

Roadside observation of child passenger restraint use

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Abstract

Background: Despite legislation and research evidence supporting the use of childhood vehicle restraints, motor vehicle crashes remain the leading cause of injury, death and disability among Canadian children.

Methods: Working in collaboration with trained car seat specialists and police officers, roadside checks were conducted to observe correct use of child restraints.

Results: Of the 1323 child vehicle restraints inspected, 99.6% of the children were restrained, 91% were in the correct seat, and 48% of restraints were correctly installed. The seat/restraint types most used incorrectly used were booster seats (31%) and seat belts (53%). The majority of incorrectly installed or fitted seats (55%) were forward facing. Common errors in installation and fit included the seat not being secured tightly enough to the vehicle, incorrect tether strap use, the harness not being tight enough, and/or the chest clip being in the wrong place.

Conclusions: The greatest proportion of incorrect seat use was among those children who transitioned to a seat belt too soon. The greatest proportion of installation and fit errors were among forward facing seats. Researchers recommend: 1) targeting parents with older children (ages 3 and above) regarding transitioning too soon from forward facing seats to booster seats, and from booster seats to seat belts; 2) targeting parents with younger children regarding correct installation of rear facing and forward facing seats; 3) collaborating with police officers to review the most common errors and encourage observation at roadside checks; and 4) creating community awareness by way of roadside checks.

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Introduction

While research and legislation continues to support the use of children's vehicle restraint systems, motor vehicle collisions remain the primary cause of death and serious injury for Canadian children under the age of 9 years [1]. In an effort to reduce the number of unrestrained motor vehicle occupant deaths and injuries by 40%, the Canadian Road Safety Vision 2010 hoped to achieve a rate of seat belt and proper child vehicle restraint use of 95% by the year 2010

[2]. According to Weber [3], the correct use of such restraint systems could reduce children's risk of death in a motor vehicle collision by as much as 74%, with the chance of serious injury diminishing by 67%. Unfortunately, the most recent Transport Canada survey indicates that Canada fell short of this goal, with the rate of children's use of restraint systems at only 91.4% of the population [4]. Although significant progress has been made in attempts to reduce the rates of death and serious injury, children

will continue to travel in motor vehicles therefore the potential for crashes remains imminent [5].

Child safety restraints are used for the purpose of reducing the risk of injury and death from motor vehicle collisions [6]. There are four stages of child restraint systems recommended by Transport Canada that include rear facing, forward facing, booster seats and seat belts [7]. They are designed to decrease the risk of ejection from the vehicle, to limit and help better distribute forces from the crash on the occupant, and secure the occupant to reduce contact with structures in the interior of the vehicle [5]. Optimal performance of child vehicle restraint systems depends on a proper fit between the seat and its occupant at the time of the crash, and the use of the seat according to the manufacturer's instructions [5, 6]. Kahane [6] identified three different levels of restraint system misuse, labeling them "correct use", "partial misuse", and "gross misuse". While correct use implies that safety benefits will not be compromised with correct installation and fit, even partially misused seats can provide benefits if the crash is not too severe, potentially reducing injuries by 48% and fatalities by 44% [6]. However, grossly misused seats provide virtually no more protection or prevention of death or serious injury than having no restraint at all. Furthermore, the value of partially misused seats decreases dramatically in front-on crashes above 48 km/hr in velocity [6]. In an observational study of over 5000 children traveling in vehicles in the United States, some form of installation or fit error was reported for almost three quarters of the seats [8, 9]. The most common errors observed were loose harness straps and the seat not being installed tightly enough to the vehicle when using the seat belt as an attachment method [8, 9]. Not having the seat firmly secured to the vehicle, as well as not having the child firmly secured in the restraint system, can independently result in excessive movement of the child during a crash, increasing the risk of potentially fatal injuries. [5]. There are many factors that can influence the decision to both use and take the time to properly use child restraint systems. Drawing from literature on booster seat use, both legislation and consistent law enforcement have been shown to affect parents' decisions to use safety seats [4, 10–14]. An additional important factor is knowledge of the risk reduction

benefits of safety seats during a crash [12, 15]. In the 1980s, a seat belt enforcement program was devised in the US with an emphasis on the health and safety benefits of wearing seat belts. The police used a warning approach prior to issuing tickets, in addition to many seat belt checkpoints conducted during the three-week program. Front seat belt use increased from 69% to 90%. Public opinion surveys indicated that 79% supported the campaign, suggesting that a high intensity enforcement program can both increase rates of seat belt use and gain the support of the community [16]. More recently, Istre et al. used a multifaceted community approach that included roadside observations to improve the use of children's restraint systems [17]. Simpson et al. determined that roadside inspections are one of the best methods for accurate data collection on restraint system use [18].

The purpose of the present study was to determine the rates of use and misuse of child vehicle restraint systems by Nova Scotia drivers. This was done in collaboration with regional police departments and the Royal Canadian Mounted Police (RCMP) by randomly creating roadside checkpoints where child vehicle restraints could be inspected by certified child seat technicians.

Methods

Participants

Participants were drivers of motor vehicles traveling with child passengers throughout the province of Nova Scotia. Data were collected on a total of 1318 child vehicle restraints, with the children ranging in age from 1 month to 15 years. The types of vehicle restraints inspected included rear facing and forward facing seats, booster seats, and seat belts. All drivers who entered the checkpoint inspection area were offered a vehicle restraint check for their children; however, only those who consented to provide the child's age, weight and height for data collection were included in the study results. Restraint inspection data were only included in the results if the child was present at the time of seat inspection, since this allowed technicians to address the appropriateness and fit of the vehicle restraint for each individual child. Seat inspections were also offered to those drivers with child seats but no

children present, although no data were collected on these restraints for analysis.

Procedure

Data collection took place at 33 roadside checkpoints scheduled in conjunction with regional police departments and the RCMP at 27 different random sites throughout urban and rural Nova Scotia. All subjects were stopped by police officers at the roadside checkpoint, where they were then invited to have their child’s vehicle restraint inspected by certified car seat technicians at a designated parking lot or side street nearby. If a child was unrestrained, police officers required the driver to appropriately restrain the child, either with their own restraint system or one provided by the team. Technicians completed a brief inspection of each child vehicle restraint, correcting any installation or fit errors noted, and providing education and recommendations to drivers as appropriate. Any seats deemed unsuitable, damaged or unsafe for the child were replaced with a new one. Drivers also received a postcard to take home detailing information on the recommended and legal stages of vehicle restraints for child passenger safety. For those drivers who agreed to participate in the study, technicians and research assistants recorded the details of each inspection, and documented the children’s age, weight and height. Technicians looked for whether the child was seated in the vehicle, if the seat used was appropriate for the child’s age, weight and height, and whether the seat was legal for use in Canada or past its expiry date. The installation of the seat was inspected, noting things such as whether the seat was tightly secured to the vehicle, if an appropriate securing system was used (i.e. seat belt or Universal Anchorage System [UAS]), and, for forward facing seats, if the top tether anchor was in use. Finally, technicians examined whether the child was properly fitted in the restraint, noting whether the correct strap height and chest clip placement were used, if the harness straps were snug, or, for children in a booster or vehicle seat, if the seat belt fit the child appropriately. Descriptive data analysis was conducted using means and frequency counts to describe the proportion of children restrained in a

correct seat, and the proportion of seats correctly installed.

Results

Of the 1323 children observed (Table 1), 99.6% were restrained in the vehicle with some form of restraint (i.e. were at least using the vehicle seat belt), with 92% of children travelling in the back seat.

Table 1. Proportion of restraint inspections by seat category

Type of restraint	n	Percent (%)
Rear facing	190	14
Forward facing	494	38
Booster seat	459	35
Seat belt	175	13
Total	1318	100

A small proportion of seats inspected (4.5%) were damaged or past their expiration dates. Replacements were provided where the expiry date had passed, or if the seat was incorrect for the child using it. The use of incorrect seats was evenly distributed throughout both rural and urban areas. An overall incorrect installation and usage rate of 53% was observed throughout the roadside checks, with the largest proportion of installation errors occurring in the forward facing car seat stage (Table 2). Of the installation errors observed, 61% were seen in urban areas, while 49% were observed in rural communities.

The most common installation errors were the seat not being tightly secured to the vehicle (32% of rear facing seats, 36% of forward facing seats), and the tether strap not being used properly with forward facing seats (28%). The most common usage error was the harness straps not being secured tightly enough when the child was sitting in the restraint; this was observed in 40% of rear facing seats and 46% of forward facing seats. The chest clip was also problematic with rear facing and forward facing seats: 28% of rear facing and 31% of forward facing children observed did not have the chest clip at the

proper armpit level. Of the booster seat and seat belt users observed, fit concerns were primarily seen in the seat belt category. Improper fitting lap belts (24%) and shoulder belts (17%) were the key errors at this stage.

Table 2. Proportion of installation and usage errors per seat stage

Type of restraint	n	Percent overall incorrect (%)	Percent incorrect by stage (%)
Rear facing	119	17	65
Forward facing	379	55	79
Booster seat	134	20	30
Seat belt	53	8	31
Total	685	52	

Nine percent of children were restrained in the incorrect seat for their age, weight and height. The majority of children who were in the wrong restraint were observed in the seat belt category, followed by those in booster seats (Table 3).

Table 3. Proportion of children restrained in the incorrect seat per seat stage

Type of restraint	Percent (%)
Rear facing	1
Forward facing	16
Booster seat	31
Seat belt	52

Of the 60 children incorrectly restrained in a seat belt, 52% of these were both under 145 cm and under 9 years of age. This indicates that half of the children in seat belts were non-compliant with provincial legislation for child vehicle restraints. For those children using a booster seat who should not have been, 94% of these children weighed less than 18 kg, which is the minimum legal limit to be safely restrained in a booster seat.

Discussion

Although close to 100% of children observed were restrained in vehicles by at least a seat belt, it appears that both correct installation and use of correct child vehicle restraints continues to be an issue.

Children restrained in the incorrect seat stage for their age, weight and height was seen throughout all four stages [7]. Transport Canada recommends restraining a child in rear facing, forward facing or booster seats for as long as possible, until the child exceeds the weight and height ranges for each restraint system [19]. The majority of children observed in an unsafe restraint category were those children using a seat belt. In Nova Scotia, legislation rules that a child should be at or above 145 cm, or at least 9 years of age to use a seat belt. However, since adult seat belts are designed for passengers over 145cm and best practice recommends that children under 145 cm, regardless of age, should be restrained in a booster seat until they properly fit the adult seat belt restraint in the vehicle [20]. While there are children currently using seat belts who do not meet the legislative requirements, there are many more who do not meet the recommended best safety practice guidelines, leaving many children at risk while travelling in a vehicle. According to best practice recommendations, almost 50% of children restrained in a seat belt would be more safely restrained in a booster seat. This finding suggests that most drivers comply with the law, but may have little or no awareness of best practice guidelines, or may choose to ignore best practice. Similarly, children inappropriately restrained in a booster seat were found to have transitioned too soon from a forward facing seat. The current findings, although higher than previously reported, are consistent with earlier reports that school-age children between 4 and 8 years old have the lowest rates of correct safety seat use, with reports of booster seat use ranging from 20 to 40% among Canadians [4]. These children were too small to be safely protected in a crash, according to Nova Scotia legal limits and best practices.

Results are mirrored when taking a closer look at the most common fit errors of those children observed wearing only a seat belt. The most commonly seen errors were: the lap belt not sitting properly on the child's thighs, or the shoulder belt not fitting properly

across the chest. These observations suggest that the child is too small to be using only a seat belt, and would be safer in a crash if using the appropriate seat for their height and weight in order that the restraint system could be properly positioned [21]. Researchers report that seat belts alone may result in ejection, and even for the largest of children (over 145 cm) the fit of a seat belt may still be inadequate [22]. Macy et al. discovered that 78% of drivers report improper positioning of the seat and lap belts for 4–9-year-old passengers, indicating that many children using only seat belts would benefit from riding in booster seats instead [23].

Rates of installation and fit error were most prominent with forward facing restraints. The current study observed an overall error rate of 53%, which is lower than the 73% observed in a large US observational study of 5000 seats [8, 9]. However, as Kahane describes, even partially misused safety seats can lose their effectiveness in head-on crashes at speeds above 48 km/hr, putting the child occupant at increased risk of injury [6]. Some of the most common installation and fit errors observed were consistent with those seen in the US, including an insecure fit of the seat to the vehicle, and loose harness straps, both of which increase the risk of the child being ejected from the seat or the vehicle during a crash [5, 8, 9]. These errors were observed with both rear and forward facing seats, although rates of error were higher for forward facing seats – perhaps because parents and caregivers of infants and younger children receive more guidance from health care professionals early in their child’s life [24]. Bliston et al. discovered a similar pattern to that found in the present study, stating that older children and seat belt users are more likely to correctly use restraints, suggesting that younger children and their caregivers need to be the target of education [25].

Anecdotally, researchers discovered that both police and the general community in rural and urban areas were very receptive to the roadside car seat checks. Police officers were seen to be proactively promoting child passenger safety, rather than having a punitive role, such as issuing tickets and fines. As with the seat belt program in the US, it appears this enforcement initiative was beneficial and well supported by the community [16].

Opportunities exist to better inform parents, and influence future legislation and enforcement that could address these unsafe practices. Drawing from the study findings, researchers recommend that parents and caregivers of older children (aged 3 years and above) be targeted with information to transition their children safely and appropriately through the car seat stages (i.e., from forward facing to booster seats and booster seats to seat belts). Secondly, parents of younger children should be targeted with specific information on the proper installation and fit of their child’s rear facing or forward facing restraints. Furthermore, the benefits of restraining children in a forward facing seat until they are greater than 18 kg, and in a booster seat until they are taller than 145 cm and properly fit an adult seat belt restraint, should be reinforced with parents. Opportunities also exist to approach policy makers to adopt legislation supporting the recommended best practice of seat belt use for children over 145 cm, regardless of the child’s age. Providing education and awareness support to police enforcement departments about the key assessments of child restraint regulations can promote police confidence in assisting families with proper child vehicle restraint. Finally, the use of roadside car seat checks in collaboration with police officers can promote community awareness for child vehicle safety, educate the public, and engage police officers in promoting safe travel for children.

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