Faculty of Medicine | University of Manitoba

Student Name: Faith Cormier

Project Title: Booster seat promotion in Winnipeg: Evaluation of a campaign targeting parents

Supervisor Name: Dr. Lynne Warda
Departmental Affiliations: Pediatrics and Child Health/WRHA Population and Public Health/Injury Prevention

SUMMARY:

Motor vehicle collisions are the leading cause of injury death for Canadian children, with improper restraint being an important and preventable contributing factor. Children 4-8 years of age are the least likely to be properly restrained, and should be in forward-facing car seats or booster seats until they are at least 4 foot 9 inches tall in order to prevent lap belt syndrome and other serious injuries.

A three-year booster seat promotion campaign was launched in 2010 in Winnipeg. The primary goal of this project was to determine the effectiveness of this campaign, in terms of observed booster seat use, using a roadside observational study. Secondary objectives were to measure self-reported booster seat use; to examine parental estimations of their child's height and weight; and to explore parents' understanding and use of booster seats, using a parent survey.

Booster seat use increased significantly throughout the campaign, from 14.7% in 2010 to 31.4% in 2012 ($p<0.001$). Booster seat use was significantly higher by self-report (68.3%) and dropped significantly by 8 years of age ($p=0.001$). Parents tended to underestimate their child's height and weight. 13 of 14 children in seat belts should have been using a booster seat, however their parents did not know that a booster seat was recommended.

The next phase of the booster seat campaign and the introduction of legislation in 2013 will be important to further increase use, particularly among children 7-8 years of age. These results may be used to inform and improve on these efforts.

ACKNOWLEDGMENTS:

Thank you very much to Dr. Lynne Warda, Dr. Caroline Piotrowski, Dr. Curt Pankratz, Tamara Taillieu, and Gemma Briggs without whom this project would not have been possible.

I gratefully acknowledge the support entirely or in part by one or all of the following sponsors; AUTO21 Network Centres of Excellence, H.T. Thorlakson Foundation, Dean Faculty of Medicine, St. Boniface Research Foundation, Manitoba Health Research Council, Manitoba Institute of Child Health, Kidney Foundation of Manitoba, Leukemia and Lymphoma Society of Canada, CancerCare Manitoba, Manitoba Medical Service Foundation, Associate Dean (Research) Faculty of Medicine, Heart and Stroke Foundation, Health Sciences Centre Research Foundation.

Student Signature

Supervisor Signature

Faith Cormier

Introduction

Unintentional injury is the leading cause of mortality for Canadian children 5-9 years of age and a leading cause of hospitalizations.[1,2] Unintentional injury includes motor vehicle traffic deaths, which occurred on a magnitude almost six times greater than any other unintentional injury in 2009.[3] Winnipeg data show that 50% of children hospitalized with spinal cord injuries are injured in motor vehicle collisions, and that 90% are unrestrained or improperly restrained (e.g. use of an adult seat belt in a young child).[4] Children should be in booster seats until they are at least 4 feet 9 inches tall.[5] When young children are inappropriately restrained in seat belts only, the lap belt crosses their mid-abdomen and the shoulder belt crosses their neck. This incorrect positioning of the seat belt leads to abdominal as well as head and neck injuries during collisions.[6] Garrett & Braunstein first described this spectrum of injury in adults, known as "seat belt syndrome", in 1962. [7] Manitoba Public Insurance claims data document that a single lap-belt injury resulting in spinal cord injury in a young child costs well in excess of 1 million dollars.[4]

Belt-positioning booster seats help to improve the fit of lap and shoulder restraint systems by lifting or "boosting" children up into the correct position. Elementary school-aged children who are restrained with seatbelts instead of booster seats are 3.5 times more likely to be injured in a car crash and 4.2 times more likely to suffer head trauma.[8] Many large-scale studies have shown a reduced risk of injury for children 4-8 years of age if they are restrained in a booster seat during a crash. These studies have found as much as an 82% reduction in side-impact injuries, a 45% reduction in serious injuries, and a 14% reduction in all types of injuries.[9,10]

Bruce et al. measured booster seat use across Canada in a roadside observation study. Booster seat use for 4-8 year olds was 31.8% (n=1289) across Canada, with a rate of 19.1% (n=70) in Manitoba. Also, Manitoba (8.7%) and Saskatchewan (8.7%) had the highest rate of unrestrained children in a moving vehicle. Overall, it was found that children aged 4-8 had the lowest (39.8%) rates of correct use of child safety seats.[11]

Booster seat legislation may be one effective way to increase booster seat use. Currently, 7 Canadian provinces have booster seat legislation.[12] Manitoba law currently requires the use of a car seat for children up to 5 years of age and 50 pounds but does not require the use of a booster seat.[13] Booster seat legislation was introduced this year in Manitoba. Bill 8, The Highway Traffic Amendment Act (Use of Child Safety Seats), had its First Reading on April 30th 2012 and received Royal Assent on June 14th 2012. The revised Manitoba law will require the use of booster seats for children less than 4 foot 9 inches and 80 pounds and nine years of age. This legislation will be effective early in 2013.

Although legislation may be one method to increase booster seat use, non-legislative interventions, such as large public education campaigns and free or low cost booster seat programs, have been implemented in many jurisdictions. While programs such as these have been evaluated for car seat use, there are few studies that evaluate non-legislative interventions for booster seat promotion. A Cochrane meta-analysis found that incentives + education, distribution + education, and education-only interventions produced beneficial effects to varying degrees.[14] A study conducted by Ebel et al. determined the effectiveness of a booster seat campaign conducted in the United States. The campaign aimed to increase parental awareness of the need for booster seats, reduce motivational and financial barriers to purchasing a seat, and use

public health messages to reinforce booster seat use. Media, publicity, education outreach, policy change, and provider education were all avenues through which booster seat use was promoted. The researchers found that booster seat use in intervention communities increased from 13.3% to 26.1% in a period of fifteen months following the start of the intervention.[15]

IMPACT, the injury prevention program of the Winnipeg Regional Health Authority (WRHA), in partnership with Manitoba Public Insurance and the Auto21 Centres of Excellence launched a Winnipeg booster seat promotion campaign in 2010. This campaign targeted parents and pediatricians through many avenues including letters sent to all Winnipeg parents from MPI and the WRHA, physician education, and booster seat promotion at large community events for children and families. Baseline roadside observations took place in 2010 when 1309 vehicle observations were made and booster seat use was 14.7%.

The primary goal of this project was to determine the effectiveness of booster seat promotion activities in Winnipeg between 2010 and 2012, in terms of observed booster seat use, using a roadside observational study. Secondary objectives were: to determine the prevalence of self-reported booster seat use among parents of 4 to 8 year old children in Winnipeg; to examine differences between parental estimations of their child's height and weight and the actual measured height and weight for each child; and to explore parents' understanding and use of booster seats.

Materials and Methods

A parent survey and a roadside observational study were conducted in Winnipeg, Manitoba, Canada. The parent survey took place at a large community event in 2011 and the roadside observational study took place in June/July 2011 and June/July 2012. This study was approved by the University of Manitoba Health Research Ethics Board.

Parent Survey

A parent survey was conducted at the 2011 Teddy Bears' Picnic in Winnipeg, Manitoba. The Teddy Bears' Picnic is a large annual community event hosted by the Children's Hospital Foundation of Manitoba. It attracts parents and children who participate in various activities and visit tents set up in the Assiniboine Park. Our parent survey took place in the "Safety Tent" where parents completed the survey, asked questions about booster seats, and had their child/children weighed and measured. The survey was administered to parents with children 4-8 years of age who presented to the "Safety Tent". Parents were first asked the age and sex of their child, followed by questions regarding the restraint type used (e.g. car seat, booster seat, seat belt). They were asked to estimate their child's height and weight and whether they thought that their child was big enough to use a seat belt only. Following the estimation of weight and height, each child was then weighed and measured to determine weight in pounds and height in inches. Using the actual height and weight of each child, it was determined whether the child was in the correct restraint for his/her size. If the restraint was incorrect, parents were asked to select why they chose this type of restraint (e.g. I did not know that booster seats are recommended for his/her size). Parents were also asked if they intended to change the form of restraint they were currently using if it was found to be incorrect. Regardless of whether the restraint was correct or incorrect,

parents were given a booster seat "prescription" as well as a pamphlet with more detailed booster seat information. Finally, parents were asked whether there was a booster seat law in Manitoba.

Data were coded and entered into SPSS Version 11.5. Descriptive analyses were conducted for each variable. Significant differences for restraint use by year of age and for gender were assessed using the Chi-Square statistic.

Vehicle Observation Study

Roadside vehicle observations were conducted throughout June/July 2011 and June/July 2012. Observational data were obtained at 27 traffic intersections throughout Winnipeg, Manitoba, Canada. Within each of Winnipeg's 12 WRHA Community Areas[i], two observation sites were chosen, totaling 24 sites. Observation sites were chosen based on proximity to schools, expected traffic volume, and presence of a traffic light or stop sign at the intersection. Additionally, three busy shopping centers were selected to be observation sites, leading to 27 sites in total. Observations were conducted Monday to Friday between 3:30pm and 6:30pm, Saturdays between 10:00am and 6:00pm, and Sundays between 12:00pm and 5:00pm. Observations were recorded using Transport Canada's methods for periodic child restraint surveillance: Roadside Site Observation Form and Site Administration Form.[16] The observational research team, composed of eight research assistants including the author, received training in the use of this method, which has been used in previous research.[17]

Observations were conducted by observers who stood at a predetermined observation point (sidewalk, grass, median) close to the selected intersection or parking lot entrance/gate. Eligible vehicles contained at least one child estimated to be between 5 to 8 years of age; vehicles were excluded if the age of the child was uncertain. Four year olds were excluded in the observational studies to ensure that no three year olds were recorded as being in the 5-8 year old age range. Data were recorded for vehicles with child occupants travelling toward the observer, stopped at a red light or stop sign in the lane closest to the curb occupied by the observer. If time permitted, the next eligible vehicle parked at the red light was observed. Data were collected until the light changed, resuming at the next red light cycle. Research assistants attended each site in pairs for 30 minutes. If there were more than 20 observations made within this time, observers had flexibility to stay longer. If there were no observations for the first 20 minutes, observers moved to their next scheduled site.

Data were coded and entered into SPSS Version 11.5. Descriptive analyses were conducted for each variable. Predictors of booster seat use were assessed for statistical significance using the Chi-Square statistic (study year/week, driver restraint use, driver sex, number of children in the vehicle). The number of vehicles and the number of children that did or did not use booster seats was analyzed. When there were multiple children in a vehicle, the booster seat use of those children could not be viewed as independent, therefore, we reported booster seat use for *children* and *vehicles* in separate analyses. Vehicles were classified as "booster users" (all children 5 to 8 years old are in booster seats), "booster non-users" (no children 5 to 8 years old are in booster

[i] WHRA Community Areas are used for informing decision-making and health planning within the Region's geographically defined communities.
http://www.wrha.mb.ca/research/cha/profiles.php

seats), and “for some children” (some children 5 to 8 years old are in booster seats while others are not).

Results

Parent Survey

There were 120 respondents. The age distribution of the sample is seen in **Table 1**. Four year-olds made up the largest percentage by year of age (29.2%). Girls accounted for 72.9% (n=86) of the sample.

The results in **Table 1**, examining restraint type by age, show that there is a significant association between the restraint type used and the age of the child ($\chi^2 = 70.67$, $p < 0.001$). Younger children are more likely to use forward-facing car seats, and the oldest children are more likely to be in seat belts only. We also examined restraint type by gender, and found that there was no significant difference between the restraint type used by parents for boys or girls ($\chi^2 = 0.29$, $p = 0.87$).

When examining booster seat use, we found that 68.3% (n=82) of respondents were using booster seats. When we examined booster seat data by year of age, 57.1% of 4-year olds were in booster seats, 68.4% of 5-year olds, 87.0% of 6-year-olds, 85.7% of 7-year-olds, and 33.3% of 8-year-olds. The trend is shown in **Figure 1** where booster seat use peaks with 6-year-olds, plateaus with 7-year-olds, and drops significantly for the 8-year-old group ($\chi^2=18.11$, $p = 0.001$).

We asked parents to estimate their child’s weight and height. 67.3% of parents underestimated their child’s weight, by a mean of 3.0 ± 6.0 pounds. Estimation errors ranged from underestimating by 35% to overestimating by 50% of the child’s total body weight. 76.1% of parents underestimated their child’s height, by a mean of 2.4 ± 3.1 inches. Estimation errors ranged from underestimating by 32% to overestimating by 14% of the child’s total height. Only one child was tall enough to use a seat belt, yet 14 children were in seatbelts without a booster seat (**Table 1**). When asked if their child was big enough to use a seat belt without a booster seat, the majority of parents said no (85.8% (n=103)).

Using the actual height and weight of each child, we determined whether or not they were using the correct restraint. There were 119 of 120 children that participated in the measuring process. If the child was over 40 pounds, they could be in a booster seat. However, if they were over 40 pounds and still using a forward-facing car seat with harness this was also deemed correct. Children were suitable to be in a seat belt only if they were over 4 foot 9 inches tall. According to our parent survey, 84.0% (n=100) of parents were using the correct car restraint for their child’s size. Only 16.0% (n=19) of children were in an incorrect restraint.

Of the children in booster seats (n=82), 92.7% (n=76) were in the correct restraint. The 6 children that were in boosters incorrectly were those children that were too small to be in a booster (less than 40 pounds). However, of the children in seatbelts (n=14), 92.9% (n=13) were in an incorrect restraint. These two findings indicate that the majority of children in seatbelts should have actually been in booster seats, whereas the majority of children in booster seats were in the correct restraint type.

If the restraint type was found to be incorrect following the weighing and measuring, parents were asked if they intended to change the form of restraint they were using. Only 8 parents responded to this question. We found that 62.5% (n=5) of parents did not intend to change their form of restraint even though it was incorrect. Only three parents said that they would change the form of restraint they were using after discovering that it was incorrect.

If parents were not using the correct restraint for their child's size, they were asked for reasons why. Thirteen parents responded to this question. Parents were given 7 options to choose from. The majority of parents said that they did not know that booster seats were recommended for their child's size (46.2% (n=6)). Three parents said that they thought their child was too big or was old enough to use a seatbelt without a booster seat. Parents were also able to choose an "Other" option and fill in their own response. Responses in the "Other" category included that they were in the process of switching seats (n=1), the seat was not comfortable (n=1), they thought it was okay to transition their child (n=1), or their child turned 8 years of age (n=1).

At the time of the survey, we asked parents (n=117) whether there are laws in Manitoba that require the use of booster seats. The vast majority of parents responded that yes there are laws in Manitoba, making up 64.1% (n=75) of the sample. Of the parents using booster seats, 71.3% (n=57) thought that there was a booster seat law.

Vehicle Observation Study

There were a total of 1541 vehicle observations and 2026 children observed in ***2011***. 51.1% (n=787) of drivers were male. The majority of drivers (84.0%) were restrained in a seatbelt. There were a total of 3249 vehicle observations and 4329 children observed in ***2012***. 51.5% (n=1673) of drivers were male and the majority of drivers (86.7%) were restrained in a seatbelt.

The age distribution of the ***2011*** and ***2012*** samples can be seen in **Table 2**. In both years, the majority of children were estimated to be 5-8 years of age (87.0% in 2011 and 84.8% in 2012). If the age of the child was coded as unknown, the observer was unable to see the child clearly enough to record an age.

Child seating position is seen in **Table 3**. In both years, the majority of children were in the back seat (80.8% and 82.9%). However, 18.3% of children were in the front seat in 2011 and 16.6% of children were in the front seat in 2012.

Restraint type is seen in **Table 4**. In ***2011***, 52.3% (n=1060) of children were in seatbelts. The next most common seating was a booster seat (19.6%). The third most common restraint type was "no booster, cannot see seatbelt" which represented 18.1% (n=367) of the population. This restraint type means that the child was definitely not in a booster seat, but the observer could not see a seatbelt. Therefore, this category could include situations such as: the child was in a lap belt, the child put the shoulder belt behind their back, or the child was not restrained. In ***2012***, 47.7% (n=2063) of children were in seat belts. The next most common restraint type was booster seats (25.4%). The third most common restraint type was "no booster, cannot see seatbelt", with 15.2% (n=657) of the population in that category.

Table 5 shows restraint types for all 5-8 year old children. In ***2011***, the majority of these children, 55.1% (n=971), were restrained in seatbelts. The next most common restraint type for these children was the "no booster, cannot see seatbelt" category, with 20.8% (n=367) of the population in this group. The third most common restraint type seen was booster seats, with 20.5% (n=362) of the sample in this category. In ***2012***, 49.4% (n=1813) of children were restrained in seat belts. The next most common restraint type seen was booster seats, with 29.7% (n=1092) of the population in booster seats. The third most common restraint type seen was the "no booster, cannot see seatbelt" category, with 16.4% (n=602) of the population in this category. The number of 5-8 year old children in booster seats increased from 20.5% in 2011 to 29.7% in 2012.

Booster seat use by vehicle for ***2011*** and ***2012*** is seen in **Table 6**. In ***2011***, we found that 20.8% (n=320) of vehicles were booster users and 77.0% (n=1187) were not booster users. In ***2012***, we found that 31.4% (n=1021) of vehicles were booster users and that 67.2% (n=2182) were not booster users.

For the ***2011*** data, we performed a cross tabulation between driver restraint and booster use and found no significant association. We also performed a cross tabulation between driver sex and booster use and found no significant association. However, there was a significant association ($\chi^2 = 44.82$, $p < 0.001$) between booster seat use and the number of children in the vehicle, which can be seen in **Table 7**. The greater the number of children in the vehicle, the less likely the vehicle was to be a booster user with all children aged 5-8 restrained in a booster seat.

For the ***2012*** data, we performed the same analyses. We did a cross tabulation between driver restraint and booster use and we found no significant association. Then we performed a cross tabulation between driver sex and booster use and found a significant association, with higher use in women (33.2%) than men (30.4%) ($\chi^2 = 6.48$, $p = 0.04$). Finally, we did a cross tabulation between the number of children in the vehicle and booster seat use and found a significant association ($\chi^2 = 90.28$, $p < 0.001$), which can be seen in **Table 7**. Similar to 2011, it appears that the greater the number of children in the vehicle, the less likely the vehicle is to be a booster user vehicle with all children aged 5-8 restrained in a booster seat.

We performed a cross tabulation between the year of data collected (***2010, 2011, 2012***) and booster use, the results of which can be seen in **Figure 2**. We found that there was a significant difference ($\chi^2 = 159.66$, $p < 0.001$) in booster seat use depending on the year of data collection. In ***2010***, where 1309 vehicles were assessed for booster use status, 14.7% (n=193) of vehicles were booster users. In ***2011***, where 1541 vehicles were assessed for booster seat status, 20.8% (n=320) of vehicles were booster users. Finally, in ***2012***, where 3249 vehicles were assessed for booster use status, 31.4% (n=1021) of vehicles were booster users.

Finally, we performed an analysis by week for the ***2012*** data, shown in **Table 8**, in order to explore the potential impact of media reporting about new legislation. We found a significant difference in booster seat use by week ($\chi^2 = 34.20$, $p < 0.001$), with a peak in Week 3 (35.4%), correlating with the passing of Bill 8.

Discussion

There are several limitations of the 2011 parent survey that may have influenced the results. First, the use of a convenience sample, as well as the sample size of 120, limits the ability to generalize the results to the general population of children in our targeted age group. Another limitation was that the study sample was skewed as it over-represented girls (72.9% (n=86)). Gender differences in booster seat use have not been documented, however, gender has not been shown to be an important predictor of seat belt use.[18] The survey may have been biased because the population that attends the Teddy Bears' Picnic may be of higher socioeconomic status, which may facilitate learning about and using booster seats. Additionally, parents that we surveyed were parents that decided to bring their children to the "Safety Tent" at the event. This means that the parents that we surveyed likely had a particular interest in safety, which included visiting our booster seat booth.

For the vehicle observations, there are some limitations that are important to note. One limitation is the fact that the majority of vans and sport utility vehicles (SUVs) have tinted back windows. This makes it difficult for observers to see clearly enough into these vehicles to make an observation recording. This means that several children being transported in vans and SUVs were missed in the observations, which may be a significant number of children. There are other limitations of roadside observations, such as the children for whom neither a shoulder belt nor booster seat could be seen. We attempted to mediate this by training all observers in the same manner and using paired observers at all of the sites so that the observations were as accurate as possible.

The primary goal of this study was to determine whether or not the Winnipeg booster seat campaign has been effective. Our data indicate that booster seat use has increased significantly between 2010, when the booster seat campaign started, and 2012, before legislation was in effect. As legislation has only recently been announced publicly, the observed increase in booster seat use since 2010 may have been influenced by the booster seat campaign, and may reflect intensified public education activities in 2012, with the launch of new provincial booster seat materials and additional media and advertising. A study conducted by Ebel et al. determined the effectiveness of a booster seat campaign conducted in the United States. The campaign aimed to increase parental awareness of the need for booster seats, reduce motivational and financial barriers to purchasing a seat, and use public health messages to reinforce booster seat use through various avenues (e.g. media, education outreach). The researchers found that booster seat use in intervention communities increased from 13.3% to 26.1% in a period of fifteen months following the start of the intervention.[15] This increase is similar to our finding that booster seat use increased from 14.7% in 2010 to 31.4% in 2012, over the duration of the campaign.

There was a large discrepancy in parent-reported booster seat use versus observed booster seat use when comparing parent survey results to the roadside observational study. In our 2011 parent survey of 4-8 year old children, we found that 68.3% (n=82) of children were using booster seats. However, our roadside observational study found that 20.5% (n=362) of 5-8 year old children were booster users. The results that we have found are similar to those found in previous research. Snowdon et al. conducted both a roadside observational study and a parking lot interview survey to determine differences in child restraint. It was found that the largest discrepancy was for children 4-8 years of age. In the roadside observational study, 29.1% of

children were correctly restrained versus 67.8% in the parking lot survey. However it is important to note that there was 67% refusal of participants for the parking lot survey, which may have included a higher proportion of booster seat non-users.[19] This article demonstrates a discrepancy found between what restraint type parents say they are using versus what is actually observed on the roads, similar to what we found in our studies.

The disparity that has been found in our study, as well as in previous research, is concerning for the safety of children. Morbidity and mortality of 4-8 year olds in vehicle crashes is largely dependant upon appropriate restraints.[6] The discrepancy may, in part, be caused by our methodology. As mentioned above, a limitation of the parent survey was that the sample may have been biased because of the population that tends to attend the Teddy Bear's Picnic, particularly the "Safety Tent". This biased population may have caused booster seat reporting in the parent survey to be higher than that of the general population. Also, we may have missed some roadside observations because of tinted windows. This may have led to the roadside observations showing lower booster seat use than the general population. Other factors that may have led to the results that we found include that the parent survey was administered publicly in front of other parents. This may have caused parents to alter their responses because of social desirability bias[ii].

The lack of a booster seat law in Manitoba may have contributed to the low rate of observed use in our sample. Studies across Canada and the United States have documented significantly higher rates of booster seat use in regions with booster seat legislation than in regions without.[6, 20] A study conducted in Michigan by Bingham et al. found that booster seat legislation is a key determinant of parents' motivation to use booster seats. They found that 70% of part-time booster seat users said that they used them because they believed that there was a booster seat law. Also, 60% of part-time users and non-users said that they would be more likely to use booster seats if there was a law. Over 90% of part-time users and non-users said that a law would make it easier for them to use booster seats.[6] Legislation may be one method to increase booster seat use in Winnipeg, Manitoba. According to the parent survey, 64.1% (n=75) of parents said that they think that Manitoba currently has a booster seat law. The fact that many parents believe there is already a law may limit the impact of a new law, without significant public education and positive enforcement. The booster seat campaign was effective in terms of increasing booster seat use between 2010 and 2012. Another campaign regarding adherence to the new legislation would likely be of benefit.

The parent survey provides additional insight into why parents are not using booster seats. The majority of parents did not know that booster seats were recommended for their child's size. Some parents said that they thought their child was too big or was old enough to use a seatbelt without a booster seat. Other parents were in the process of switching seats or their child felt the seat was uncomfortable. The literature finds several common parental misconceptions, such as booster seats being unsafe, as they are not anchored to the vehicle like a child safety seat is. Also, some parents believe that age and height are less important than child "fit"/weight in terms of safety seat transitioning.[21,22] In addition, as children grow older, they may resist booster seat use.[23, 24] Many parents have identified negative child responses as a reason for allowing their

[ii] Social desirability bias: the tendency of respondents to answer questions in a manner that will be viewed favorably by others.

child's/children's non-use or misuse of booster seats.[25] Rivara et al. and Vaillancourt et al. found that older booster seat aged children are more frequently teased or bullied regarding booster seat use.[23,26] This may be an important reason for decreased booster seat use in the older children in our sample.

Booster seat use has been found to vary significantly by year of age. In the parent survey, we found that booster seat use peaks with 6-year-olds, plateaus with 7-year-olds, and drops significantly for the 8-year-old group. A 2003 United States National Highway Traffic Safety Administration (NHTSA) telephone survey found that booster seat usage peaked at ages 4 (29%), 5 (32%), and 6 (27%), and declined sharply thereafter.[10] Ebel et al. also found that booster seat use decreased as child age increased. They found that booster seat use was highest for 4-6 year old children, but was uncommon for 7 and 8 year olds.[15] Based on our results and those of previous research, older children (7 or 8) in the booster seat age range are less likely to be restrained in booster seats. Therefore, an important focus of booster seat campaigns should be on proper use for the older segment of the booster seat aged population.

Family and vehicle size have been shown to be factors in booster seat use.[25] We found there was a significant association between the number of children in the vehicle and whether that vehicle was a booster seat user or not. The greater the number of children in the vehicle, the less likely the vehicle was to be a booster user for all 5-8 year old children in the car. Potential reasons for this observation might include that children in larger families are more likely to be prematurely graduated to a seat belt due to cost or availability of the correct restraint device for each child in the family. It is also possible that when there are more children in the car, the other children are friends without booster seats. Simpson et al. found that parents described booster seats as more challenging or "nearly impossible" to use when there were extra child passengers in the vehicle.[25]

An additional finding of note was that booster seat use varied by the week the vehicle observation took place. This analysis was performed to determine whether a media effect might have been present as there was a large media focus in June 2012 when observations took place. Booster seat use increased significantly in Weeks 3 and 4, and declined slightly from those in Week 5. We speculate that this could have been influenced by the fact that Bill 8, The Highway Traffic Amendment Act (Use of Child Safety Seats), received Royal Assent on June 14th 2012 (Week 2).

An important finding in the parent survey was that parents tended to underestimate the weight and height of their child. In a study conducted by Edwards et al. (2006) it was found that many parents did not know the height or weight of their children, not even approximately.[27] Similar findings were found by Apsler et al. and Ebel et al.[28,15] Height is the most important predictor of seat belt fit. Parental estimates of height are important to consider for booster seat legislation, which uses height requirements. Booster seat promotion that includes actual weighing/measuring events and promotes the 4 foot 9 inch height requirement may improve compliance with the law.

Finally, a number of interesting findings were noted, both for driver characteristics and for front seat child passengers. Booster seat use varied by driver sex in 2012, with women using booster seats slightly more than men. Ebel et al. found that females were more likely to be driving children correctly restrained booster seats[15], similar to what we found in 2012. We found no significant association between driver restraint and booster seat use. However, Ebel et al. found that driver seat belt use was strongly associated with correct booster seat use.[15]. Lastly, many

children (18.3% in 2011 and 16.6% in 2012) were seated in the front seat. In future booster seat campaigns, it will be important to highlight proper child position in the vehicle. Guidelines from Transport Canada, the American Academy of Pediatrics and the National Highway Traffic Safety Administration recommend that children remain in the back seat until they are 13 years of age.

Conclusion

The main goal of this project was to determine whether the 2010-2012 Winnipeg booster seat campaign has been effective. We found that booster seat use increased significantly from 14.7% in 2010 to 31.4% in 2012. Although 31.4% booster seat use is still lower than desired, significant progress has been made. As booster seat legislation has only recently been announced publicly, we conclude that an increase in booster seat use over the past three years may have been influenced in part by the booster seat campaign and intensified efforts by campaign partners.

Although the campaign has helped to increase booster seat use, we anticipate that future legislation will help to increase use even further. The new Manitoba legislation will require booster seat use for children up to 4 foot 9 inches, 80 pounds, and nine years of age. This legislation will take effect in early 2013. We hope to conduct further studies that will track changes in booster seat use following legislation.

References

1. Public Health Agency of Canada. (2005). Table 1: Leading causes of death, Canada, 2005, males and females combined: counts (crude death rate per 100,000). Retrieved from http://www.phac-aspc.gc.ca/publicat/lcd-pcd97/table1-eng.php
2. Public Health Agency of Canada. (2006). Table 2: Leading causes of hospitalizations, Canada, 2005/06, males and females combined: counts (crude rate per 100,000). Retrieved from http://www.phac-aspc.gc.ca/publicat/lcd-pcd97/table2-eng.php – leading cause of hospitalizations
3. Public Health Agency of Canada. (2009). Child and Youth Injury in Review, 2009 Edition – Spotlight on Consumer Product Safety. Ottawa, ON: Government of Canada.
4. IMPACT Injury Prevention Program, Winnipeg Regional Health Authority. (2011). Booster Seat Backgrounder. Winnipeg, MB: IMPACT.
5. Society for Advancement of Violence and Injury Research. (2012) Success Story: Harborview ICRC Booster Seat: Community Booster Seat Promotional Campaigns. Retrieved from www.savirweb.org/assets/73_successstoryharborviewicr.pdf
6. Bingham, R.C., Eby, D.W., Hockanson, H.M. & Greenspan, A.I. (2006). Factors influencing the use of booster seats: A state-wide survey of parents. *Accident Analysis and Prevention*, *38(5)*, 1028-1037.
7. Garrett, J.W. & Braunstein, P.W. (1962). The seat belt syndrome. *Journal of Trauma*, *2*, 220-8.
8. Winston, F.K., Durbin, D.R., Kallan, M.J. & Moll, E.K. (2000). The danger of premature graduation to seat belts for young children. *Pediatrics*, *105(6)*, 1179-1183.
9. Arbogast, K.B., Jermakian, J.S., Kallan, M.J. & Durbin, D.R. (2009). Effectiveness of belt positioning booster seats: an updated assessment, *Pediatrics*, *124*, 1281-1286.
10. National Highway Traffic Safety Administration. (2003). 2003 motor vehicle occupant safety survey. *U.S. Department of Transportation, Volume 5 Child Safety Seat Report*. Retrieved from http://www.nhtsa.gov/people/injury/research/2003MVOSSVol5/pages/index.htm

11. Bruce, B.S., Snowdon, A.W., Cunningham, C., Cramm, C.L., Whittle, K., Correale, H., Barwick, M., Piotrowski, C., Warda, L., Harrold, J. (2011). Predicting parents' use of booster seats. *Injury Prevention, 17(5),* 313-318.
12. Safe Kids Canada. (2012). Car and Booster Seat Legislation Chart. Retrieved from http://www.safekidscanada.ca/Professionals/Advocacy/Documents/26794-CarSeatLaws.pdf
13. Child Restraining Devices Regulation, Man Reg 411/87 R. Retrieved from http://www.canlii.org/en/mb/laws/regu/man-reg-411-87-r/latest/man-reg-411-87-r.html
14. Ehiri, J.E., Eiere, H.O., Magnussen, L., Emusu, D., King, W., Osberg, J.S. (2006). Interventions for promoting booster seat use in four to eight year olds traveling in motor vehicles. Cochrane Database of Systematic Reviews 2006, Issue 1. Art. No.: CD004334.
15. Ebel, B.E., Koepsell, T.D., Bennett, E.E., Rivara, F.P. (2003). Use of child booster seats in motor vehicles following a community campaign. *JAMA*, *289:7*, 879-884.
16. Transport Canada (2011). Data Collection Techniques. Retrieved from http://www.tc.gc.ca/eng/programs/environment-urban-guidelines-practitioners-tdmguide2009-3-1677.htm
17. Transport Canada (2007). Keeping Kids Safe in Cars: Child Passenger Safety Promotion in Aboriginal Communities - Final Report. September 2007. TP 14775 E
18. Thuen, F. & Rise, J. (1994). Young adolescents' intention to use seat belts: the role of attitudinal and normative beliefs. *Health Education Research*, *9(2)*, 215-223.
19. Snowdon, A., Rothman, L., Slater, M., Kolga, C., Hussein, A., Boase, P. & Howard, A. (2010). Methodology of estimating restraint use in children: Roadside observation or parking lot interview survey. *Accident Analysis and Prevention*, *42(6)*, 1545-1548.
20. Snowdon, A., Rothman, L., Slater, M., Kolga, C., Hussein, A., Boase, P. & Howard, A. (2009). A comparison of booster seat use in Canadian provinces with and without legislation. *Injury Prevention*, *15(4)*, 230-233.
21. Snowdon, A.W., Polgar, J., Patrick, L. & Stamler, L. (2006). Parents' knowledge about and use of child safety systems. *The Canadian Journal of Nursing Research*, *38(2)*, 98-114.
22. Simpson, J.C., Wren, J., Chalmers, D.J., Stephenson, S.C.R. (2003). Examining child restraint use and barriers to their use: Lessons from a pilot study. *Injury Prevention*, *9*, 326-31.
23. Rivara, F.P., Bennett, E., Crispin, B., Kruger, K., Sarewitz, A. (2001). Booster seats for child passengers: Lessons for increasing their use. *Injury Prevention*, *7*, 210-13.
24. Winston, F.K., Kallan, M.J., Elliott, M.R., Xie, D., Burbin, D.R. (2007). The effect of booster seat laws on appropriate restraint use by children 4 to 7 years old involved in crashes. *Archives of Pediatrics & Adolescent Medicine*, *161*, 270-275.
25. Simpson, E.M., Moll, E.K., Kassam-Adams, N., Miller, G.J., Winston, F.K. (2002). Barriers to booster seat use and strategies to increase their use. *Pediatrics*, *110*, 729-36.
26. Vaillancourt, T., Brittain, H., Bennett, L. (2010). Places to avoid: Population-based study of student reports of unsafe and high bullying areas at school. *Canadian Journal of School Psychology*, *25*, 40-54.
27. Edwards, S.A., Anderson, R.W.G., Hutchinson, T.P. (2006). A survey of drivers' child restraint choice and knowledge in South Australia (CASR012), Centre for Automotive Safety Research, Adelaide.
28. Apsler, R., Formica, S.W., Rosenthal, A.F. (2003). Increases in booster seat use among children of low income families and variation with age. *Injury Prevention*, *9*, 322–325.

Figures and Tables

Table 1. Parent Survey: Restraint type by age.

Restraint Type	Age (years) 4	5	6	7	8	Total children in each restraint type
Forward-facing car seat w/ harness	15 (42.9%)	6 (31.6%)	2 (8.7%)	1 (3.6%)	0 (0.0%)	24 (20.0%)
Booster seat with seat belt	20 (57.1%)	13 (68.4%)	20 (87.0%)	24 (85.7%)	5 (33.3%)	82 (68.3%)
Seat belt only	0 (0.0%)	0 (0.0%)	1 (4.3%)	3 (10.7%)	10 (66.7%)	14 (11.7%)
Total children in each age group	35 (29.2%)	19 (15.8%)	23 (19.2%)	28 (23.3%)	15 (12.5%)	120 (100.0%)

($p < 0.001$)

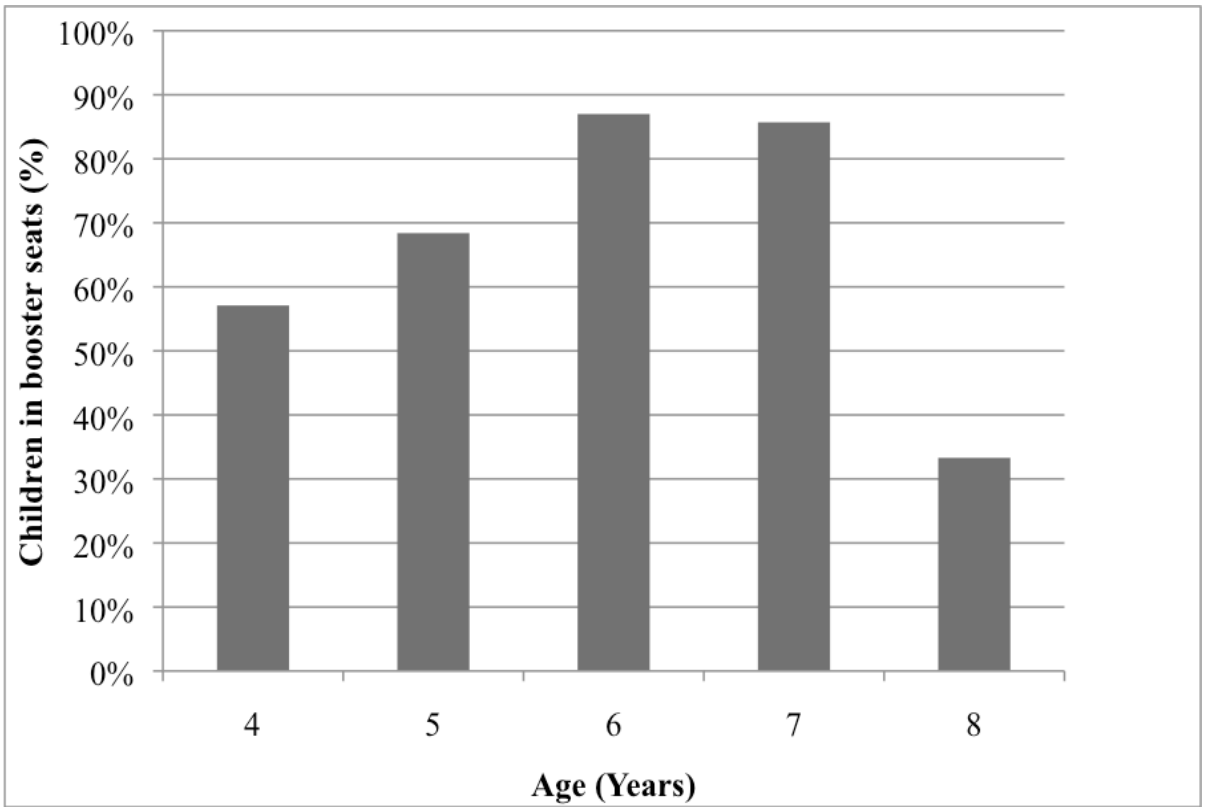

Figure 1. Parent Survey: Children reported to be in booster seats. ($p = 0.001$)

Table 2. Vehicle Observations: Child age.

	2011		2012	
	N	%	N	%
<1	5	0.2%	34	0.8%
1-3	152	7.5%	339	7.8%
5-8	1762	87.0%	3672	84.8%
9-14	103	5.1%	276	6.4%
Unknown	4	0.2%	8	0.2%
Total	2026	100.0%	4329	100.0%

Table 3. Vehicle Observations: Child seating position.

	2011		2012	
	N	%	N	%
Front seat	371	18.3%	718	16.6%
Back Seat	1638	80.8%	3588	82.9%
Unknown	17	0.8%	23	0.5%
Total	2026	100.0%	4329	100.0%

Table 4. Vehicle Observations: Child restraint type.

	2011		2012	
	N	%	N	%
Forward-facing infant seat	2	0.1%	9	0.2%
Rear-facing infant seat	6	0.3%	23	0.5%
Child seat	92	4.5%	317	7.3%
Booster seat	397	19.6%	1098	25.4%
Seat belt	1060	52.3%	2063	47.7%
No restraint	43	2.1%	132	3.0%
No booster, cannot see seatbelt	367	18.1%	657	15.2%
Unknown	59	2.9%	30	0.7%
Total	2026	100.0%	4329	100.0%

Table 5. Vehicle Observations: Child restraint type for all 5-8 year olds.

	2011		2012	
	N	%	N	%
Child seat	8	0.5%	16	0.4%
Booster seat	362	20.5%	1092	29.7%
Seat belt	971	55.1%	1813	49.4%
No restraint	40	2.3%	126	3.4%
No booster, cannot see seatbelt	367	20.8%	602	16.4%
Unknown	14	0.8%	23	0.6%
Total	1762	100.0%	3672	100.0%

Table 6. Vehicle Observations: Booster use per vehicle.

	2010		2011		2012	
	N	%	N	%	N	%
Yes	193	14.7%	320	20.8	1021	31.4%
No	1103	84.3%	1187	77.0	2182	67.2%
For some children	12	0.9%	15	1.0	32	1.0%
Unknown	1	0.1%	19	1.2	14	0.4%
Total	1309	100.0%	1541	100.0%	3249	100.0%

Table 7. Vehicle Observations: Total number of children per vehicle and booster use.

	2011		2012	
	N	% booster use	N	% booster use
1 child	1096	22.1%	2272	32.5%
2 children	405	19.7%	874	31.4%
3 children	40	5.0%	103	11.0%
Total	1541	100.0%	3249	100.0%

($p < 0.001$)

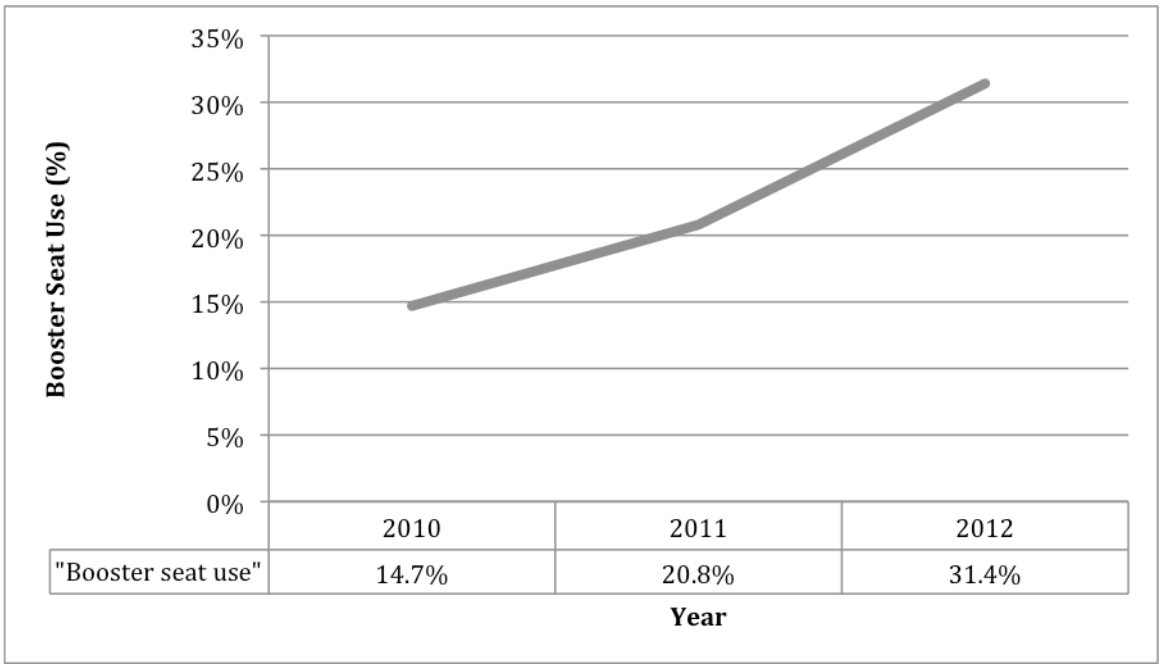

Figure 2. Booster seat use in 2010, 2011, and 2012. ($p < 0.001$)

Table 8. 2012 booster seat use by week of data collection.

Week	Total Observations (N)	Booster Seat Use (%)
1 – June 3rd-9th	507	28.2%
2 – June 10th-16th	986	27.7%
3 – June 17th-23rd	904	35.4%
4 – June 24th-30th	541	35.3%
5 – July 1st-7th	287	31.4%

($p < 0.001$)