summary of the recoding that was done, are shown in Table 4.

Seating location of passengers was coded into three categories: front seat, rear center seat, and rear outboard seating position. This is important because the American Academy of Pediatrics recommends that children under the age of 12 be seated in the back seat of a vehicle if possible. In this analysis, children were classified as properly restrained in the front seat if the child was correctly using the recommended seat for his or her age and weight. A child seated in any front seat position of a vehicle, including vehicles with only one row of seating, was classified as being in the front seat. Rear center seats were singled-out because many vehicles only have a lap belt option for center-seated passengers. Vehicle model year was of interest to us because some tribal representatives suggested that we may encounter older vehicles which were not equipped with seat belt restraint systems.

Table 4. Independent Variables: Units of Measure and Summary of Recoding

Variable	Unit of Measure	Description of Recoding
Child Characteristics		
Child age	Years	None
Child weight	Pounds	None
Child Gender	Male Female	None
Seating location of child passengers	Front seat Rear center seat Rear outboard seat	Nine specific seating positions collapsed into three categories
Driver relationship to child	Parent Other	Father, Mother, and Stepparent collapsed into *Parent,* all other relationships (Grandparent, Aunt, cousin, sibling, sitter, neighbor, friend) collapsed into *Other*
Seat eligibility (Recommended restraint)	Rear-facing infant seat Child harness seat Booster seat	Assigned based on reported age and weight of the child
Driver Characteristics		
Driver seatbelt use	Yes No	None
Driver gender	Male Female	None
Perception of a tribal child safety seat law	Yes No Don't know	None
Distance from home	Minutes	None
Vehicle Characteristics		
Model Year	Year	None
Vehicle Type (# rows of seats)	Car (2 rows) Truck (1 row) Van/SUV (3 rows)	None
Number of children in the vehicle eligible for study participation	1 2 3+	Calculated based on number of children that participated the study in each vehicle
Type of law and enforcement	Tribal law/enforcement State law/enforcement No law/enforcement	Created based on discussions with tribal leaders, police, and documentation of existing laws

Specific Aims

Three specific aims were developed and evaluated:

Specific aim #1:

Describe characteristics of American Indian child passengers, drivers, and vehicles surveyed in six Northwest tribes.

Specific aim #2:

Classify children into subgroups by restraint status and describe characteristics of each subgroup of children.

Specific aim #3:

Identify child, driver, and vehicle characteristics that are associated with proper, incorrect, and non restraint use among Northwest American Indian children traveling in motor vehicles.

Statistical Approach

The descriptive phase of the analysis (Specific Aims #1 and #2) was done with *SPSS,* version 14.0 (SPSS, Inc., Chicago, IL). *SAS* version 8.2 (SAS Institute, Inc., Cary, NC) was used to conduct the binary regression modeling with adjustment for clustering (Specific Aim #3).

Specific aim #1:

Describe characteristics of American Indian child passengers, drivers, and vehicles surveyed in six Northwest tribes

Descriptive statistics for child passengers, drivers, and vehicles were calculated, including frequencies and percentages in subcategories of each categorical variable and mean ± standard deviation (SD) for continuous variables.

Specific aim #2:

Classify children into subgroups by restraint status and describe characteristics of each subgroup of children

Children were classified into three subgroups: properly restrained, incorrectly restrained, and unrestrained. Children who were using the restraint recommended for their reported age and weight and appeared to be using the restraint in the recommended position were classified as properly restrained. Children who were restrained using a restraint not recommended for their reported age and weight or using the restraint incorrectly (e.g. lap belt only, shoulder belt behind arm or back) were classified as incorrectly restrained. Children who were not using any type of restraint were classified as unrestrained. We did not include child seating position in our definition of proper restraint, for example, a 2-year-old child properly restrained in a child harness seat was deemed properly restrained even if he was seated in the front seat of the vehicle.

Frequencies and percentages were calculated for each subgroup and cross-tabulated by categorical independent variables. Chi square tests were calculated to ascertain significant differences within subgroups. For continuous variables, means were calculated across restraint status subgroups and a one-way ANOVA was performed to test for significantly different means for normally distributed variables. For continuous variables that were not normally distributed, the nonparametric Kruskal Wallis analysis of variance (rank-based) test was used to test differences across restraint status. Post hoc comparisons were conducted to determine where the differences between restraint categories lied. Tukey's Honestly Significant Difference (HSD) was used for normally distributed variables, and the nonparametric Mann Whitney U was used for non-normally distributed continuous variables.

<u>Specific aim #3:</u>

Identify child, driver, and vehicle characteristics that are associated with proper, incorrect, and non restraint use among Northwest American Indian children traveling in motor vehicles.

Restraint status subgroups were labeled as follows:

Restraint status:	PR	Properly restrained
	IR	Incorrectly restrained
	UR	Unrestrained

The following hypothesis was tested:

Hypothesis: (PR ≠ IR ≠ UR) Different child, driver, and vehicle characteristics are significantly associated with one or more subgroups of child restraint status.

The hypothesis was tested with three separate binary logistic regression models in which the independent variables were regressed on each combination of subgroups of the outcome variable: 'Properly Restrained' vs 'Unrestrained'; 'Incorrectly Restrained' vs 'Unrestrained'; and 'Properly Restrained' vs 'Incorrectly Restrained'. Because more than one child who met study eligibility criteria was in some vehicles we observed, a generalized estimating equations (GEE) method with an exchangeable working correlation structure [45, 46] was used to adjust for the fact that children in the same vehicle are not independent of each other.

The process for building all regression models followed the sequence outlined by Hosmer and Lemeshow in *Applied Logistic Regression* [47]. Univariate analysis of each variable was conducted first, then tribe was entered with each individual factor to adjust for unknown confounders related to culture and/or location. If variables were of known demographic significance or had a p-value <0.25, they were selected for inclusion in the preliminary models. This method of evaluating variables protected against creating unstable estimates by over fitting the model while at the same time allowing for the development of inclusive models that could adequately test the hypotheses.

The choice of variables to retain in the models was verified using manual selection and elimination procedures. Significance of the variables was reassessed by comparing Wald statistics, odds ratios and confidence intervals with those from the univariate and tribe-adjusted models. Reduced models were compared to larger models using the likelihood ratio test. Eliminated variables were added back to the model if they controlled for important characteristics even though not significant at the $p=0.05$ level.

Some variables had categories with small cell sizes which caused the regression models to become unstable. Categories for these selected variables were collapsed to improve the stability of the model. Variable categories were created while considering the usefulness of the categories for tribal intervention planning. Categorical variables were created from continuous variables at various cut points to assess scale. The model was refit with the categorical variables and the estimated coefficients verses the midpoints of the groups were plotted. No parametric forms were suggested by the plot, so the continuous variables were assumed to be linear in the logit.

Confounding and effect modification were assessed and all potential interactions were evaluated. Interactions were included in the final model if the interpretation made logical sense, if the interpretation would be useful for planning education materials and interventions, and if including the interaction did not result in small cell sizes.

RESULTS

Specific Aim #1:

Describe characteristics of American Indian child passengers, drivers, and vehicles surveyed in six Northwest tribes

We received consent from 594 drivers, and recorded information on 806 children traveling with them. This represents 88 percent of all drivers approached during the study time frame. Driver refusal rates differed somewhat by tribe, ranging from 5 to 19 percent.

A total of 775 children (in 574 vehicles) met criteria for infant seat, child seat, or booster seat use. Those excluded from the analysis include children age 8 years old or older, and 6-7 year old children weighing 80 pounds or more. Characteristics of these children, drivers, and vehicles are presented in Table 5. Mean child age was 3.8 years (standard deviation [SD]: 2.2 years); 11 percent of children were less than one year of age, 36 percent were between one and less than four years of age, and most children (53 percent) were between four and eight years of age. Mean child weight was 40 pounds (SD: 16 pounds); 8 percent of children were less than 20 pounds, 41 percent were between 20 and less than 40 pounds, and 48 percent of children were between 40 and 80 pounds as reported by the driver. We recorded information on 366 boys (47 percent) and 405 girls (52 percent). Children were most commonly seated in the rear outboard (53 percent) or rear center seats (15 percent), however, 32 percent of children were front-seat passengers. Based on reported weight and age, 11 percent of children observed were eligible for a rear-facing infant seat, 41 percent were eligible for a forward–facing child harness seat, and 48 percent were eligible for a booster seat.

Table 5. Characteristics of American Indian Child Passengers (n=775 age 8 or under), Drivers and Vehicles (n=574) Surveyed in Six Northwest Tribes

	Percentage or Mean ± SD	n*
Child age (years)		
<1	11.4	88
1-<4	36.1	280
4-8	52.5	407
Mean ± SD	3.8 ± 2.2	775
Child weight (pounds)		
<20	8.4	67
20-<40	41.1	330
40-80	48.3	371
Mean ± SD	40 ± 16	768
Child Gender		
Male	47.2	366
Female	52.3	405
Seating location of child passengers		
Front seat	31.5	244
Rear center seat	14.7	114
Rear outboard seat	53.2	412
Driver relationship to child		
Parent	68.0	527
Other	32.0	248
Recommended restraint, based on age and weight		
Rear-facing infant seat	11.4	88
Child harness seat	40.8	316
Booster seat	47.9	371
Driver seatbelt use		
Belted	50.7	291
Unbelted	48.8	280
Driver gender		
Male	27.4	157
Female	72.6	417
Driving time from home (minutes; mean ± SD)	12 ± 17	573
Model Year		
>2000	17	96
1995 – 1999	30	171
1990 – 1994	30	170
< 1990	23	132
Vehicle Type (# rows of seats)		
Car (2 rows)	79	53
Truck (1 row)	9	69
Van/SUV (3 rows)	12	451

** Some sample sizes (n) are less than 775 due to missing data.*

Almost three-fourths (73 percent) of drivers were female, and, on average, were 12 minutes from home. The median distance from home was five minutes, with reported distance from home ranging from 1 to 150 minutes. Sixty-eight percent of the child passengers were driven by a parent and 32 percent by another relative or friend. Sixteen percent of children were driven by a grandparent or great-grandparent, and 8 percent were driven by an aunt or uncle. The remaining 8 percent of children were driven by a sitter, neighbor, cousin, sibling, or family friend. Fifty-one percent of drivers who consented wore a seat belt. Men and women drivers were equally likely to be wearing a seat belt, with 54 percent of men and 50 percent of women being restrained. Drivers who refused to participate were less likely to be wearing a seat belt than those who consented to participate (31 percent).

Vehicle model years ranged from 1963 to 2003. Although we did not note if a vehicle did not have restraint systems, only eight children (1 percent) were riding in a vehicle manufactured before 1968 when it became mandatory for all vehicles manufactured in the U.S. to be equipped with seat belts [48]. Four percent of children were riding in vehicles manufactured in the 1970s, 15 percent in vehicles manufactured in the 1980s, 30 percent in vehicles manufactured between 1990 and 1994, 30 percent in vehicles manufactured between 1995 and 1999, and 17 percent in vehicles manufactured between 2000 and 2003.

Most children (79 percent) were riding in a car or other vehicle with two rows of seats. Twelve percent of children were riding in a van or sport utility vehicle (SUV) with three rows of seats. Nine percent of children were riding in a truck with only one row of seating.

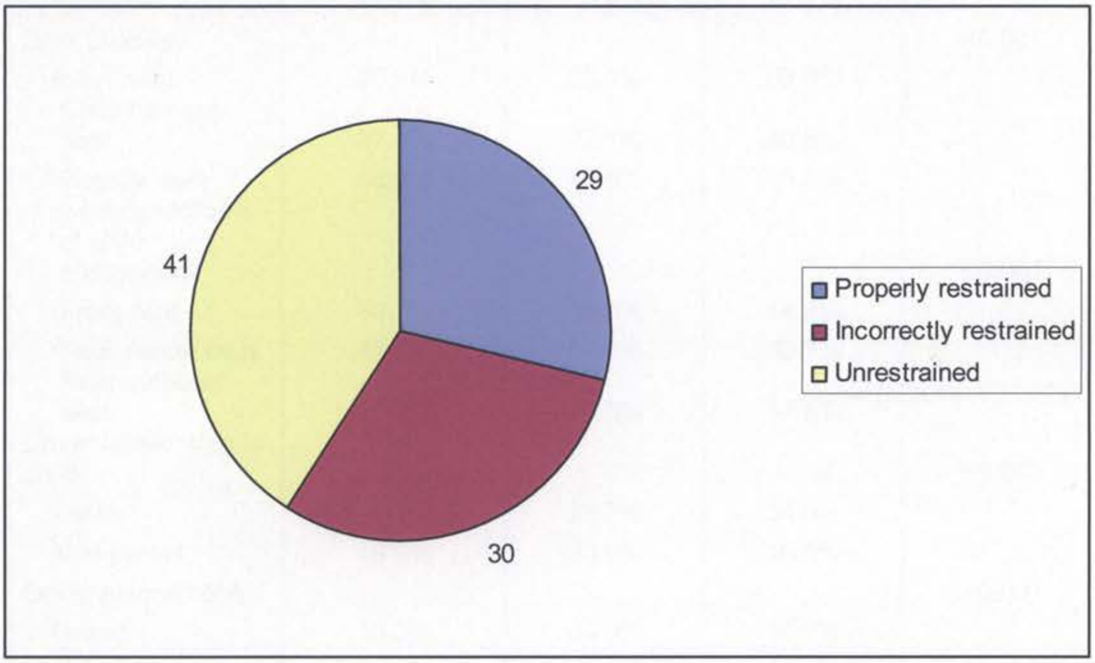
Three of the six participating tribes had enacted laws similar or identical to their respective state passenger restraint laws in 2003, and such laws were enforced by tribal police. Two tribes did not have well-defined or inhabitable lands and drivers were subject to state passenger restraint laws and state, county, or local law enforcement. One tribe had no passenger restraint laws. For an overview of state passenger restraint laws in both 2003 and 2007, see Table 3 on page 8.

Specific Aim #2:

Classify children into subgroups by restraint status and describe characteristics of each subgroup of children

Overall, 29 percent of children were properly restrained, 30 percent were incorrectly restrained and 41 percent were completely unrestrained in the vehicle (see Figure 2).

Figure 2. Percent of Children in Each Restraint Use Category



Chi square tests

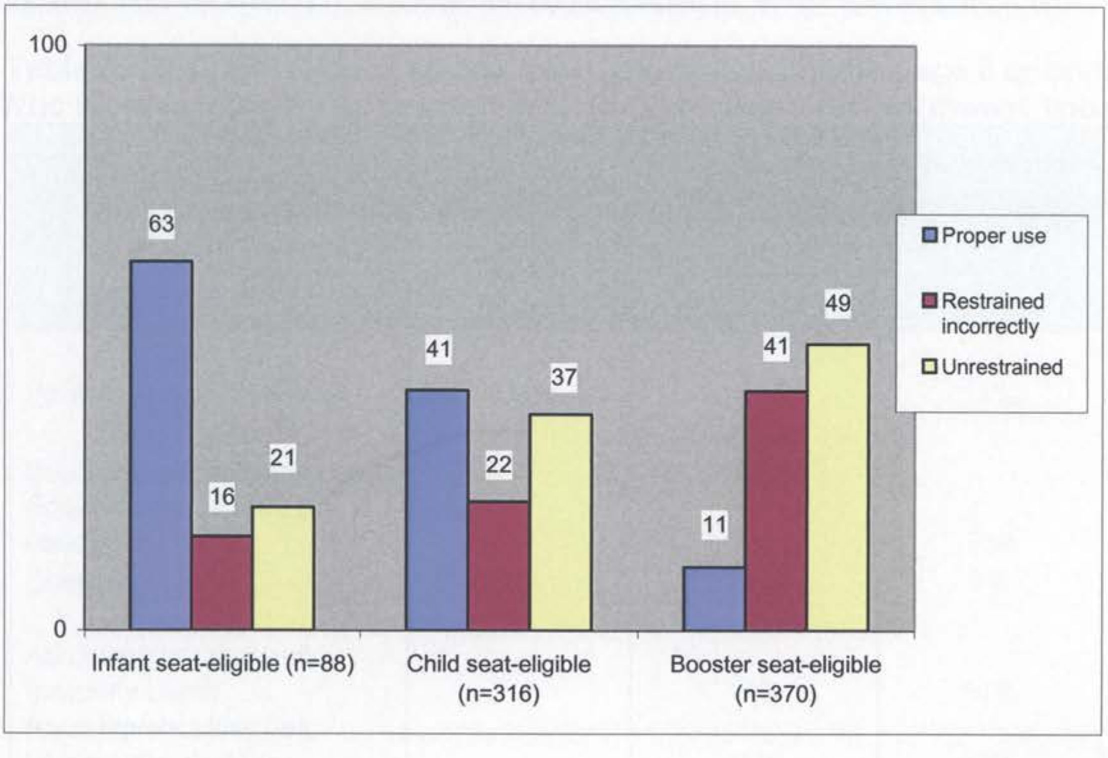
Chi square tests of independence were calculated for each categorical variable by child restraint status. Six categorical variables were significantly associated with child restraint status ($p<0.05$). Seat eligibility, seating location, driver relationship to the child, driver seat belt use, type of vehicle (number of rows of seating), and type of law and enforcement all had significantly different proportions of children by restraint categories. Child gender and driver gender were not associated with child restraint status. See Table 6 for row percentages and Chi Square p-values for each of the categorical variables in the analysis.

Table 6. Row Percentages and Chi Square p-Values

Characteristic	Unrestrained (n=315)	Incorrectly Restrained (n=234)	Properly Restrained (n=225)	Chi Square p-value
Child gender				0.65
Male	39.7%	29.6%	30.7%	
Female	41.7%	30.6%	27.7%	
Seat Eligibility				<0.001
Infant seat	20.5%	15.9%	63.6%	
Child harness seat	37.0%	22.1%	40.8%	
Booster seat	48.6%	40.5%	10.8%	
Seating location of child passengers				<0.001
Front seat	60.7%	25.0%	14.3%	
Rear center seat	42.1%	27.2%	30.7%	
Rear outboard seat	27.9%	34.5%	37.6%	
Driver relationship to child				<0.001
Parent	36.4%	28.7%	34.9%	
Non-parent	49.8%	33.6%	16.6%	
Driver seatbelt use				<0.001
Belted	15.3%	44.0%	40.7%	
Unbelted	67.5%	16.1%	16.4%	
Driver gender				0.323
Male	37.1%	34.1%	28.7%	
Female	42.0%	28.8%	29.2%	
Vehicle Type				<0.001
Car (2 rows)	41.7%	27.9%	30.4%	
Truck (1 row)	54.9%	26.8%	18.3%	
Van or SUV (3 rows)	25.5%	45.5%	29.1%	
Type of law/enforcement				<0.001
Tribal law & enforcement	45.7%	30.2%	24.1%	
State law & enforcement	16.9%	38.2%	44.9%	
No law	69.1%	8.3%	22.7%	

As illustrated in Figure 3, 63 percent of infant seat-eligible children were properly restrained in rear-facing infant seats, 41 percent of child seat-eligible were properly restrained in child harness seats, and only 11 percent of booster seat-eligible children were properly restrained in booster seats. Of infant-seat-eligible children, 21 percent were completely unrestrained. Of child seat-eligible children, 37 percent were completely unrestrained. Booster seat-eligible children were at particular risk for riding unrestrained (49 percent). Sixteen percent of infant-seat eligible children were incorrectly restrained, while 22 percent of child seat-eligible children were incorrectly restrained. Booster seat-eligible children were the most likely to be incorrectly restrained with 41 percent using a restraint incompatible with the child's age and weight or using a booster seat incorrectly.

Figure 3. Percent of American Indian Children Properly Restrained, Incorrectly Restrained, and Unrestrained in Motor Vehicles by Recommended Restraint in Six Northwest tribes



As presented in Table 7, we found that in addition to those riding unrestrained, many other children were prematurely using restraints designed for older or larger children. Among infants less than one year of age who were incorrectly restrained (n=14), 100 percent were prematurely using a forward-facing child seat. Among child seat-eligible children who were incorrectly restrained (n=70), 36 percent had prematurely graduated to a booster seat (with proper belt), and 44 percent were using adult lap and/or shoulder belts (14 percent properly, 30 percent improperly). More than half (54 percent) of 150 incorrectly restrained booster seat-eligible children were prematurely, but properly, using adult lap/shoulder belts. Another 26 percent were using the lap belt only or lap/shoulder belt with shoulder portion behind the back or arm. A small percentage (11 percent) were still in child harness seats, although their weight exceeded the recommended limit for the child seat (40 pounds), and another 7 percent used high or low-back booster seats, but were not using the seat belt correctly. Twenty percent of child seat-eligible and 3 percent of booster seat-eligible children were using shield boosters with the shield on, which is not recommended for either age/weight group.

Table 7. Restraint Misuse among American Indian Children age 8 or under Who Were Incorrectly Restrained in Motor Vehicles in Six Northwest Tribes

	Incorrectly Restrained Infant Seat-Eligible (n=14)	Incorrectly Restrained Child Seat-Eligible (n=70)	Incorrectly Restrained Booster Seat-Eligible (n=150)
Forward facing child seat	100%		11%
Booster seat (properly used)		36%	
Booster seat (incorrectly used)*		0%	7%
Shield booster		20%	3%
Adult lap/shoulder belt (properly used)		14%	54%
Adult lap/shoulder belt (incorrectly used)**		10%	13%
Lap belt only		20%	13%

* Booster seats deemed improperly used because belt was not placed properly.
** Adult lap/shoulder belt deemed improperly used because shoulder belt was behind child's back or arm.

Means

All continuous variables (child age, child weight, vehicle model year, driver age, and distance from home) were significantly associated with child restraint categories (ANOVA or Kruskal Wallis tests p<.05). From post-hoc comparisons (Tukey's Honestly Significant Difference [HSD] for child weight and Mann Whitney U for others) we found that child age and weight were significantly lower for properly restrained children. Vehicle model year was significantly older for unrestrained children and driver age was significantly younger for properly restrained children. Distance from home in minutes was significantly shorter for unrestrained children.

Table 8. Means, SDs, and Test p-Values for Continuous Variables

Characteristic	Unrestrained (n=315)	Incorrectly Restrained (n=234)	Properly Restrained (n=225)	Test* p-value
Child age (years)	4.4 ± 2.1	4.5 ± 2.1	2.2 ± 2.2	<0.001
Child weight (pounds)	43.0 ± 15.6	44.6 ± 14.5	29.2 ± 12.3	<0.001
Vehicle model year	1991 ± 7.6	1994 ± 6.5	1994 ± 5.8	<0.001
Driver age	34.0 ± 13.4	35.0 ± 12.1	31.9 ± 10.6	0.026
Distance from home (minutes)	8.9 ± 11.3	14.4 ± 18.2	15.6 ± 22.3	<0.001

*ANOVA for child weight, Kruskal Wallis test for others
Post-hoc comparisons: Tukey's HSD for child weight, Mann Whitney U for others

Specific Aim #3:

Identify child, driver, and vehicle characteristics that are associated with proper, incorrect, and non restraint use among Northwest American Indian children traveling in motor vehicles.

Hypothesis: (PR $\neq$ IR $\neq$ UR) Different child, driver, and vehicle characteristics are significantly associated with one or more subgroups of child restraint status.

The findings of the multiple logistic regression models support the hypothesis: significant child, driver, and/or vehicle characteristics exist between children who were properly, incorrectly, and unrestrained in the vehicle. Results of all three binary logistic regression models are shown below in Table 9 (page 37).

Properly restrained vs unrestrained

For the properly restrained versus unrestrained multivariate model, the strongest association with proper restraint use was the child's seat eligibility. Infants had 25 times greater odds of proper restraint use, and child seat eligible children 8.7 times greater odds of proper restraint use than booster seat eligible children. The second strongest association with proper restraint use was driver seat belt use. Drivers who were wearing a seat belt had 6.5 times greater odds of having the child passenger properly restrained than drivers who were unrestrained.

Children in rear outboard seats had 5.6 times greater odds of proper restraint use and rear center seated children had 3.4 times greater odds of proper restraint use than children in the front seat. Child passengers riding in areas subject to state seat belt laws that are enforced by state, county, or city police had 4.3 times higher odds of proper restraint use than children riding in areas with no seat belt law or enforcement. Children riding in areas subject to tribal seat belt laws and enforcement had similar odds of being unrestrained as children riding in areas without a seat belt law.

A child being driven by his or her own parent had nearly four times greater odds of proper restraint use than a child being driven by a friend, sitter, or other relative. Driver age is not significant in the multivariate model, but is included in the model because it confounds the driver relationship to the child variable. The age of the vehicle also played a role in proper child restraint use. Children in newer vehicles were had greater odds of proper restraint than children in older vehicles. The odds of proper restraint increase 5 percent for each newer vehicle model year. Conversely, for each year that a vehicle aged, the child had 5 percent greater odds of being unrestrained. The correlation estimate from the GEE model (estimating the degree of correlation due to children riding in the same vehicle with the same driver) was 0.361.

Incorrectly restrained vs unrestrained

In the incorrectly restrained versus unrestrained model, driver seat belt use had the strongest association, with belted drivers having 9.5 times greater odds of having a child using a restraint, though it was either the wrong restraint for the child or it was being used incorrectly. Children riding in areas subject to a state seat belt law and state, county, or city police enforcement had 6.6 times greater odds of being incorrectly restrained than children in areas without a seat belt law. Children riding in areas subject to tribal law and enforcement had 2.4 times greater odds of being incorrectly restrained than those not subject to a seat belt law.

Children in a rear outboard seating position had 1.78 times greater odds of being incorrectly restrained than children in the front seat. Children in the rear center seat had similar odds of being incorrectly restrained as children in the front seat. Seat eligibility was not significant in this model; however, child age was significantly associated with incorrect restraint use versus no restraint use. With each 1 year increase in age, children had 0.90 times the odds of being incorrectly restrained. Stated differently, with each 1 year increase in age, children had 10 percent higher odds of riding unrestrained in the vehicle than of riding incorrectly restrained.

Table 9. Results from Three Separate Multivariate Binary Logistic Regression Models

	Properly Restrained vs Unrestrained		Incorrectly Restrained vs Unrestrained		Properly Restrained vs Incorrectly Restrained	
	OR	95% CI	OR	95% CI	OR	95% CI
Child age (years)			0.90	0.81 - 0.98		
Seat eligibility						
Infant seat	25.10	10.55 - 59.71			15.71	7.27 - 33.93
Child seat	8.65	4.88 - 15.34			7.54	4.54 - 12.51
Booster seat (referent)	1.00	---			1.00	---
Seating location						
Front seat (referent)	1.00	---	1.00	---	1.00	---
Rear center seat	3.39	1.59 - 7.21	0.96	0.56 - 1.66	1.78	0.85 - 3.72
Rear outboard seat	5.57	3.08 - 10.07	1.78	1.22 - 2.60	1.93	1.13 - 3.28
Driver relationship to child						
Parent	3.88	1.80 - 8.34			2.85	1.54 - 5.27
Nonparent (referent)	1.00	---			1.00	---
Driver age	1.01	0.98 - 1.04			1.01	0.98 - 1.03
Driver seatbelt use						
Restrained	6.51	3.65 - 11.61	9.47	5.72 - 15.68		
Unrestrained (referent)	1.00	---	1.00	---		
Vehicle model year	1.05	1.01 - 1.10	1.03	1.01 - 1.07		
Distance from home (minutes)			1.02	1.01 - 1.04		
Type of law and enforcement						
Tribal law & enforcement	1.07	0.56 - 2.06	2.38	1.15 - 4.93	0.61	0.26 - 1.40
State law & enforcement	4.43	1.92 - 10.26	6.61	2.88 - 15.20	1.09	0.45 - 2.63
No law & enforcement (referent)	1.00	---	1.00	---	1.00	---

Estimate of correlation between children in the same vehicle (GEE working correlation) are as follows: for properly restrained vs unrestrained, 0.361; for incorrectly restrained vs unrestrained, 0.702; for properly restrained vs incorrectly restrained, 0.105.
OR = Odds Ratio
95% CI = 95 percent confidence interval

Both vehicle model year and distance from home were significant in this model. For each newer vehicle model year, children had 3 percent greater odds of being incorrectly restrained. For each minute further from home, children had 2 percent greater odds of being incorrectly restrained instead of unrestrained. The correlation estimate from the GEE model (estimating the degree of correlation due to children riding in the same vehicle with the same driver) was 0.702.

Properly restrained vs incorrectly restrained

Of the three groups, children who were properly restrained and children who were incorrectly restrained had the fewest significant differences. The three variables that were different between the two groups were seat eligibility, driver relationship to the child, and seating location. Infants had 15.7 times greater odds of being properly restrained, and child seat eligible children had 7.5 times greater odds of being properly restrained than booster seat eligible children. Children who were riding in the vehicle with their parents had nearly three times greater odds of being properly restrained rather than incorrectly restrained compared to children riding with another relative, friend, or sitter. Children seated in the rear outboard position had 1.93 times greater odds of being properly restrained than children seated in the front seat. The correlation estimate from the GEE model (estimating the degree of correlation due to children riding in the same vehicle with the same driver) was 0.105.

Tribe adjusted model

The same analysis was done with tribe entered into the multivariate model to adjust for observed and unobserved differences between communities involved in the study. Law status could not be entered into this model because only one tribe lacked a seat belt law. The resulting model, as seen in Table 10, has the same variables as the previous model with slightly different odds ratios and confidence intervals.

Table 10. Results from Three Separate Multivariate Binary Logistic Regression Models – Tribe Adjusted

	Properly Restrained vs Unrestrained		Incorrectly Restrained vs Unrestrained		Properly Restrained vs Incorrectly Restrained	
	OR	95% CI	OR	95% CI	OR	95% CI
Child age (years)			**0.89**	**0.81 - 0.98**		
Seat eligibility						
Infant seat	**28.59**	**11.71 - 69.77**			**17.45**	**7.81 - 38.97**
Child seat	**9.77**	**5.30 - 18.01**			**8.22**	**4.85 - 13.93**
Booster seat (referent)	1.00	---			1.00	---
Seating location						
Front seat (referent)	1.00	---	1.00	---	1.00	---
Rear center seat	**3.25**	**1.52 - 6.96**	0.99	0.57 - 1.72	1.69	0.80 - 3.57
Rear outboard seat	**5.38**	**2.99 - 9.70**	**1.80**	**1.23 - 2.66**	**1.84**	**1.06 - 3.17**
Driver relationship to child						
Parent	**4.10**	**1.95 - 8.62**			**2.78**	**1.40 - 5.51**
Nonparent (referent)	1.00	---			1.00	---
Driver age	1.01	0.98 - 1.04			1.01	0.98 - 1.03
Driver seatbelt use						
Restrained	**6.39**	**3.50 - 11.67**	**9.23**	**5.47 - 15.60**		
Unrestrained (referent)	1.00	---	1.00	---		
Vehicle model year	**1.05**	**1.00 - 1.09**	**1.03**	**1.00 - 1.07**		
Distance from home (minutes)			**1.02**	**1.00 - 1.04**		

Estimate of correlation between children in the same vehicle (GEE working correlation) are as follows: for properly restrained vs unrestrained, 0.293; for incorrectly restrained vs unrestrained, 0.710; for properly restrained vs incorrectly restrained, 0.097.
OR = Odds Ratio
95% CI = 95 percent confidence interval

Properly restrained vs unrestrained

For the properly restrained versus unrestrained multivariate model, the strongest association with proper restraint use was the child's seat eligibility. Infants had 28.6 times greater odds of proper restraint, and child seat eligible children had 9.8 times greater odds of proper restraint than booster seat eligible children. The second strongest association with proper restraint use was driver seat belt use. Children riding with drivers who were wearing a seat belt had 6.4 times higher odds of proper restraint than drivers who were unrestrained.

Children in rear outboard seats had 5.4 times greater odds of proper restraint and rear center seated children had 3.3 times greater odds of proper restraint than children in the front seat. Child passengers riding in areas subject to state seat belt laws that are enforced by state, county, or city police had 4.3 times greater odds of proper restraint than children riding in areas with no seat belt law or enforcement. Children riding in areas subject to tribal seat belt laws and enforcement had equal odds of being unrestrained as children riding in areas without a seat belt law.

The odds of proper restraint was 4.1 times greater for children being driven by his or her own parent compared to a child being driven by a friend, sitter, or other relative. Although driver age is not associated with child restraint use, the model is adjusted for the age of the driver because driver age is associated with driver relationship to the child. The age of the vehicle was also associated with proper child restraint use. Children in newer vehicles had higher odds of proper restraint use than children in older vehicles. The odds of proper restraint increase 5 percent for each newer vehicle model year. Conversely, for each year that a vehicle aged, the child had 5 percent greater odds of being unrestrained. The correlation estimate from the GEE model (estimating the degree of correlation due to children riding in the same vehicle with the same driver) was 0.293.

Incorrectly restrained vs unrestrained

In the incorrectly restrained versus unrestrained model, driver seat belt use had the highest odds ratio, with children riding with belted drivers having 9.5 times greater odds of using a restraint, though it was either the wrong restraint for the child or it was being used incorrectly. Children in a rear outboard seating position had 1.8 times greater odds of incorrect restraint use than children in the front seat. Seat eligibility was not significant in this model; however, child age was significantly associated with incorrect restraint use. With each 1 year increase in age, the odds of riding unrestrained in the vehicle increase by 11 percent.

Both vehicle model year and distance from home were significant in this model. For each newer vehicle model year, children had 3 percent greater odds of incorrect restraint use. For each minute further from home, children had 2 percent greater odds of incorrect restraint use, rather than using no restraint at all. The correlation estimate from the GEE model (estimating the degree of correlation due to children riding in the same vehicle with the same driver) was 0.710.

Properly restrained vs incorrectly restrained

Of the three groups, children who were properly restrained and children who were incorrectly restrained had the fewest significant differences. The significant differences between the two groups were seat eligibility, driver relationship to the child, and seating location. Infants had 17.5 times greater odds of proper restraint, and child seat eligible children had 8.2 times greater odds of proper restraint than booster seat eligible children. Children who were riding in the vehicle with their parents had 2.8 times greater odds of proper restraint use rather than incorrect restraint use compared to children riding with another relative, friend, or sitter. Children seated in the rear outboard position had 1.8 times greater odds of proper restraint use than children seated in the front seat. The correlation estimate from the GEE model (estimating the degree of correlation due to children riding in the same vehicle with the same driver) was 0.097.

Driver Survey Results

Approximately half of all drivers reported that they felt children were old enough to use an adult seatbelt at or before 6 years (49 percent) and/or 60 pounds (57 percent), even though safety experts recommend booster seat use until 8 years and 80 pounds [44, 49]. Nearly half of all drivers (47 percent) responded that they did not know whether there were tribal child restraint laws in their community. Fifty-nine percent of drivers reported that they would be interested in receiving more information or training on child safety seat use.

Drivers of the 71 booster seat-eligible children who were observed in their booster seats cited reasons for use such as “safety” (25 percent), “best fit for child” or “allows child to see out” (24 percent), “it is the law” (11 percent) and “got it for free” (11 percent). Forty-four percent of drivers who had unrestrained or improperly restrained booster seat-eligible children in the vehicle (n=247) reported that they did indeed own a booster seat. However, most often cited reasons for not using booster seats among this group were “seat in another vehicle” (14 percent) “do not have” (11 percent), “child too big or too old” (11 percent), “child does not like” (6 percent), “no room for seat in vehicle” (6 percent), and “short trip” (6 percent). Other reasons given included “could not afford” (5 percent), “lost/broken” (5 percent), “gave it away” (5 percent), “adult seat belt is OK” (4 percent), and “don’t usually transport child” (3 percent).

DISCUSSION

Significant Findings

The strongest associations with proper child restraint in this study were seat eligibility (a function of child's age and weight), driver seat belt use, and driver relationship to the child. Being subject to a state or tribal seat belt law was also associated with restraint use after controlling for child, driver, and vehicle characteristics in the multiple logistic regression model. Adjusting for tribal differences (by entering tribe into the logistic regression models) may be adjusting for law/enforcement status as the models do not change and odds ratios do not change significantly. Another explanation for these findings is that law and enforcement status could be adjusting for tribal differences. This could be true if tribes that have the same types of child safety seat laws and enforcement are similar to each other in ways that determine child restraint use. Because only one tribe did not have seat belt laws, we are limited in what we can conclude about the effect of law status on proper child restraint. There may be confounding factors not measured in this study that may contribute to the lack of restraint use in that particular community.

Children who were incorrectly restrained had more in common with children who were properly restrained than children who were unrestrained. PR and UR children differed significantly on six child and/or driver-related characteristics, IR and UR children also differed significantly on six child and/or driver-related characteristics, while PR and IR children only differed on three characteristics. The three factors that made the difference between proper and incorrect restraint use was the child's seat eligibility (infants were most likely to be properly restrained, while booster-age children were least likely), seating position (rear outboard seated children had the greatest odds of being properly restrained) and whether or not the child was riding with his or her own parent. Parents of the child passengers had 3.9 times greater odds of having the children properly restrained than unrestrained, and had 2.9 times greater odds of having the children properly restrained than incorrectly restrained. Many drivers told us that the reason they did not have the child in a seat was because it was not their own child and/or the child had a seat, but it was in another vehicle.

Infants had the highest overall and proper restraint use with 79 percent restrained, and a total of 63 percent properly restrained. Most hospitals, including the Indian Health Service and/or tribally-operated hospitals near the communities in this study, have policies stating that infants cannot leave the hospital without an infant car seat. The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) and other similar programs make infant seats available to parents in need. For these reasons, parents are highly likely to own an infant seat. Also, since most infant car seats double as a carrier, an infant may be more likely to have his seat with him. Additionally, infants are possibly the least likely age group to "complain" about being restrained.

Children in the front seat had the highest odds of being unrestrained or incorrectly restrained. Seating location was not included in the definition of proper or incorrect restraint use in this analysis, so this finding is independent of that definition. Drivers who are concerned about children's safety are potentially more likely to follow recommendations and seat children in the back of the vehicle and have the children restrained. In this sample, children in the front seat were significantly older than children seated in the back (t-test = 2.42, $p = 0.018$), and older children are at a greater risk for incorrect and non-restraint use. However, the relationship between seating position and restraint use remains after adjusting for child seat eligibility.

Drivers of newer vehicles had greater odds of having children restrained. Any number of reasons could explain this finding: these drivers could be early adopters, have higher income (a known correlate of seat belt use), be more educated, or drivers could be driving a newer vehicle because they are more safety conscious and want a vehicle with the newest safety features. Newer vehicles could also be more conducive to child safety seat use, for example, Since September 1, 2000, all vehicle manufacturers have been required to install a top tether anchor to secure forward-facing child safety seats. As of September 1, 2002, nearly all newly manufactured passenger vehicles were also required to have lower anchors installed in at least two rear seating positions [31]. Some newer vehicles also have built-in child safety seat systems, eliminating the need to purchase a separate child seat.

Distance from home was associated with incorrect restraint use compared to non-restraint use. This suggests that a longer car trip may motivate drivers to restrain children who might ride unrestrained on a shorter trip. Distance from home was not associated with proper child restraint use.

Drivers who thought they were subject to a tribal child safety seat law were not more likely to have children properly restrained than drivers who either did not know if they were subject to a law or said they were not subject to a law. Potentially, the enforcement of a law is more influential to drivers than simply having a law on the books. We did not measure enforcement of child safety seat laws (number of tickets given per time period), but personal communications with tribal police in three tribes suggest that only a few citations are given per year. Personal communications with community members from the tribes involved with this project that were subject to tribal seat belt laws and enforcement suggest that even when citations are given, they can be revoked by making a plea to the tribal council.

An analysis of the 2003 Northwest Tribal Child Safety Seat data was previously published in the American Journal of Public health [43]. The previous analysis grouped children into two groups: properly restrained and not properly restrained (incorrectly restrained + unrestrained). The independent variables in this analysis are similar to the multivariate model published previously, however, most of the estimates have become stronger because children who were incorrectly restrained are more similar to children who are properly restrained than with those who were unrestrained. For example, in the AJPH article, drivers who were belted had 2.4 times greater odds of having the children properly restrained than drivers who were not wearing a seat belt. When children are separated into three categories of restraint status as is done in this current analysis, we find that drivers who were belted had 6.5 times greater odds of having children properly restrained than unrestrained and had 9.5 times greater odds of having children incorrectly restrained than unrestrained. Thus, combining incorrect and unrestrained children masked the true association with driver seatbelt use. From this current analysis, we also find that type of law and enforcement are associated with child restraint status.

Driver relationship to the child as a predictor of child restraint status is illustrated differently using three models instead of one. The previous analysis found an interaction between driver age and driver relationship to the child, and that for each 5 year increase in driver age, parents are had 25 percent greater odds of having a child properly restrained. In the three model analysis, we find that driver age is indeed a confounder for driver relationship to the child (and so it is included in the models as an adjusting factor) and that drivers who were not the parents of the child passengers had greater odds of having the children both unrestrained and incorrectly restrained. This is likely because non-parent drivers do not have child safety seats, or if they do have them, they may not be the appropriate seat for the child's age and weight. Thus, non-parent drivers use adult seat belts to restrain the children, which are not appropriate for the children in this analysis. Vehicle model year and distance from home are also associated with child restraint status in three categories, which was not found in the previous analysis.

Comparisons to National Data

Nationally, 99 percent of infants, 94 percent of toddlers (age 1-3), and 83 percent of booster-age children (age 4-7) are restrained with some type of seat belt [50]. Restraint use in this sample was much lower with 79 percent of infants, 66 percent of toddlers, and 51 percent of booster-age children using some type of restraint (see Table 11). Generally, restraint use in rural communities lags behind urban and suburban communities, and most of the sites sampled in this study were rural. In 2002, 87 percent of children age 0-7 in rural communities were restrained, compared to 59 percent in this sample [50]. Clearly, restraint use in these communities is exceedingly low, even in comparison to the lower restraint use in rural communities nationwide.

Table 11. Percent of Children Using any Restraint by Age: Comparisons to National Data

	Percentage using any type of restraint		
	National (2002)	NW AI/AN (2003)	National Rural (2002)
Infants (<1)	99	79	NR
Toddlers (1-3)	94	66	NR
Booster-age (4-8)	83	51	NR
TOTAL	NR	59	87

NR = not reported

The estimates of driver seat belt use in this study (51 percent) are consistent with the 2004 National Highway Traffic Safety Administration and Bureau of Indian Affairs estimates of seat belt use on reservations (55 percent) [4]. NHTSA found that one of the indicators of high belt use is the presence of a primary safety belt law. They also found that the seat belt laws of the states in which the tribal reservations were located were also correlated with seat belt use on the reservation. At the time of data collection for this study (summer 2003), Oregon and Idaho States only required child passenger restraint systems for children up to age 4 and 40 pounds. Washington State required booster seats for children up to age 6 and 60 pounds. In this study, 75 percent of drivers subject to state law were belted, compared to 47 percent of drivers subject to tribal laws, and only 22 percent who were not subject to any seat belt law

As seen in national studies, driver restraint use was significantly associated with proper child restraint, however, drivers were less likely to wear their own seat belt (51 percent) compared to the general population in these areas (63 percent, 88 percent and 99 percent for Idaho, Oregon and Washington respectively). Non-parent drivers were significantly less likely to have properly restrained children. Since many AI children are cared for by grandparents or other relatives, this may provide insight into a potential focus for educational or other interventions.

POTENTIAL INTERVENTIONS

AI/AN Cultural Considerations

Many factors — historical, political, sociocultural, and geographical — impact health perceptions among American Indians [51]. The American Indian vision of health encompasses mind, body, and spirit--operating not just at the level of the individual, but also involving family, community, and society [52]. Family dynamics play a critical role in the health of American Indians [53]. In our experience, American Indian children are often cared for by grandparents and other relatives or friends. In this study, 32 percent of AI children were traveling with a driver that was not his or her own parent, reinforcing the need for community-wide interventions and not just interventions targeting parents of young children.

Perceptions of the inevitability of injury, disease, and death within the reservation environment have been reported [54]. This perception, paired with mistrust of outside researchers, health educators, and clinicians, contribute to the health disparities found among many American Indian communities. Efforts to identify disparities in health perceptions and worldviews are essential for developing education interventions that precipitate behavior change.

Tribal Seat Belt Laws

Laws make a statement about the priorities of a community, especially when they are enacted at the tribal level and there is more community ownership of the law. The act of passing a law says that the community makes safety a priority and validates the use of child safety seats as an acceptable practice. In this sample, seat belt and child safety seat laws were associated with driver and child restraint use, but there was no difference between incorrect restraint use and proper restraint use by law status. In areas where there are no seat belt or child passenger safety laws, tribal leaders could encourage legislation and enforcement of such laws. For tribes that already have laws in force, concentrated campaigns such as Click-it-or-Ticket could potentially increase seat belt use. The Bureau of Indian Affairs (BIA) Indian Highway Safety Program hired a law enforcement liaison in 2005 to support occupant protection laws and increase enforcement efforts on tribal reservations with NHTSA's Click-it-or-Ticket mobilizations [29]. Tribes could take advantage of this additional support from BIA and NHTSA to take action in their own community.

Many drivers consider themselves to be good drivers, and thus have a low perceived risk of crashing. The perceived risk of getting a ticket may outweigh the risk of crashing and could motivate these drivers to restrain children and themselves. The Navajo nation experienced a significant drop in hospital discharges due to motor vehicle injuries concurrent with enactment of the Navajo Nation occupant and child restraint laws [30]. The effectiveness of their law and enforcement serves as a model of an effective injury control measure that can be implemented by other tribes.

Child Passenger Safety Technicians

Tens of thousands of individuals have been certified as Child Passenger Safety (CPS) technicians and instructors since the standardized curriculum and certification program began in 1997. CPS technicians and instructors put their knowledge to work through a variety of activities, including child safety seat checks where parents and caregivers receive education and hands-on assistance with the proper use of child restraint systems and safety belts. National certification of these individuals helps to enhance the credibility and professionalism of all child passenger safety advocates and practitioners, the child passenger safety community, and the organizations and programs that use the services of certified CPS technicians. Documented CPS training and experience may also help to reduce an institution or agency's liability [55].

A certified Child Passenger Safety technician could be an invaluable resource for tribes. Tribes could hire a CPS technician, or train a current employee and have him/her devote part time to child passenger safety efforts. The national standardized CPS certification course is usually four to five days long and combines classroom instruction, hands-on work with car seats and vehicles, and a community safety seat checkup event, where students demonstrate proper use and installation of child restraints and safety belts and then teach these skills to parents. Successful completion of this course certifies the individual as a CPS technician for two years. At the time of this publication, registration for all certification courses was $60 [55]. In 2003, when the Northwest Tribal Child Safety Seat Study was conducted, only 1 tribe employed a CPS technician. This tribe had the highest restraint use of the six participating tribes, with 82% of drivers using a seat belt, 88% of children using any type of restraint, and 52% of children properly restrained. In 2007, two of the six tribes that participated in the study employed a CPS technician.

Distributing Seats

Providing free or low cost seats to families as well as to others who may drive children only occasionally could increase the percentage of properly restrained AI/AN children. Nineteen percent of drivers cited not having a seat as the primary reason for not using a booster seat, and another 6 percent said their primary barrier was cost. Having more seats available could potentially increase child safety seat use for grandparents, aunties, child care providers, and other non-parents who did not have children restrained properly. Most tribes in the Northwest work closely with WIC which often provides rear-facing infant car seats to families in need. Tribes could start a dialog with WIC personnel about securing funding for forward-facing child seats and booster seats as well. Other Northwest tribes have reported working closely with their respective counties, state, and/or injury prevention center to obtain free or low cost child safety seats.

An intervention that has been implemented in some tribes with varying levels of success is a child safety seat loaner program. The idea is that daycares, preschools, elementary schools, community centers, health clinics, and other places children are transported to and from regularly, keep a few infant seats, child seats, and booster seats on hand for children to use on a temporary basis. This program is especially useful for drivers who rarely transport children, or in cases where a friend or family member is making an unplanned pick-up of a child from daycare or school. The drawbacks of this program are that the institution or agency holding the seat may not have staff that knows what type of seat each child should use, staff or driver may not know how to install the seats into the vehicle, and the institution or agency has little or no control over the condition and maintenance of the seat. A child safety seat loaner program could be more effective if implemented under the supervision of a certified CPS technician. The technician would be responsible for checking seats in and out of the program, maintaining the seats, and keeping current on child safety seat recalls. Many of the tribal communities have a clinic, school, and daycare all within close proximity of each other. For communities like this, the CPS technician could store the seats in a central location and oversee the distribution and installation of the seat into each vehicle, and see that the children are correctly restrained in the seat. In communities that are more spread out, the CPS technician could train staff at each of the institutions to correctly choose a seat for a child and assist in the installation of the seat into the vehicle.

Interventions to Increase Booster Seat Use

Table 12 lists reasons drivers of booster-eligible children gave for not having the child in a booster seat along with three broad-based interventions that could potentially address these reasons for non-use and subsequently increase booster seat use. An estimated 41 percent of these drivers could benefit from free or reduced price child seats. The vast majority of these drivers (97 percent) could benefit from messages reinforcing the importance of booster seat use. These messages could come various sources including health care providers, child care providers, CPS technicians, tribal television, tribal newspapers, WIC program, MCH program, posters, crash test videos, and health fairs. At a community gathering, one tribe displayed a car that had been in a severe crash. People were reportedly shocked to learn that a child had been a passenger in the vehicle when it wrecked. The child had survived because she had been in her booster seat. This intervention had a lasting impact on the attitudes toward child restraint use in this particular community.

Twenty-five percent of drivers in Table 12 could benefit from being taught how to properly use a booster seat. An additional 10 percent of drivers who had a child passenger restrained in a booster seat, but were using the seat incorrectly, could benefit from a training on proper booster seat use. A certified CPS technician would be an appropriate instructor to counsel drivers either in a group setting or on an individual basis on proper child restraint use. Fifty-nine percent of all drivers in this study reported that they would be interested in receiving more information or training on child safety seat use. A multifaceted approach to child passenger safety interventions, including seat distribution, education, and technical support, would be the most effective at increasing child safety seat use. These interventions could largely be implemented by a CPS technician.

Table 12. Potential Interventions to Address Drivers' Reasons for Not Using a Booster Seat

	Percent reported	Potential Interventions		
		Free/reduced price seats or loaner program	Teaching how to use seat	Teaching importance of seat
Reported reasons for not using a booster seat:				
Seat is in another vehicle	13.9	X		X
Do not have a booster seat	11.3	X	X	X
Child too big/old/does not need	11.3			X
Short driving distance	6.5			X
No room for seat in vehicle	6.5			X
Child does not like seat	5.6			X
Did not know about booster seats	5.2	X	X	X
Gave away seat/took out of car	4.8			X
Cannot afford	4.8	X		X
Felt adult belt was OK	3.9			X
Not driving own vehicle	3.0	X		X
Not driving own kids/don't usually drive kids	3.0	X	X	X
Booster seats are too small	3.0		X	
No time/too busy/inconvenient	2.6			X
Boosters are not safe/do not ever use vehicle restraints	2.6		X	X
Seat is lost/broken	2.2	X		X
Percentage that could benefit from intervention:		41.2%	25.1%	97.0%

Interventions that improve the acceptability of booster seats to children may increase booster seat use. Four percent of drivers said the primary reason the child was not in a seat was because the child did not like the seat. Allowing the child to choose his own seat or to design a "cool" seat cover for the booster may get the child to feel ownership of the booster seat. Some parents noted that their child liked the booster seat because it allowed the child to see out of the vehicle better. Messages like this could help with a child's acceptance of a child seat or booster seat.

It is important to keep in mind that some restraint is always likely to be better than none [49]. Drivers who secured child passengers with some type of restraint, though incorrectly, were providing some measure of safety for the children. These drivers may need different interventions than drivers of unrestrained children. An education intervention including materials on when to graduate children to an adult seat belt may be effective since drivers were already taking a step toward making the child safer when riding in the vehicle. Drivers with children incorrectly restrained are different from those who have children unrestrained, as shown in Table 9 (page 37); they are more likely to be restrained themselves, and more likely to be driving in an area with some kind of law as opposed to no law.

Finally, children do what adults do. Restrained adults ride with restrained children, either because the driver restrains the child, or older children follow the driver's rules, or the child is mimicking driver behavior. Interventions emphasizing restraint use for everyone in the vehicle, including adults, may be more effective than only targeting children.

LIMITATIONS

This study has some noted limitations. We did not gather information on all passengers in the vehicle, only the driver and all children age 8 years and under. Thus, we did not record the total number of people in the vehicle, nor whether the number of persons in the vehicle exceeded the number of available seating positions. In addition, we relied on reported age and weight of the children and did not independently validate driver report. We also did not ask drivers to estimate child's height. Child's height is part of some of the published criteria for assessing recommended restraint [49]. However, prior investigators have noted that most drivers were not able to report child height [13]. Therefore we did not ask drivers to estimate the child height and determined recommended restraint use based on child's age and weight.

We confined the study to AI/AN children and drivers. If a non-AI/AN driver volunteered that there were AI/AN children riding in the vehicle, we included them in the study. However, we could have missed AI/AN children traveling with non-AI/AN drivers if the driver did not volunteer the race of the children.

Child restraint system use is most likely overestimated by this study. Drivers who refused to participate were significantly less likely to be wearing a seat belt (p=.003), so presumptively, the children were also less likely to be restrained. Infant, child, and booster seats were not checked to see that they were properly installed, and straps were not checked for proper placement or tightness. Other studies have estimated child safety seat and booster seat misuse due problems such as to incorrect installation, incorrect snugness of fit, and incorrect safety belt locking clip ranging from 77 percent - 96 [21, 34, 56]. Children were classified as correctly restrained if they were using the correct restraint in the front seat, which is not recommended for children under 12.

Children could be misclassified as to proper restraint if they were in a child harness seat with a weight capacity greater than 40 pounds. In this sample, 16 children with reported weight over 40 pounds were in child harness seats. This analysis required children to be in mutually exclusive seat categories, so a child could not be said to be correctly restrained in both a child harness seat and a booster seat. At the time of data collection (2003), child seats with a weight capacity over 40 pounds were difficult to find, and when manufactured, were expensive ($300). For these reasons, it is unlikely that many of these 16 children were in seats with the higher weight capacity.

Another potential source of misclassification lies in the reporting of child's weight. Drivers may not know the child's weight, and an incorrect guess could result in children being misclassified as to seat eligibility. Non-parent drivers may be more likely to report an incorrect child weight, which could account for some of the difference between parents and non-parents in the properly restrained vs incorrectly restrained model. However, incorrect weight reporting cannot account for the fact that non-parents were four times more likely to have children completely unrestrained than parent drivers.

One weakness of the data is the wide confidence intervals on some of the estimates. The wide confidence intervals around estimates for infant seat users is a result of so few infants being unrestrained (n=21). A multinomial model (simultaneous regression) may be more efficient, resulting in narrower confidence intervals, and may yield slightly different results. A simultaneous regression may also have more power to detect differences among the various independent variables, however the software used (SAS) did not allow for a simultaneous regression for clustered data.

SUMMARY AND CONCLUSIONS

Motor vehicle crashes remain the leading cause of death for American Indian and Alaska Native children, who have the greatest motor vehicle occupant mortality of any race or ethnic group in the United States. There is overwhelming evidence that child safety seats are effective at reducing injury when used properly (4, 5,16). Despite national progress in increasing seat belt and child restraint use, this study shows that American Indian children in Northwest tribal communities face epidemic rates of being completely unrestrained (41 percent) or incorrectly restrained (30 percent). Children between 4 and 8 years of age are at particular risk for incorrect use of booster seats and early graduation to adult seat belts. Factors associated with proper restraint use include child's seat eligibility (a function of age and weight), seating location, child's relationship to the driver, seat belt use by the driver, vehicle model year, and law and enforcement status. While adult drivers in these communities were commonly unaware of laws regarding vehicle restraints for children, they were receptive to receiving more information and training on proper use of child safety seats.

Culturally appropriate interventions to increase use of infant, child and booster seats should be designed and implemented with tribal communities as full partners in the process. Such interventions might include strategies to get all occupants (adults and children) to use proper restraints; stressing importance of regular use, even for short trips; increase availability of proper seats for all vehicles that children ride in regularly; include training on proper use, not only for parents, but all regular caregivers. Employing a certified CPS technician could be a valuable resource for the tribe. Community-based initiatives aimed at improving enforcement of existing child passenger safety laws and/or extending laws to cover safe transportation of children through age 8 could also be effective.

Understanding barriers and facilitators to the use of child passenger restraint systems in tribal communities can guide prevention efforts for American Indian communities across the United States. There is a pressing need for culturally appropriate interventions designed by community members. Community-based initiatives aimed at improving enforcement of child passenger safety laws and/or extending law to cover safe transportation of children may also be effective. Supporting communities in the development and tailoring of culturally relevant interventions may improve implementation, and sustain decision-making and change behaviors in the use of child restraints for AI/AN children.

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APPENDIX A

2003 Northwest Tribal Child Safety Seat Study survey instrument

Northwest Tribal Child Safety Seat Study

1. Date ______/______/______
2. Your Initials __________
3. Tribe ______________________________
4. Site ______________________________
5. Start ____________ 6. Stop __________
7. Refused?
   2 No
   1 Yes why? ________________________
8. AI/AN?: 1 Native 2 Non-Native
   3 Other: ________________
9. Sex of Driver? 1 Female 2 Male
10. Driver wearing lap/shoulder belt?
   1 Yes 2 No
11a. Distance from home? ____________minutes
11b. Driver's age? ____________yrs
11c. Vehicle model year? ____________yr

Child Passenger #1

12. Age __________yrs 13. Weight ______lbs
14a. Sex: 1 Female 2 Male
14b. Driver relation to child:
   1 Mother 2 Father 3 Sitter
   4 Other ________________________
15. Seat position (circle one):

1	D	1	2	or	2	D	1	2
	3	4	5			3	4	5
						6	7	8

16. Restraint Used (circle one):
   0 **None**

   1 Rear facing **infant seat**
   2 **Forward-facing seat** with harness

   3 **High back booster** w/ lap/shoulder belt
   4 **High back booster** w/ shoulder belt behind back or under arm

   5 **No-back booster** w/ lap/shoulder belt
   6 **No-back booster**, lap belt only or shoulder belt behind back/arm

   7 **Shield booster**

   8 **Lap/shoulder belt** – proper use
   9 **Lap belt only**
   10 **Lap/shoulder belt** w/ shoulder belt behind back/under arm

Child Passenger #2

17. Age __________yrs 18. Weight __________lbs
19a. Sex: 1 Female 2 Male
19b. Driver relation to child:
   1 Mother 2 Father 3 Sitter
   4 Other ________________________
20. Seat position (circle one):

1	D	1	2	or	2	D	1	2
	3	4	5			3	4	5
						6	7	8

21. Restraint Used (circle one):
   0 **None**

   1 Rear facing **infant seat**
   2 **Forward-facing seat** with harness

   3 **High back booster** w/ lap/shoulder belt
   4 **High back booster** w/ shoulder belt behind back or under arm

   5 **No-back booster** w/ lap/shoulder belt
   6 **No-back booster**, lap belt only or shoulder belt behind back/arm

   7 **Shield booster**

   8 **Lap/shoulder belt** – proper use
   9 **Lap belt only**
   10 **Lap/shoulder belt** w/ shoulder belt behind back/under arm

Child Passenger #3

22. Age __________yrs 23. Weight __________lbs
24a. Sex: 1 Female 2 Male
24b. Driver relation to child:
   1 Mother 2 Father 3 Sitter
   4 Other ________________________
25. Seat position (circle one):

1	D	1	2	or	2	D	1	2
	3	4	5			3	4	5
						6	7	8

26. Restraint Used (circle one):
   0 **None**

   1 Rear facing **infant seat**
   2 **Forward-facing seat** with harness

   3 **High back booster** w/ lap/shoulder belt
   4 **High back booster** w/ shoulder belt behind back or under arm

   5 **No-back booster** w/ lap/shoulder belt
   6 **No-back booster**, lap belt only or shoulder belt behind back/arm

   7 **Shield booster**

   8 **Lap/shoulder belt** – proper use
   9 **Lap belt only**
   10 **Lap/shoulder belt** w/ shoulder belt behind back/under arm

27. In your opinion, at what age is a child old enough to use only an adult seat-belt?________years
28. In your opinion, at what weight is a child big enough to use only an adult seat-belt?________pounds

If child is 3-8 years and booster seat used, ask:
29. Why have you chosen to use a booster seat?________________________

If child is 3-8 years and no booster/child seat present, ask:
30. Have you heard about booster seats? 1 Yes 2 No
31. Do you own a booster seat? 1 Yes 2 No
32. Why have you chosen not to use a booster seat?________________________

33. Does the tribe have child safety seat laws? 1 Yes 2 No 3 Don't Know/Not Sure
34. Would you be interested in attending a workshop or training on child safety seats? 1 Yes 2 No
35. Where do you get your information on child safety seats?