HHS Public Access

Author manuscript

Inj Prev. Author manuscript; available in PMC 2024 May 23.

Published in final edited form as:

Inj Prev. ; 30(2): 92–99. doi:10.1136/ip-2023-045044.

Surveillance methods and interventions implemented in American Indian and Alaska Native communities to increase child restraint device and seat belt use in motor vehicles: a systematic review

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Abstract

Background: American Indian/Alaska Native (AI/AN) children are disproportionately affected by injuries and deaths related to motor vehicle crashes. We aimed to synthesize published evidence on surveillance methods and interventions implemented in AI/AN communities and analyze characteristics that make them successful in increasing child restraint device and seatbelt use.

Methods: Studies were collected from the PubMed, Scopus, and TRID databases and the CDC Tribal Road Safety website, Community Guide, and Indian Health Service registers. Included studies collected primary data on AI/AN children (0–17) and reported morbidity/mortality outcomes related to child restraint device or seatbelt use. Studies with poor methodological quality, published before 2002, whose data were collected outside of the U.S., or were non-English, were excluded. Checklists from the Joanna Briggs Institute were used to assess risk of bias. In the synthesis of results, studies were grouped by whether a surveillance method or intervention was employed.

Results: The final review included 9 studies covering 72,381 participants. Studies conducted surveillance methods, interventions involving law enforcement only, and multipronged interventions. Multipronged approaches were most effective by utilizing the distribution of child restraint devices combined with at least some of the following components: educational programs,

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Contributors

CV, CG, and WS conceptualized the research plan, determined the search terms and inclusion criteria, and analyzed and interpreted the data. CV and CG completed data abstraction. CG and ES reviewed articles and completed the quality assessment. All authors participated in drafting, revising, and approving the final manuscript.

Ethics approval

Ethics approval was not required because this study did not involve human subjects and made use of publicly available, non-identifiable information.

Competing interests

The authors declare no competing interests.

media campaigns, enactment/enforcement of child passenger restraint laws, incentive programs, and surveillance.

Discussion: Although this review was limited by the number and quality of included studies, available resources suggest that we need multipronged, culturally tailored, and sustainable interventions fostered by mutually beneficial and trusting partnerships. Continued investment in AI/AN road safety initiatives is necessary.

INTRODUCTION

American Indian/Alaska Native (AI/AN) children are disproportionately affected by non-fatal injuries and deaths related to motor vehicle crashes compared to other races/ethnicities.[1–2] Between 2008 and 2018, the motor vehicle crash occupant death rate among AI children (0–19) was between 1.3 to 3.0 times higher than the national rate.[3] According to data collected by the Fatality Analysis Reporting System, which is maintained by the National Highway Traffic Safety Administration (NHTSA), the number of child passenger deaths (per 100,000) in AI/AN children (0–17) between 2015 and 2019 was the highest of all races/ethnicities, with a rate of 2.67 as compared to 1.15 and 0.57 in White and Asian Pacific Islander populations respectively.[4]

Child restraint devices (CRDs), including child safety seats (CSSs) and belt-positioning booster seats (BPBSs), and seatbelts are effective in preventing death and injury from motor vehicle crashes.[5–7] Despite their effectiveness and the implementation of policies to encourage their use, CRDs/seatbelts are severely underutilized by the AI/AN population for economic, social, legislative, and practical reasons.[8–10] Correct CSS use ranges from 63–80% for AI/AN infants and 5–41% for toddlers. Approximately 11% of eligible AI/AN children use BPBSs.[10–11] In 2020, seatbelt use in front seat passengers was estimated at 76% among AI/AN in comparison to the national average of 90.3%.[12–13]

All 50 states and the District of Columbia have child passenger restraint laws. Seatbelt laws are credited with increased seatbelt use and decreased injury severity.[14–19] However, child restraint laws vary greatly among the 574 federally recognized AI/AN tribes in the U.S., which operate as sovereign nations.[10, 20] Many AI/AN tribes have passed child restraint laws to decrease the morbidity and mortality of AI/AN children.[10, 21] Interventions encouraging behavioral modification through CRD distribution, community-wide media campaigns, educational programs, enhanced law enforcement campaigns, incentive programs, and surveillance have also been effectively utilized to increase child passenger safety (CPS).[22]

Current systematic reviews on motor vehicle injury prevention interventions for children do not address surveillance methods and interventions implemented specifically in AI/AN communities. This systematic review aims to synthesize published evidence on both surveillance methods and interventions implemented in AI/AN communities and analyze the characteristics that make them successful in increasing CRD/seatbelt use.

METHODS

This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines to report findings.[23] This review was not registered and did not have a previously published protocol.

Eligibility criteria

Studies that met the following criteria were included: (1) published between 2002 and 2022, (2) used primary data collected in the U.S., (3) included AI/AN populations, (4) reported morbidity and mortality directly related to CRD or seatbelt use, (5) investigated children (0–17) as the key population, and (6) published in English. The following were exclusion criteria: (1) seatbelt use primarily in adults, (2) motor vehicle crashes related to health behaviors primarily in adults, (3) motor vehicle crashes unrelated to CRD or seatbelt use, (4) effectiveness of the surveillance method or intervention not discussed, and (5) no AI/AN populations.

Search strategy

Studies were primarily collected from the PubMed, Scopus, and TRID databases. Resources and publications specific to AI/AN motor vehicle safety on the CDC Tribal Road Safety website,[24] Community Guide,[25] and Indian Health Service (IHS)[26] registers were also searched. Some gray literature including those in the Community Guide and CDC Tribal Road Safety website were reviewed.[24–25] The full search terms are attached as supplemental material. All sources were last consulted in April 2023.

Selection of studies and quality assessment

Study selection consisted of the following stages: (1) identification screening, (2) title and abstract screening, and (3) full-length review and quality assessment. Upon executing the search strategy, duplicate studies and non-applicable literature (e.g., non-English, published prior to 2002, etc.) were removed. Each title and abstract was screened for eligibility by a reviewer (CG). Two reviewers (CG & ES) then independently read the full-length of remaining articles to assess eligibility and quality.

To conduct the quality assessment, the reviewers used 4 of the Joanna Briggs Institute Critical Appraisal Tools corresponding to relevant study designs: analytical cross-sectional (8 items), cohort (11 items), quasi-experimental (9 items), and qualitative (10 items).[27] These instruments included criteria needed to ensure high quality reporting and low risk of bias and have been validated. The reviewers used a 3-point Likert scale of “poor”, “fair”, and “good” to categorize each article by quality: articles with scores considerably lower than half the total number of quality assessment items were considered “poor” in quality and excluded. The two reviewers discussed each article’s eligibility and quality score/category until consensus was reached.

Data extraction and synthesis

Outcomes were sought for rates or changes in the use of CRDs or seatbelts reported with proportions, odds ratios (ORs), or risk ratios (RRs). For each included article, a data

abstraction form was used to collect the following information: study design; sample size; target population; outcomes; and strengths and limitations. This form and all data extracted can be provided upon request by the corresponding author. Two reviewers (CG & CV) independently completed abstraction forms for each article and discussed all responses until consensus was reached. All results were compatible with the outcomes being sought, and no information was missing or unclear, so the data did not require adjustments for synthesis.

For ease of presentation, studies were grouped for synthesis based on study focus: outcomes of surveillance studies were synthesized separately from studies of interventions, which were grouped by the type of intervention approach employed. We used a narrative synthesis approach to allow for adequate description of the surveillance or intervention components being employed. Because of the small number of included studies, and because statistical synthesis methods were not used, we did not conduct heterogeneity, sensitivity, reporting bias, or certainty assessments. The outcomes of individual studies were tabulated by study focus and displayed with the study's quality assessment score, target population, sample size, and strengths and limitations.

Patient and public involvement

Patients and/or the public were not involved in the design, conduct, reporting, or dissemination of the research plan.

RESULTS

Search results

A total of 119 records were identified from the Scopus, PubMed, and TRID database searches (n=95), and the CDC Tribal Road Safety website,[24] Community Guide,[25] and IHS registers (n=24).[26] Fifty-two (52) titles and 27 abstracts were screened, resulting in 14 articles that underwent full-text review. Two (2) additional articles were reviewed for eligibility from the references of articles that underwent full-text review;[28–29] 1 was excluded.[29] A total of 9 articles were included in the synthesis. Figure 1 illustrates the study selection.

Study characteristics

Of the 9 articles included, more than half (n=5) employed interventions that used a multipronged approach, which combines CRD distribution with education/training, media campaigns, enactment/enforcement of laws, incentive programs, or surveillance.[8, 30–34] Other studies focused on interventions using law enforcement only (n=1)[21] and surveillance methods (n=3).[9, 11, 28] All 9 studies were rated "good" during quality assessment and covered 72,381 total participants (Table 1).

Surveillance methods

All three studies focused on the use of surveillance methods to increase CRD/seatbelt use were related to the Native Children Always Ride Safe (Native CARS) project, a collaboration between six Northwest tribes to improve CPS through community-specific interventions.[9, 11, 28] By providing data to help inform the planning, implementation, and

assessment of formal interventions, surveillance methods were instrumental to the Native CARS project. In the quality assessment, points were deducted from the studies mainly due to potential misclassification from relying on drivers' reports of children's characteristics.

Lapidus et al. (2005) conducted an observational survey on CRD use in 6 tribes located in Idaho, Oregon, and Washington in 2003 to inform the development of the Native CARS project.[11] Data were collected from drivers by trained observers at 47 specified sites on 6 reservations, such as elementary schools and local businesses. This study reported that 63% of infant seat-eligible, 41% of CSS-eligible, and 11% of BPBS-eligible children were properly restrained in motor vehicles. Other than being unrestrained, many children were observed prematurely using CRDs designed for older children. Driver seatbelt use (OR = 2.39; 95% CI: 1.51, 3.80), driver's relationship to child (not the parent) (OR = 0.27; 95% CI: 0.16, 0.44), driver's age (if parent of the child in 5-year increments) (OR= 1.25; 95% CI: 1.00, 1.56), and child's age (each additional year of age) (OR= 0.60; 95% CI: 0.48, 0.75) were strong predictors of proper child restraint use.[11]

Lapidus et al. (2013) utilized an observational survey in 2009 contrasted with data collected in 2003 to determine changes in proper restraint use over time before formal Native CARS interventions had been implemented.[9] This growing database informed communities on the child, driver, vehicle, and surrounding environment characteristic correlates of improper child passenger restraint. While the overall proportion of properly restrained children increased from 2003 to 2009, this varied widely by tribe. AI/AN children were 1.6 times more likely to be properly restrained (95% CI: 1.43, 1.85) in 2009 compared to 2003. The largest improvement in restraint use from 2003 to 2009 was seen in the age group 4–7 (RR = 2.24, 95% CI: 1.73, 2.92). However, contextual factors such as occupant restraint laws in Idaho, Oregon, and Washington, expanded to include BPBS-eligible children, likely influenced this increase. Despite this improvement, 29% of AI/AN children rode unrestrained and an additional 22% rode improperly restrained.[9]

The Native CARS project was implemented in a staggered design, with three tribes implementing interventions from 2009–2011 and three implementing interventions from 2011–2013, allowing for an evaluation point in 2011 to compare CRD use in intervention tribes and pre-intervention tribes. Smith et al. developed a survey instrument consisting of an observational survey and driver interview.[28] Community members were hired and trained to assess ageappropriate child restraint methods and collect data following survey protocol. Child restraint was categorized as "properly restrained", "incorrectly restrained", and "unrestrained" at the time points: 2009, 2011 and 2013. Proper child restraint was highest in 2011 at 61%, as compared to 49% in 2009 and 60% in 2013. Unrestrained status was lowest in 2013 at 14%, as compared to 29% in 2009 and 18% in 2011. The proportion of properly restrained children generally decreased with age, with children 0–1 having the highest across the three time points, and children 7–12 having the lowest across the three time points.[28]

Interventions

Law enforcement—One study in this review focused solely on the implementation and enforcement of an occupant restraint law. Occupant and child restraint laws are a commonly

used intervention nationwide. However, because many AI/AN tribal homelands are exempt from the traffic laws of surrounding states, many tribal homelands have enacted their own laws regarding CRD/seatbelt use.[10, 21] The Navajo Nation occupant and child restraint laws were enacted in 1988, with primary enforcement beginning in 1990. Phelan et al. compared data from Navajo Area IHS hospitals from the pre-intervention period (1983–88) to the post-intervention period (1991–95) to test both the rate of discharge from hospitals and the severity of injuries.[21]

The authors reported that >75% of injured and hospitalized Navajo children (0–19) were passengers in motor vehicles before the laws were implemented. The mean age of children in this study was 11.3 and >50% were male.[21] After the enforcement of the law, there was a statistically significant ($p = 0.0001$) reduction in mean annual hospital discharge rates (per 100,000) for motor vehicle related injury. For children, there was an almost 50% decrease in the rate, from 81.7 to 41.3 on average. The largest reduction was seen in the 0–4 age group (62.2 to 28.0), followed by the 5–11 age group (55.3 to 26.0), and finally the 12–19 age group (81.7 to 41.3).[21]

Injury severity was described as the proportion of discharges with “moderate-to-severe” injuries or (NISS >4) on the new injury severity score (NISS) scale. There was no statistically significant difference in injury severity with NISS >4 for children pre-intervention (47.7%) and post-intervention (47.9%) on average. However, for those aged 0–5, there was a statistically significant ($p = 0.03$) reduction in injury severity from 43.0% to 25.8%.[21]

While there was an increase in CRD/seatbelt use after the enactment and primary enforcement of the law, the authors caution that other interventions including (1) Navajo IHS area-wide campaigns focused on CPS education and (2) CSS rentals and giveaways during this time likely contributed to the decreased morbidity observed.[21] The study’s quality was therefore mainly limited by the difficulty to account for these trends and others, such as national or state child restraint laws.

Multipronged approach—Five studies used a multipronged approach to increase CPS. These studies combined CRD distribution with different approaches such as educational programs, community-wide information campaigns, enactment or enhanced enforcement of laws mandating CRD/seatbelt use, incentive programs, and surveillance. Quality scores were deducted across these studies mainly due to the potential of infidelity in implementing the designed intervention and difficulties making comparisons between groups.

Ride Safe is a CPS program designed to increase CSS use and reduce motor vehicle related injuries in children 3–5. It was implemented during 4 school years between 2002 and 2006 and at 14 Tribal Head Start Centers in Arizona, Michigan, Minnesota, New Mexico, Nevada, and Wisconsin. The program included distribution of CSS; a CPS educational curriculum for use by teachers, coordinators, and staff; funding for CPS Technician certification training; and surveillance activities. During the first year of program implementation, Letourneau et al. reported that children were 2.55–3.03 times more likely to be observed restrained

than pre-intervention. However, at the end of year 3, the OR was only 1.54, suggesting unsustained gains in CSS use.[8]

Letourneau et al. utilized a multipronged approach to achieve significant success in CRD/seatbelt use among Ho-Chunk Nation (HCN) Members in Wisconsin over a 5-year period (2005–2008).[30] General educational events such as crash simulations, community safety and health expositions, and media awareness through seatbelt signs, billboards, radio PSAs, newspaper articles and ads, and emails were utilized, along with targeted education/training, such as Safer Native American Passenger (SNAP) Training (a culturally appropriate tool that provides CPS training and awareness),[31] CPS Technician certifications, and campaigns that incentivized employee-spotted seatbelt use with $20 gift cards.[30] Finally, the project utilized enhanced law enforcement via the Click it or Ticket Campaign, where the HCN partnered with nearby police departments to enforce occupant restraint laws. Observational surveys were conducted to assess CSS and seatbelt use rates. CSS use increased from 26.4% in 2003 to 78.4% in 2008. Over the study period, toddlers were 2.38 times more likely to be in a CSS than pre-intervention. Furthermore, for each additional year of the program, toddlers were 41% more likely to be properly restrained.[30] Notably, improvements were sustained.

West et al.[32] focused on the use of education, media, and law enforcement in alignment with strategies recommended by Community Guide and the CDC.[25] Four tribes, the Tohono O'odham Nation (TON), HCN, White Mountain Apache Tribe (WMAT), and the San Carlos Apache Tribe (SCAT) participated in the study conducted between 2005 and 2009. TON, WMAT, and HCN utilized education, media, and enforcement for seatbelt and CSS use. SCAT focused solely on law enforcement. On the TON reservation, CSS use increased from 34% to 49%, and seatbelt use increased from 37% to 68%. On the HCN reservation, CSS use increased from 41% to 76%, and seatbelt use increased from 33% to 63%. The WMAT reservation saw the largest relative increase in child restraint: CSS use increased from 14% to 58%, and seatbelt use increased from 10% to 32%. The SCAT reservation established a primary seatbelt law but reported no data on seatbelt use. However, motor vehicle crashes involving injuries and/or deaths decreased 31%.[32]

Piontkowski et al. conducted a study on the SCAT reservation located in east-central Arizona over a 10-year period beginning in 2004.[33] The intervention utilized media campaigns, community events such as health fairs and community meetings, incentive programs for officers to encourage sustained participation in the program, and a primary occupant restraint law, which was more stringent than Arizona's secondary state law. CSS use increased from 20% to 52%, and front seat seatbelt use increased from 19% to 47% after enforcement of the law.[33]

In the study conducted by Billie et al., five tribal communities, the Yurok Tribe, Hopi Tribe, Rosebud Sioux Tribe, and two tribes who requested their name not to be used (Tribe A and B), utilized different strategies to increase CSS use.[34] All tribes had a CSS distribution program combined with parental education on proper age and size appropriate restraint use. The Yurok and Hopi tribe also implemented increased citations for children riding unrestrained. The Yurok, Rosebud, and B tribes also conducted CSS use checkpoints, while

the A, B, and Yurok tribes also utilized media campaigns. CSS use increased 40% for Tribe A, 38% for Rosebud, 34% for Yurok, 32% for Hopi reservations, and 6% for Tribe B. It is important to note that Tribe B had the highest baseline CSS use at 82.6%, as compared to only 8.0% in the Rosebud tribe, which helps explain the relatively low CSS use increase.[34]

DISCUSSION

Closing the gap in injury disparities in children requires addressing motor vehicle related injuries in AI/AN children. To our knowledge, this review is the first to assemble current evidence on surveillance methods and interventions addressing this disparity through improving CRD and seatbelt use.

All studies reported significant increases in CRD/seatbelt use.[8–9, 11, 21, 28, 30–34] Some studies also reported reductions in injury severity, particularly in children 0–5.[21–28, 30–32] A common feature of all the interventions was direct collaboration with the AI/AN community and support from law enforcement agencies.[8, 21, 30, 32–34] Recommendations from the research reviewed were consistent: utilize a multipronged approach, build trust and partnerships, culturally tailor interventions, and focus on sustainability.

A general theme observed throughout the literature is that the provision of CRDs and education alone is insufficient. The most successful initiatives to increase CRD/seatbelt use were multipronged interventions, which also included media campaigns, AI/AN community law enactment/enforcement, incentive programs, or surveillance.[22, 30–34] A few of these studies chose intervention methods directly from existing guides, such as the Tribal Motor Vehicle Injury Prevention Best Practices Guide and Community Guide.[22, 25] Notably, the importance of enacting and enforcing child restraint laws, such as issuing citations for violators and conducting check points, was highlighted in many of the studied interventions.[8, 21, 30, 33–34] Increasing CRD/seatbelt use among AI/AN communities may require consistent reinforcement. This finding aligns with previous studies which have shown that tribes with CPS laws weaker than NHTSA recommendations had a higher risk of children riding improperly restrained compared to tribes subject to state legislation that met NHTSA guidelines.[9]

Building trust and partnerships is another critical element of successful interventions. Based on a history of discrimination, racism, and exploitation, many AI/AN communities distrust non-member researchers. Therefore, researchers must recognize the importance of collaborating, gaining the trust of the communities they want to work alongside, and creating mutually beneficial partnerships.[32, 34–35] It is critical to engage AI/AN communities and organizations in both the planning and implementation of the intervention, including pre-intervention surveillance, where possible.

The evidence also demonstrates that tailoring prevention programs to be culturally appropriate allows for successful uptake of CRD/seatbelt use. Given the enormous geographic, economic, and cultural diversity of tribes within the U.S., researchers must recognize traditional approaches and unique barriers to implementation in order to effect

significant change.[36] This cultural tailoring should occur throughout the planning, design, and implementation of interventions with AI/AN communities.[34] Key elements of culturally tailored programs are using local language, symbols, and images in media campaigns; employing local spokespeople for educational events; and utilizing local project coordinators.[37]

Finally, sustainability is a major barrier to the success of interventions. Multiple studies showed that increases in CRD/seatbelt use could not be sustained without continued education and enforcement after the program had finished.8 Consistent staffing and funding over multiple years, high-visibility enforcement of child restraint laws, sustained community and stakeholder support, accessibility to services, meticulous management of data, thorough evaluation, and a designated program coordinator who has ties to the community are important features of sustainability.[29, 33]

Limitations and gaps in the literature

The results of our review must be interpreted in the context of several limitations. Although the included studies were generally considered good quality, most were determined to have at least some risk of bias. In studies of surveillance methods, results were mainly limited by the potential of errors in participants' own reports. In studies of interventions, results were mainly limited by lack of comparison groups and randomized designs. Additionally, this review used a narrative synthesis approach which did not allow for any statistical conclusions.

Although our search spanned more than 20 years, we identified only a few studies describing surveillance methods and interventions designed to improve CRD/seatbelt use specifically in AI/AN children. The limited number of studies in the literature is surprising given the impact of motor vehicle related deaths and injuries in this population. Most of the CPS research conducted in AI/AN communities focus on populations 18 and older, leaving major gaps in understanding effective culturally tailored approaches to increase the proper restraint of children. Furthermore, the most recent study included in this review was published in 2016, and of the studies excluded, the most recent publication date was 2019. This is indicative of a lack of research being conducted and published in AI/AN communities to address CPS through increased proper use of CRDs/seatbelts.

Recommendations

Although interventions in this review have been shown to be successful, CRD/seatbelt use in AI/AN communities remains lower than national, regional, and state estimates.[9] Hence, we should prioritize continued and increased investment in the research and implementation of interventions that are multipronged, fostered by partnerships, culturally tailored, and sustainable. Furthermore, the enactment and enforcement of both primary and secondary occupant and child restraint laws is necessary. As reported by West et al., the SCAT saved $2.7 million over a fouryear period (2004–2008) as a result of fewer motor vehicle crashes, fewer injuries per crash, and reduced injury severity from primary seatbelt law enforcement.[32] This is particularly useful in AI/AN communities who are also disproportionately

impacted by poverty, with the 2010 Census reporting a 64% unemployment rate and 41.5% poverty rate on the SCAT reservation.[33]

Conclusion

Motor vehicle deaths and injuries disproportionately affect AI/AN children, and this disparity requires more attention. Fortunately, the literature provides evidence-based guidance on how to best address child passenger safety in this population. Interventions have proven effective when they take a multipronged approach, use partnerships, especially to enforce occupant and child restraint laws, and focus on cultural tailoring and sustainability. AI/AN motor vehicle safety research in children should be prioritized because reducing the burden of injury and deaths in children through efforts such as CRD distribution, education/training, and enhanced enforcement of laws may create intergenerational knowledge, awareness of proper child restraint, and modified safety behavior. With continued investment in AI/AN road safety initiatives, the injuries and deaths that child passengers face in and around AI/AN communities can be reduced.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Funding

This work was supported by a grant from the National Center for Injury Control and Prevention, Centers for Disease Control and Prevention (grant number 1R49CE003090).

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KEY MESSAGES

What is already known on this topic

American Indian/Alaska Native (AI/AN) children are disproportionately affected by non-fatal injuries and deaths related to motor vehicle crashes compared to other races/ethnicities. Between 2008 and 2018, the motor vehicle crash occupant death rate among AI children (0–19) was between 1.3 to 3.0 times higher than the national rate, largely due to the misuse or complete nonuse of child restraint devices and seatbelts.

What this study adds

To our knowledge, this is the first systematic review to specifically address motor vehicle injury prevention interventions related to child restraint device and seatbelt use in AI/AN children and adolescents.

How this study might affect research, practice, or policy

This study emphasizes the importance of continued investment in motor vehicle safety research and program implementation in AI/AN children. By creating lasting knowledge and awareness of proper child restraint and encouraging modified behavior, these programs can reduce injuries and deaths in AI/AN child passengers.

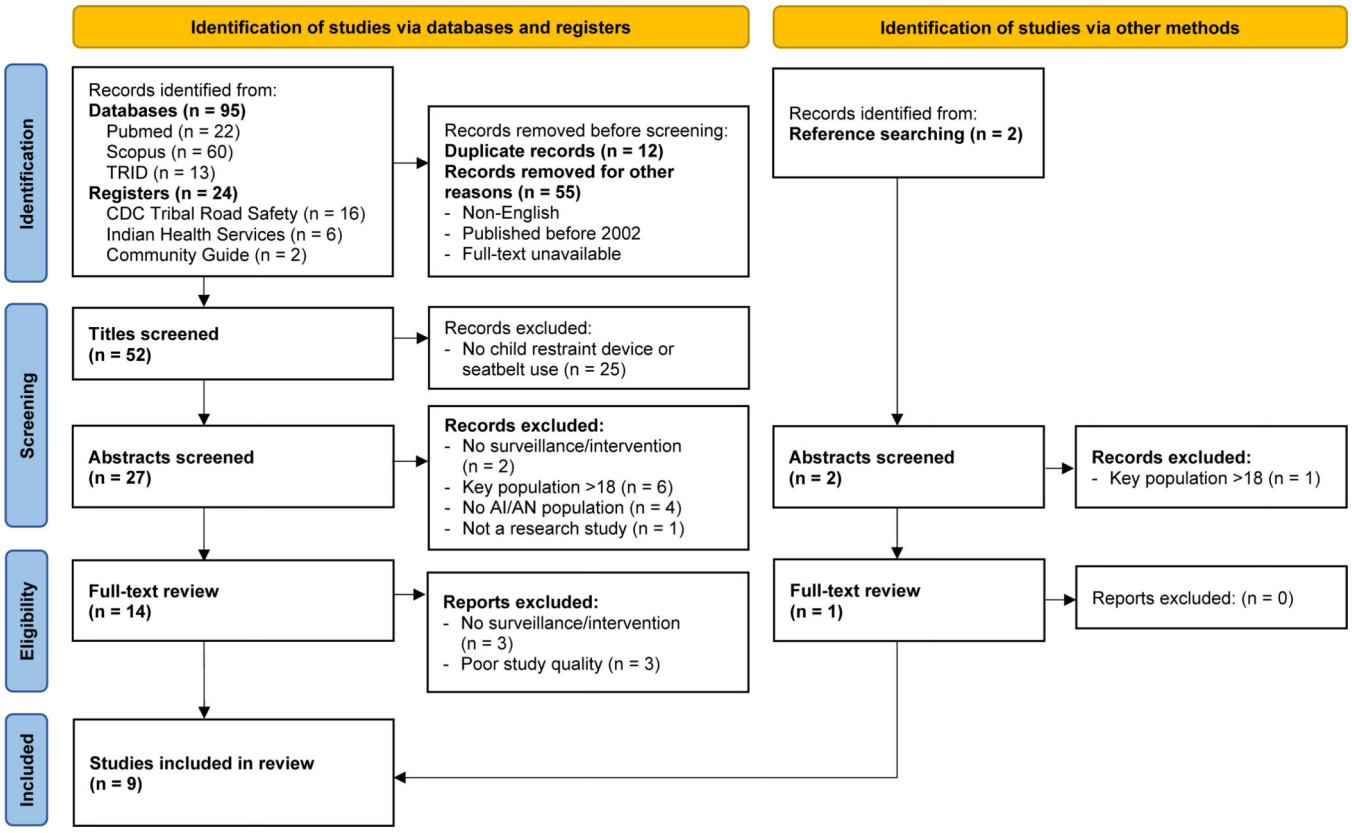

Figure 1. Flow diagram of study selection
Diagram adapted from PRISMA.[23]

Table 1.

Study outcomes and characteristics organized by study focus

First author (Year)	Study design (Quality score)	Target population, sample size	Outcomes	Strengths and limitations
Surveillance method				
Lapidus (2005)[11]	Analytic cross-sectional (8/8)	Northwest American Indian/Alaska Native (AI/AN) children (0–8), n=775	Of the children traveling, 41% were unrestrained. Proper restraint varied from 63% among infant seat-eligible children to 11% among booster seat-eligible children and was associated with younger child's age (OR per year=0.60; 95% CI=0.48, 0.75), seating location (OR front vs. rear=0.27; 95% CI=0.16, 0.44), driver seat belt use (OR=2.39; 95% CI=1.51, 3.80), and relationship (OR for nonparent vs. parent=0.28; 95% CI=0.14, 0.58).	Strengths: • Confounders identified and accounted for. • Measurements were valid and reliable with high statistical power. Limitations: • Possible misclassification from relying on drivers' reports of child age and weight. • Study confined to AI children and drivers. Some AI children riding with non-AI drivers may have been missed. • Vehicles were not entered to assess whether CSSs (child safety seats) were correctly installed. Proper restraint may be overestimated.
Lapidus (2013)[9]	Quasi-experimental (6/9)	Northwest AI/AN children (0–12), n=1,853	Of the children observed, 71% of children used a form of restraint. Only 49% were properly restrained, with variation between 24-70%. AI/AN children were more likely to be properly restrained in 2009 than in 2003 (RR=1.63; 95% CI=1.43, 1.85). The largest improvement was observed in children aged 4 to 7 with RR=2.24; 95% CI=1.73, 2.92.	Strengths: • Temporality clearly established. • High statistical power. Limitations: • Possible misclassification from relying on drivers' reports of child age and weight. • Study observations in 2003 were conducted in the summer while in 2009 they were conducted in the spring; there may be some bias as a result of seasonal differences based on school schedules.
Smith (2014) [28]	Analytic cross-sectional (7/8)	Northwest AI/AN children (0–8), n=5,351	In 2009, 2011, and 2013, the restraint status of traveling children included properly restrained (49%, 61%, 60%), improperly restrained (22%, 21%, 26%), or unrestrained (29%, 18%, 14%). The largest increase in proper child restraint use was in the age group 9–12 with baseline of 34% and 52% in 2013. In 2013, children 7–8 had the lowest proper restraint use at 46% while children 0–1 had the highest at 75%.	Strengths: • Temporality clearly established. • High statistical power. • Confounders identified and accounted for. Limitations: • Possible misclassification from relying on drivers' reports of child age, weight, and height. • Drivers who declined participation were less likely to be wearing a seatbelt and more likely to have unrestrained or improperly restrained child passengers.
Law enforcement				
Phelan (2002) [21]	Quasi-experimental (6/9)	Navajo Nation children (019), n=866	Comparing the period before (1983–88) and after (1991–95) the passage of a 1988 primary enforcement seatbelt and child restraint law, discharge rates for motor vehicle injury decreased significantly (p=0.0001) in all age groups. Severity of injury declined in young children. The proportion of children with new injury severity score >4 decreased significantly for children aged 0–4 (p=0.03).	Strengths: • Temporality clearly established. • High statistical power. Limitations: • Difficult to account for secular trends such as nationwide/state-wide enactment of restraint laws. • Unable to account for the proportion of children transferred off reservation lands and out of the Navajo IHS.
Multipronged approach				
Letourneau (2008)[8]	Quasi-experimental (7/9)	AI/AN children (3–5), n=3,500	At the end of the first year (2003), children were 2.55 times as likely to be restrained than pre-intervention, with conservative estimates using data	Strengths: • Temporality clearly established. • Conservative data analysis done to account for attrition.

First author (Year)	Study design (Quality score)	Target population, sample size	Outcomes	Strengths and limitations
			from 11 of the 14 sites suggesting an OR=1.74, p=<0.01. Overall CSS use rate for all sites and rounds at end of intervention was 47.5% (95% CI=33.8, 61.1).	Limitations: • Incomplete reporting about program implementation did not allow for accurate reporting of the number of CSS installed and distributed. • Inconsistencies in data collection as a result of financial limitations and staff unfamiliarity with data collection.
Letourneau (2009)[30]	Quasi-experimental (7/9)	Ho-Chunk Nation (HCN) children (0–7), n=5,431	CSS use increased from a baseline of 26.4% in 2003 to 78.4% in 2008 (p<0.0001).	Strengths: • Temporality clearly established. • Confounders identified and accounted for. Limitations: • Sample may have included non-HCN members.
West (2014) [32]	Quasi-experimental (6/9)	AI/AN children (012), n=626	In the Tohono O'odham Nation from 2005–2009, CSS use calculated as the proportion of total children who are restrained in observational surveys increased 45% (from 34–49%). In HCN from 2005–2009, it increased 85% (from 41–76%). The White Mountain Apache Tribe (WMAT) and San Carlos Apache Tribe (SCAT) did not collect data on CSS use in this study. However, WMAT officers reported a 314% (from 14–58%) increase in confidence in educating the community on proper CSS use from 2004–2008.	Strengths: • Temporality clearly established. Limitations: • Results among tribes cannot be compared because uniform data collection on the same measures across all four tribes was not possible because of differences in information collected by the police and data accessibility issues. • Study focused on all age groups. However, CSS use was collected on children aged 0–12.
Piontkowski (2015)[33]	Quasi-experimental (6/9)	SCAT children (012), n=479	Based on observational surveys carried out at 3 checkpoints, CSS use calculated as the proportion of total children who are restrained increased 160% (from less than 20% to 52%) between 2004–2013.	Strengths: • Temporality clearly established. • Measurements were valid and reliable. • High quality data management. Limitations: • Low officer staffing contributed to lower than expected enforcement of laws, which decreased the predicted impact of the program.
Billie (2016) [34]	Quasi-experimental (6/9)	AI/AN children (0–12), n=53,500	Between 2010–2014, CSS use increased 40% for unidentified Tribe A, 38% for Rosebud, 34% for Yurok, 32% for Hopi, and 6% for unidentified Tribe B.	Strengths: • Temporality clearly established. • Measurements were valid and reliable. • High quality data management. Limitations: • The five tribal communities had different levels of infrastructure which may have caused certain program implementations to be more effective.