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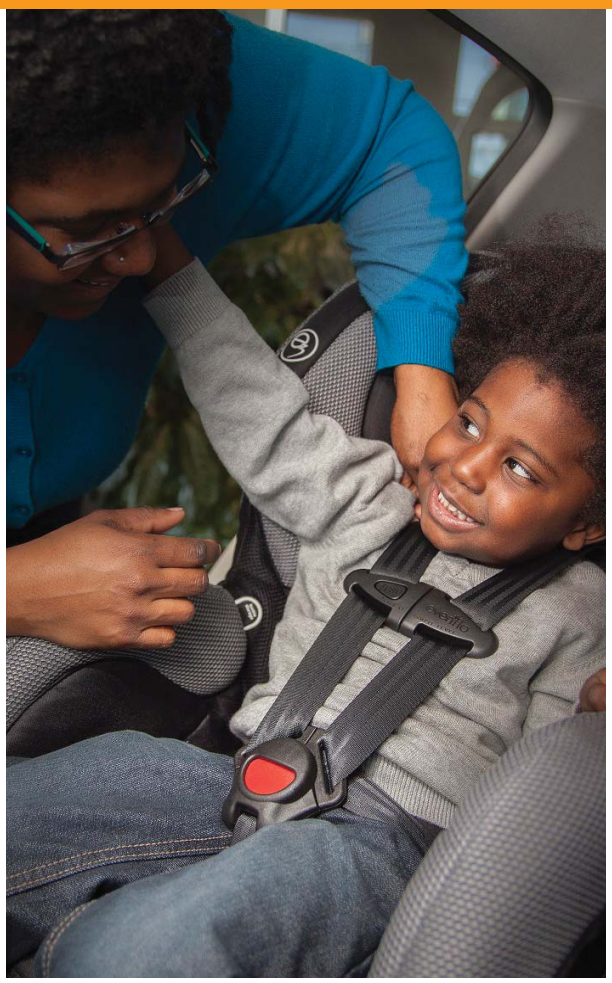

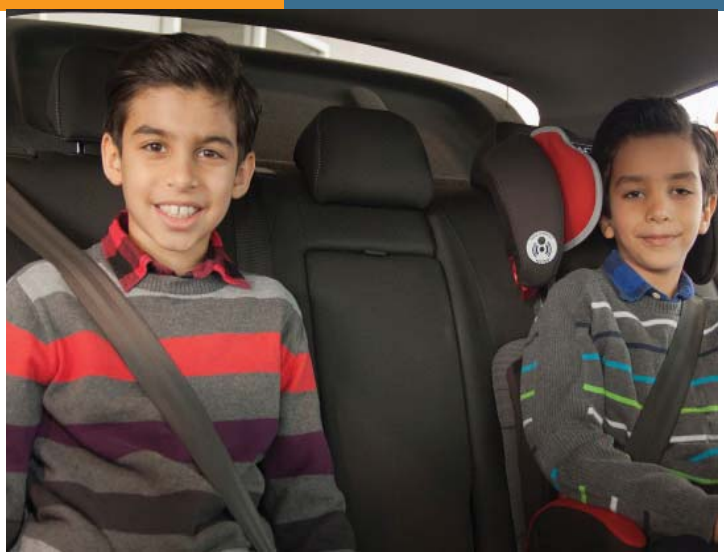

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SAFETY CAMPAIGNS TO PROMOTE THE USE OF CHILD RESTRAINTS:

ARE THEY EFFECTIVE?

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THE TRAFFIC INJURY RESEARCH FOUNDATION

The mission of the Traffic Injury Research Foundation (TIRF) is to reduce traffic-related deaths and injuries. TIRF is a national, independent, charitable road safety institute. Since its inception in 1964, TIRF has become internationally recognized for its accomplishments in a wide range of subject areas related to identifying the causes of road crashes and developing programs and policies to address them effectively.

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1. INTRODUCTION

Motor vehicle collisions continue to be the leading cause of death among children in many jurisdictions around the world. To illustrate, it is estimated that 319 children aged 0 to 14 were killed in the EU in 2012 (Jost et al. 2014), although it was also noted that there was substantial variation in the level of child safety across countries. For example, it was reported that children in Greece had a much greater risk of being a victim as a passenger in a vehicle as compared to children in Switzerland (Jost et al. 2014). In addition, in Spain, there were 37 children killed in vehicles in 2012 and nine of these children were not restrained. Similarly, according to the Canadian Paediatric Society (CPS), many deaths and injuries each year are directly attributed to non-use or misuse of child restraints. Children and adolescents aged 0-19 accounted for 16% of motor vehicle traffic collision fatalities and 19% of injuries in Canada in 2006 (van Schaik 2008).

Elsewhere, a review of various studies in the United States estimated that child safety seats that were correctly installed and used for children aged 0–4 years could reduce the need for hospitalization by 69%, and that in the United Kingdom, new rules governing the use of child restraints rather than adult seat-belts for children would reduce child deaths or injuries by 2,000 cases annually (FIA Foundation for the Automobile and Society 2009). It should also be noted that securing one's child in the vehicle not only makes the child safer, but it increases safety for all persons in the vehicle since unbelted rear seat passengers can become objects that collide with drivers or front seat passengers in a frontal crash (Kidd and McCartt 2014).

The European Transport Safety Council (ETSC) and the CPS believe that many deaths and injuries can be prevented through increased enforcement of child restraint provisions, public education and clinician advocacy (ETSC 2006; van Schaik 2008). The importance of proper restraint use among children in vehicles has been clearly demonstrated by several studies over two decades (Markl 2012; Bruce et al. 2011; Grossman and Garcia 1999; Zaza et al. 2001). Research from Belgium and Germany, reported in an ETSC Fact Sheet on child restraints (2006), measured the risks of fatality and injuries death among unrestrained children in vehicles and determined that these risks are substantial. To illustrate:

- children that were unbelted or unrestrained were seven times more likely to be killed or severely injured;
- the crash consequences of unrestrained children at 50km/h were equivalent to those associated with a 10 meter fall;
- that an eight year old child weighing 30kg will be thrown forward with a force 25 times its body weight; and,
- without a child safety seat a crash at just 15km/h can be fatal (ETSC 2006).
- In a matched cohort study involving children aged 4 to 8 years, unrestrained passengers were 2.8 times more likely to die than those who were restrained with booster seats and seatbelts (Rice et al. 2009).

It is equally important that adults (parents, caregivers) correctly use the safety equipment that is available. While securing one's child by means of an infant seat, booster seat or seat belt is preferable to not using restraints, in order for children to receive the maximum protection the restraints must be used properly. Of concern, this is often not the case. A review of more than 5,000 child car seats were checked by experts in Ireland and it revealed that as many as three out of four seats may be incorrectly installed (Jost et al. 2014). A population surveillance study of child passengers in Canada showed that inappropriately restrained children were still almost twice as likely to be at risk of injury in a collision compared to children who were properly restrained (Santschi et al. 2008).

Most recently, as evidence of concern associated with this problem, in November 2014 the United Nations Road Safety Collaboration announced a global campaign for the Third UN Global Road Safety Week, (May 4-10, 2015) on children and road safety (#SaveKidsLives) in order to promote attention to this important problem and also to encourage countries to take action on it to increase road safety among children (See http://www.who.int/roadsafety/week/2015/en/).

In order to increase understanding of ways that the use of child restraints can be strengthened, the Traffic Injury Research Foundation (TIRF) conducted a literature review on behalf of the Canadian Automobile Association (CAA) to examine the effectiveness of campaigns that have been previously undertaken to promote child passenger safety. Research focused on educational and promotional campaigns in Europe, North America and other countries that emphasized increased or correct use of a range of child safety devices was included in the review. More specifically, this research related to campaigns on the following types of devices:

- infant seats
- booster seats;
- rear-seat placement of children; and,
- safety equipment use in general.

2. METHODOLOGY

Using the TIRF library and web searches (e.g., including European Transport Safety Council, PubMed, Transportation Research Board, Transport Canada, among others), several reports and articles were identified to potentially be included in the literature review. Some non-public research articles evaluating child restraint programs were identified at the Missouri Department of Health website on evidence-based interventions. Research related to child restraints was taken from the following website: http://health.mo.gov/data/interventionmica/MotorVehicleInjuries/index_5.html

The following keywords and combinations were used to structure the search:

- effectiveness, evaluation, assessment, analysis, study, research
- multi-media campaigns
- multimedia interventions
- community-based programs (programmes)
- community-based interventions
- programs
- health promotion programs
- interventions
- intervention strategies
- child restraints
- child restraints in cars, child restraints in vehicles
- child safety seats
- child safety
- child seatbelts
- child booster seats
- booster seats
- child car seats
- standards
- rear-seat placement of children
- safety equipment use in general

3. DESCRIPTION OF LITERATURE REVIEW

A majority of the publications that were included in the literature review were articles or reports that evaluated the effectiveness of a specific campaign to promote child occupant safety in a specific jurisdiction. In addition, some these publications were, in turn, meta-analyses or systematic reviews that summarized the effectiveness of several child restraint campaigns (Grossman and Garcia 1999; Klassen et al. 2000; Zaza et al. 2001; Towner and Dowswell 2002; Turner et al. 2005; Ehiri 2012).

The literature contained in this review was drawn from 59 studies: nine studies from around the world (Sweden, Norway, Greece, Slovenia, Poland, Australia, New Zealand); eight were from Canada, and 41 from the United States. To facilitate comparisons, the results of effectiveness are organized according to the unique type of safety restraint (i.e., infant seats, booster seats, rear-seat placement and general restraint use) for children aged less than one year up to 12 years, as usage is often dependent on the age or size of child passengers.

To help clarify the population of children included in each category, according to the United Nations Uniform Provisions on Child Restraint Systems (UNECE regulation R44), the target audience for each type of restraint, in general, is as follows:

- Group 0+: From birth to approx. 12-15 months (13kg), Rear-facing seat with 3- or 5-point harness
- Group 0+/1: From birth to approx. 4 years (18kg), Rear- and forward-facing seat with 5-point harness.
- Group 1: From 9 months to approx. 4 years (9kg-18kg), Can be rear-facing but mostly forward-facing seat with 5-point harness.
- Group 1/2/3: From 9 months to approx. 12 years (9kg-36kg), Forward-facing seat with 5-point harness, which then converts to a booster using the adult seat belt restraint.
- Group 2/3: From 4 years to approx. 12 years (15kg- 36kg), Forward-facing high-backed or backless booster seat using the adult seat belt restraint (Jost et al. 2014).

It should also be noted that the laws associated with child restraints do vary across jurisdictions. For example, in Europe, the UNECE regulation on child restraints that came into effect in 2013 further strengthened these standards by including new requirements that rear-facing child seats must be used until children are at least 15 months (instead of nine months), and some Nordic and Scandinavian countries require such usage until children are up to four years old. It also required that seats must additionally be tested for side impacts as opposed to only frontal impacts. More recently, the police in EU countries can now manage offences across borders including non-use of child restraints with a new Directive (EU) 2015/413 of the European Parliament (March 11, 2015) that facilitates cross-border exchange of information on road safety-related traffic offences, although there is no harmonisation in terms of penalties across countries (See http://etsc.eu/faq-eu-cross-border-enforcement-directive/).

In Canada, eight jurisdictions require children to be seated in a booster seat until they are 145 cm tall or have a minimum seated height of 63 cm (Parachute Canada 2012). According to the Insurance Institute for Highway Safety, only 17 out of 51 jurisdictions in the United States have legislation in place that requires children to be in the rear seat of a vehicle (IIHS 2015). Furthermore, the existing legislation varies widely in design and intent. In some states, it is mandated that children under one year of age must ride in the back seat whereas other states have set the age limit at 11 years. Some states use a child's weight as the determining factor and other states have even included a physician's provision that allows children to use an adult seat belt if it offers the best protection.

There are also important complexities associated with the research on this topic that make it challenging to draw comparisons across the studies included in this review. These complexities are briefly discussed below to provide some important context for the interpretation of the results.

First, there is considerable variation that exists with regard to the diversity of campaigns that have been conducted on child restraints and/or child passenger safety, particularly in relation to the different dissemination mechanisms that were utilized by the campaign. These mechanisms generally included educational materials, media campaigns, and educational hands-on workshops.

- **Educational materials.** Some campaigns primarily utilized brochures and posters to disseminate information about the importance of using child restraints (Greenberg-Seth et al. 2004).
- **Media campaigns.** The use of television and radio ads was adopted for several child restraint use campaigns (Foss 1989; Decina et al. 1994; Istre et al. 2002; Lee et al. 2003; Greenberg-Seth et al. 2004).
- **Educational/demonstration workshops.** Typically, educational workshops promoted restraint use among parents of children and other caregivers. One example is the seating clinic where parents were shown the proper method to safely secure their children. Other educational workshops coincided with booster seat giveaways to promote booster seat use (Lee et al. 2003; Tessier 2010).

In addition, while campaigns using these strategies were most often targeted towards parents and other adults, there were also some restraint use campaigns that were geared specifically towards children and used different mechanisms. For example, in a campaign that was geared towards children aged 4 to 8 years who attended an after-school program in Virginia, a puppet show was used to educate children on the state's booster seat law as well as the injuries that could be sustained without the proper use of such a device (Gallina et al. 2010). In Tennessee, Ollie Otter, a booster seat and seatbelt safety mascot, visited K-4 schools in Tennessee to promote the use of booster seats and encourage children to wear their seatbelts (Anitsal et al. 2010).

Finally, the organizations that conducted the evaluations of child restraint use campaigns were varied, however, almost all agencies fit within one of the following categories:

- **Health departments, hospitals and universities.** This category included a wide range of health organizations, hospitals, and also medical schools housed within universities. Of importance, some of the studies that were reviewed evaluated programs specific to child restraints, whereas others

dealt with a range of other child safety issues. This means that the results may not have been directly attributable to the campaign effort focused on child restraints specifically. For example, in 1986, the Quebec Safety League's awareness campaign involving only child restraint use was evaluated by the Montreal Childrens' Hospital (Pless et al. 1986). The Eastern Virginia Medical School was involved in an evaluation of the Boost 'Em in the Back Seat Progam which encouraged parents to seat their children in booster seats in the rear row of vehicles (Will et al. 2009). In the Cincinnati area, an emergency department-based intervention campaign took place to improve booster seat use for children aged 4-7 from lower socioeconomic families (Gittelman et al. 2006). Finally, in a Harvard School of Health study evaluating 'Kids in the Back', a community-based intervention program that promoted rear seating for children, it was suggested that since community-based programs had been successfully applied in other areas of injury prevention, that this could also be used in the protection of child vehicle occupants (Greenberg-Seth et al. 2004).

Conversely, the 'Baby, Be Safe' program in Washington, D.C. was presented to selected parents who brought their children aged 6-20 months to a medical centre (Nansel et al. 2002). However, this program was not only concerned with child restraint use but also educated parents on such topics as smoke detectors, hot water, cleaning products and stair gates. Similarly, the Safe Kids/Healthy Neighborhoods injury prevention program in Harlem was evaluated by using data provided by the Northern Manhattan Injury Surveillance System (NMISS). This injury prevention program examined child restraint use as well as assaults, gunshot wounds and outdoor falls (Davidson et al. 1994). Lastly, the Head Start program in Washington State offered educational materials on smoke detectors, batteries and ipecac as well as age-appropriate child restraints (Johnston et al. 2002).

- **Government and industry.** Examples here included the Slovenian Agency for Traffic Safety which conducted a five-year evaluation of a national road safety campaign on child restraints, and the Motor Transport Institute in Poland which conducted a three-year study. Centers for Disease Control (CDC) which funded a study to evaluate the Strike Out Child Passenger Injury booster seat campaign. Strike Out incorporated education about booster seat use in children ages 4–7 years within instructional baseball programs. The effectiveness of Strike Out in increasing correct restraint use among participating children was tested in rural communities in Indiana, Illinois, Arkansas and Alabama (Aitken et al. 2013). The Auto 21 Network Centres of Excellence (AUTO21), a multi-disciplinary, auto-related research and development (R&D) initiative, provided funding for the Dalhousie University study on parents' use of booster seats (Bruce et al. 2011). Evaluations of a campaign designed to increase the use of child restraints in Pennsylvania and Washington were financed by the National Highway Traffic Safety Administration (Decina 1994; Ebel et al. 2003a).

It is also important to note that a variety of community organizations were often involved in the dissemination of these campaigns as well as their evaluations. To illustrate, researchers also relied upon these organizations to help with recruitment or dissemination of the message such as, local children's instructional baseball (T-ball) associations (Aitken et al. 2013), child care centres (Snowdon et al. 2009; Keay et al. 2012), and churches (St. Louis et al. 2008; Istre et al. 2002).

4. EFFECTIVENESS OF CAMPAIGNS

The results of a review of 59 evaluations of child restraint campaigns (infant seats, booster seats, rear seating and safety equipment use) are discussed below. In particular, the results are organized and presented according to the following key features of the evaluations to help facilitate comparisons of similar studies:

- Efficacy of the campaign (before/after data on either restraint use or correct restraint use);
- Reliability of the data that were collected; and ,
- Use of incentives (means of motivating the target group to safely secure their children).

It is important to also acknowledge the variety of limitations associated with the studies that were reviewed in order to help place the results in context and accurately interpret them. These limitations are also summarized at the end of this section.

4.1 Efficacy of the campaign

Generally speaking, summarizing the results across studies was challenging due to the vast array of study designs, target groups, intervention types, measures of effectiveness and outcome assessments that were utilized (Grossman and Garcia 1999). In addition, the lack of homogeneity among the studies examined also makes it difficult to compare the results of individual studies. However, most of these campaigns compared the actions of parents of an intervention group compared to parents of a control group in terms of using child restraints for their children, as well as doing so in a correct manner, and used either observational or self-report measures. Hence it is possible to draw some comparisons.

As mentioned in Section 3 (Description of Literature Review), some of the studies were meta-analyses or systematic reviews of several studies. The results of these studies are summarized first, followed by results from studies of individual interventions.

Eighteen studies that evaluated clinical or community-based interventions designed to increase the use of child restraints were reviewed by Grossman and Garcia (1999). In summarizing gains made in seat belt use rates as a result of campaigns, they reported increases from 12% to 52% in the short term compared to the baseline period. However, increases in seat belt rates were more modest (5% to 14%) compared to the baseline period when the post-test evaluation occurred one month or more following the intervention.

Another review of five community-based studies aimed at increasing motor vehicle restraint use among children was conducted. Four of the studies were conducted in the United States and the other study originated in Australia. Based on this review, the authors concluded that community-based interventions delivered in day-care or school settings served to increase restraint use among young children (Klassen 2000). Of importance, they reported that findings from these studies reveal that programs that involve multiple strategies that both educate pre-school children and parents in combination with coercive

techniques can increase the use of child restraints in motor vehicles. It particular, it was noted that using a 'carrot' approach may be beneficial to increase compliance and to help reduce situations in which children resist the car seat and parents are reluctant to require it be used.

A review of ten community-based intervention programs focused on parental education about a range of topics such as burns, smoke detectors, bicycle helmets, and child restraints. Norway and the United States Norway each accounted for three of these studies, and Norway, Sweden, Greece and New Zealand all were represented with one study in this review. Five of these studies focused on an urban population, four examined rural populations, while another looked at populations from both groups. Communities that were studied ranged in population from 1,000 to 155,000. The main criterion for success of these programmes was measured according to injury rates resulting from all of these types of incidents. Hence, it was not possible to draw conclusions about the effectiveness of the child restraint components alone (Towner & Dowswell 2002).

In another systematic review, eight community-based intervention studies (one from Sweden and seven from the United States) dealing with child restraint use were examined. Only one of these studies was rural-based, the other studies targeted urban or suburban populations ranging from 30,000 to 240,000 persons. The outcome measures were either injury rates or child restraint usage rates. Among studies measuring injury outcomes, reductions ranging from 35%-55% were reported in the study communities. Improvements in booster seat use (13%), toddler restraint use (11%), and rear restraint use (8%) were reported in studies measuring differences in restraint use as the result of interventions (Turner et al. 2004).

A different intervention review of five studies measuring the effectiveness of campaigns to promote booster seat use was conducted that included one Australian study and four American studies. It was determined that all of the interventions that promoted booster seat use yielded positive results. The authors suggested that the two campaigns which combined free booster seat distribution and two other campaigns which featured education-only interventions were more beneficial than the campaign which focused primarily upon enforcement (Ehiri et al. 2012). Lastly, 10 studies evaluating the effectiveness of education and intervention programmes to promote child safety seat use were reviewed by Zaza et al. (2001). It included one each from Sweden, New Zealand and Canada, and seven were from the United States. The median overall increase in safety seat use from the baseline period to post-intervention period was 9.9%. The intervals between these two periods ranged from one to 4.5 months.

Table 1 contains information about individual studies including the location of the study, the type of safety device evaluated in the study, the target age group, and the interval between the baseline and post-campaign observation periods. Differences in the percentage of subjects in the intervention group who were restrained in the baseline and post-campaign observation periods are also shown. Where applicable, differences in restraint use between these two observation periods are shown for control group subjects. Each of these studies is also summarized below.

The Slovenian Agency for Traffic Safety undertook a five-year evaluation of a child restraint education program that was included in a 10-country study (EUCHIRES) delivered in the European Union. The objective of the campaign was to raise awareness about and inform the proper use of child restraint systems. The primary audience for the campaign was primary school children aged 4 to 12; secondary audiences included teachers, parents and the general population. Dissemination strategies included television and radio ads, brochures and posters, an initial educational program for teachers and programs delivered in schools to children. Evaluation measures included several process indicators (e.g., persons reached using different mechanisms) as well as outcome indicators (e.g., observational surveys). This campaign was found to be effective and it increased child restraint use from 53% in 2005 (before the campaign was utilized) to an 80% usage rate in 2009 and a 91% usage rate in 2011 (Markl 2013).

A Rhode Island-based observational study evaluated a campaign in which parents who attended an educational training session received free seats, educational programs were provided to all daycare staff and children, and signs in parking lots informed parents about child restraints. The study found that during the pre-test period, only 44% of 4-8 year olds were restrained in their vehicles and that during the post-test period, this had improved to 74% (Apsler et al. 2003). However, this study did not include a control group. Similarly, observations of pre-test and post-test booster seat use among 822 children aged 4-7 were carried out in Pennsylvania where the "Boosting Restraint Norms" social marketing campaign was delivered by community partners. It revealed that increases in booster seat use were more pronounced among the intervention group (38.9% to 50.0%) than the control group (57.9% to 59.8%) for this particular study (Bryant-Stephens et al. 2013).

In California, restraint use among children aged 4 years of age and under was observed before and after the launching of the Child Passenger Safety Initiative (CPSI) which lasted 18 months. Before the campaign, 89.4% of children were restrained compared to 94.4% after the campaign (Cooper et al. 2004). Again, this study did not have a control group.

In the Seattle area, a controlled trial evaluation of a booster seat community intervention was conducted. This campaign was targeted to both parents and children and was delivered via brochures, newspaper articles, resource kits for child care providers, and discounts for booster seat purchases. The study sought to observe booster seat use of 4-8 year olds prior to and 15 months after the start of the campaign. Observation team members asked adults the age, height and weight of the children who were being seated in their vehicles. The percentage of booster seat use among 3,609 eligible children in the intervention communities improved from 13.3% to 26.1% in the intervention group while there was a more modest increase (17.3% to 20.2%) in the control group (Ebel et al. 2003a).

In Dallas, a program to promote the use of infant seats among a target group in a Hispanic neighbourhood was staged in community health center where the intervention was done, day care centers that were sites of interventions, and the parking lots of eight grocery stores. Child safety seats were distributed to parents and they were required to attend classes, delivered by Hispanic teachers certified in child passenger

safety, which focused on the proper use and installation of child safety seats before receiving a seat. Class instructors also appeared at health fairs and special events sponsored by the health center, distributed pamphlets about child safety seat and seat belt use, and conducted child safety seat inspections and demonstrations.

Observations of infant seat use for 0-4 year olds were conducted before and 36 months after the program was launched. These observations occurred at parking lots of the three study sites and it was noted whether children were restrained in accordance with current Texas state law, however, safety seats were not directly examined to gauge whether the seats were correctly installed. Among the intervention group, there was a greater improvement (19.0% to 72.0%) than there was among the control group (62.0% to 68.0%) from the pre- and post-tests (Istre et al. 2002).

To help place these findings it context, it should be noted that a preliminary survey of Hispanic pre-school-aged children in West Dallas in1997, showed that the child restraint usage among this Hispanic population was much lower with just 19% of pre-school children being transported using proper safety restraints as compared to all races in the rest of the city (62%) (Womack 2001). Hence, usage in this specific community was exceptionally low, although not unusual in light of research showing that minority and low-income populations are less likely to use restraints in vehicles as compared to the general population (Louis & Lewis 1997; Harper et al. 2000; Lee et al. 1996; Istre et al. 2002); in other words, it was possible to make significant gains with such an intervention.

In addition, authors attributed the effectiveness of the campaign to several factors including, that it was ongoing for a period of a few years, it integrated cultural and religious factors (e.g., priests were asked to bless the infant car seats) as well as Hispanic teachers, staff in the community health centre incorporated messages as part of clinical routine, and feedback about the progress of the program from surveillance data was utilized. They also noted that the intervention group was observed at the health centre, and this may have contributed to a 'socially desirable responding' effect, meaning that these parents may have been more inclined to be more motivated to use the seats travelling to the health centre where the intervention was delivered, as compared to parents from the control group who were observed at day care centres and shopping centres. In summary, this was a very tailored community intervention that was unique as compared to other child passenger safety programs that are typically delivered, and the program results may not be generalizable to other populations and ethnic groups (Istre et al. 2002).

A study that observed more than 3,800 subjects in Montreal compared pre- and post-campaign restraint use rates among children aged 0-11 years of age. However, the campaign, which involved a press event, posters, public service announcements on radio and television, as well as discussion on radio and television program, was primarily aimed at parents of 0-4 year olds, and the comparisons for this age group are shown in Table 1 (Pless et al. 1986). Of note, this campaign was targeted towards a mainly French-speaking audience.

In summary, the results of these evaluations, generally speaking, reveal that restraint use among individuals in campaign intervention groups are more inclined to secure their children with restraints after being exposed to the campaign, suggesting that there are some benefits associated with these interventions. However, it is equally important to note that there are important variations in the level of rigor associated with these studies, and that the size of the increases that are reported vary from small to large.

Table 1. Percent change in observed restraint use from baseline to post-campaign for intervention and control groups.

Study	Safety Device	Target Group Age	Interval (Months)	Intervention Group		Control Group	
				Baseline	Post-campaign	Baseline	Post-campaign
Apsler et al. 2003 (USA)	Restraint use	4-8 yrs	1-2	44.0	74.0	-	-
Bryant-Stephens et al. 2013 (USA)	Booster seats	4-7 yrs	6	38.9	50.0	57.9	59.8
Cooper et al. 2003 (USA)	Restraint use	0-4 yrs	13 (avg.)	89.4	94.4	-	-
Ebel et al. 2003a (USA)	Booster seats	4-8 yrs	15	13.3	26.1	17.3	20.2
Greenberg-Seth et al. 2004 (USA)	Rear seating	<13 yrs	24	33.0	49.0	28.0	41.0
Istre et al. 2002 (USA)	Infant seats	0-4 yrs	36	19.0	72.0	62.0	68.0
Pless et al. 1986 (Canada)	Restraint use	0-4 yrs*	6	20.4	34.1	-	-
Pierce et al. 2005 (USA)	Booster seats	3-5 yrs	.5	6.0	34.0	-	-

As well as the use of child restraints in general, some studies evaluated the correct use of these restraints. These studies are summarized in Table 2 and briefly described below. The first study by Howard et al. (2006) was conducted following a one-week Canada-wide media campaign. A knowledge test was administered by telephone to parents of 4-9 year olds, and the test included a question regarding the appropriate age to transition children from booster seats to seat belts. The authors suggested that although parents may not have remembered the key details of the campaign, they may have learned enough to realize the implications of non-use of child restraints for their own children (Howard et al. 2006).

In an Australian study (Keay et al. 2012) of the Buckle-Up Safely program, which consisted of distribution of printed educational material, parent information sessions, supply of child restraints at subsidized cost, and free restraint checks for parents of children attending childhood education centres, it was observed that there was a greater improvement in the use of age appropriate restraint use among children attending

intervention centres (71.0% to 82.0%) than those attending control group centres (74.0% to 73.0%). In another U.S. study, an evaluation of a campaign which included a 26-minute video dealing with child passenger safety, the distribution of brochures and booklets published by the National Highway Traffic Safety Administration (NHTSA) about correct child restraint use, a summary of current state child restraint laws, and a new car seat geared towards expectant parents was undertaken in Hawaii (Tessier 2010). Once the children of these parents were 2-3 months old, a follow-up evaluation was conducted to determine how knowledgeable the parents were about the correct use of infant seats. It was discovered that parents in the intervention group (32.0%) were more likely to use the infant seats correctly than parents in the control group (11.0%). Conversely, in Colorado, 18 months after baseline data were collected for a booster seat campaign where child care centre staff promoted booster seat use, distributed educational materials, and emphasized the existing laws, post-intervention data were collected which showed that among the intervention group, there was little change in correct use of this safety device (Thoreson et al. 2009).

Table 2. Percent change in correct use of restraints from baseline to post-campaign for intervention and control groups.

Study	Safety Device	Target Group Age	Interval (Months)	Intervention Group		Control Group	
				Baseline	Post-campaign	Baseline	Post-campaign
Howard et al. 2006 (Canada)	Booster seats	4-9 yrs	.25	13.8	19.4	-	-
Keay et al. 2012 (Australia)	Infant, booster seats	3-5 yrs	7	71.0	82.0	74.0	73.0
Pierce et al. 2005 (USA)	Booster seats	3-5 yrs	.5	48.5	68.4	-	-
Tessier 2010 (USA)	Infant seats	2-3 months	4-5	-	32.0	-	11.0
Thoreson et al. 2009 (USA)	Booster seats	4-8 yrs	18	40.0	41.0	36.0	42.0

Although Table 2 includes only studies that have one post-test period, other studies included more than one post-test period. For example, the Motor Transport Institute of Poland carried out an annual educational awareness campaign combined with an educational programme aimed at children and their parents related to seat belt and child restraint systems between 2005 and 2007; this campaign was delivered in 10 EU countries. The focus of this initiative strategy was to deliver a campaign that to made seat belt use more attractive and funny for children aged 4 to 12 using a positive strategies, and to also target parents with incentives and enforcement efforts. Campaign materials included television and radio ads, and scripts for teachers about the campaign. There was an annual press launch for this initiative which took place in November 2005 and July-August 2006 and 2007. Effectiveness was measured using pre- and post-tests based upon public opinion poll and focus groups with the target audiences. Evaluation results showed that 52% of children in Poland were properly transported in vehicles prior to these campaigns and

the annual campaigns showed a gradual increase in the number of children transported properly according to valid regulations. At the conclusion of the three-year study, it was reported that 83% of children were transported using child restraint systems. Similarly, the Slovenia study discussed previously also included annual post-test periods over a five-year period.

A study by Snowdon et al. (2009) involved testing parental knowledge about when to safely and accurately transition their children into the correct safety device based on the age, height, and weight of a child. Parents were asked when a child should be transitioned from: 1) rear-facing to forward facing infant seats; 2) forward-facing infant seats to booster seats; and 3) booster seats to seat belts. Knowledge was compared from a pre-test period to a six-week post-test to a one-year post-test which followed the intervention program. Among the program's components were a computer simulation of a crash involving a child occupant to draw parents' attention to the seriousness of potential crash outcomes, a storybook for children to help parents interact with their children on the topic of child restraint use (Bobby Shooster Rides Safely in His Booster), a CD-ROM for parents to view at home with statistical and educational information on booster seat use, and fridge magnets and growth charts which indicate the ideal restraint use based on a child's height and weight (Snowdon et al. 2009). The percentage of parents who correctly answered the correct age for transitioning children from rear-facing to forward facing infant seats rose from 63.5% in the pre-test period, rose to 77.6% in the six-week post-test period, then decreased to 67.5% in the one-year test period. The percentage of parents who correctly answered the correct age for transitioning children from forward-facing infant seats to booster seats was 72.3% in the pre-test period, 84.2% in the six-week post-test period, and 80.6% in the one-year post test period. By comparison, the percentage of parents who correctly answered the correct age for transitioning their children from booster seats to seat belts over the three periods were 53.5%, 71.5%, and 67.3%, respectively. Although there were improvements observed in the correct use of restraints by parents of children of all ages, the only significant transitional improvement after one year was that which measured the transition of children from booster seats to seat belts.

Overall, these studies suggest that the gains from such programs are apparent to varying degrees in the short-term, however, the level of knowledge is not sustained over time. In other words, these efforts do not appear to produce substantial improvements in the level of knowledge about child passenger safety in the longer-term.

Table 3 differs from the previous two tables in that the reported observations pertain to those program participants who were the 'unconverted' during the baseline period. In other words, during the baseline period, these respondents would have been in the following categories:

- not using an age-appropriate safety device for their child;
- unaware of how to correctly use the safety device; or,
- not always securing their child in the vehicle despite having been exposed to the campaign.

As can be seen, there are some substantial improvements made among the 'unconverted' respondents from the baseline period. In the Johnston et al. (2002) study in particular, there are among control group participants, a greater number who intend to obtain a safety device, learn about safety device use, always buckle up their child, and use a booster seat. What remains to be seen, however, is how long this positive behaviour will be sustained.

Table 3. Percent changes in positive knowledge or use of child restraints from baseline to post-campaign for intervention and control groups.

Study	Safety Device	Target Group Age	Interval (Months)	Intervention Group		Control Group	
				Baseline	Post-campaign	Baseline	Post-campaign
Obtained safety device							
Johnston et al. 2002 (USA)	Booster seats	4-5 yrs	3	0	21.5	0	5.3
Learned about safety device use							
Johnston et al. 2002 (USA)	Booster seats	4-5 yrs	3	0	33.3	0	8.8
'Always' buckle up child							
Johnston et al. 2002 (USA)	Booster seats	4-5 yrs	3	0	13.8	0	7.6
Intend to use booster seat							
Gallina et al. 2010 (USA)	Booster seats	4-8 yrs	0	0	73.3	-	-

Another means to evaluate the merits of a campaign is to measure changes in how aware the target group is about child restraints and how they are to be correctly used. Several studies show that infants, toddlers and preschoolers who had been previously restrained in infant seats were transitioned directly into seat belts instead of booster seats (Snowdon et al. 2009). Parents who place their children prematurely in adult seat belts may prove to be an especially difficult subgroup to convince when promoting increased booster seat use since they may be confident of their children's safety (Apsler et al. 2003).

In Sweden, there were three intervention periods during which car safety for children campaigns was delivered and free infant seats were distributed to families of newborns courtesy of hospitals child-health care centres, and private dealers (Ekman et. 2001). Safety campaigns consisted of the coverage of legislation combined with the local promotion of child restraint use through injury prevention programs involving information, training and supervision. The four municipalities where the program was first introduced in 1983 (Värmland and Malmöhus counties, Malmö, and Falköping) experienced greater average annual injury reductions from 1978-1996 among child occupants (2.8%) than in six counties that comprised the second area to be exposed to interventions (1.8%), and the rest of Sweden (0.4%).

Of concern, the awareness of child restraint legislation may be high in the short-term but can decrease in the longer term. For example, in California, 79.4% of pre-intervention respondents were aware of a new booster seat law introduced in January 2002, but this proportion decreased to 74.6% one year later. This decrease in awareness may have been attributable to a gradual decline in media coverage of the legislation once it had been introduced (Cooper et al. 2004).

4.2 Reliability of data

Another important feature of evaluation studies pertains to the quality of the data that are collected and analyzed as their reliability provides important context to interpret the results. A Seattle study, described previously, which evaluated the effectiveness of a campaign to increase booster seat use required observation team members to approach parents at child-care centres and after school programs. These parents were in the process of seating their children in the vehicle and were asked about the age, height and weight of the child to determine their eligibility for the study. Not only did this strategy allow observers to exclude non-eligible children, but it also gave them the opportunity to see if the child was properly restrained in the booster seat campaign (Ebel et al. 2003a). By contrast, post-campaign data collected in another observational study on booster seat and rear-seating practices among the target population may have been less robust. In this instance, persons observed in the parking lot of a child care centre may not have necessarily seen the video (Will et al. 2009).

Legislation, enforcement or campaigns undertaken by different agencies that coincide with the campaigns being studied can also inadvertently occur and serve to confound study results. As a consequence, the positive changes witnessed between the pre- and post-campaign periods may not be entirely attributable to the campaign itself. To illustrate, in a Pennsylvania study measuring booster seat use among 4-7 year olds, the authors mentioned that no community outreach activities sponsored by law enforcement occurred in either the intervention or control community (Bryant-Stephens et al. 2013), however this factor may not be consistently considered, or controlled for, during campaign evaluations.

4.3 Use of incentives

In the various studies that were reviewed, different incentives were utilized to motivate parents/caregivers to safely secure children in their vehicles. Some studies incorporated positive incentives that were designed to motivate child restraint use through rewards while negative incentives used the possibility of fear or punishment to achieve the same objective. Positive incentives generally included the free distribution of infant or booster seats (Ekman 2001; Tessier 2010), the free loaning of infant or booster seats (Lindqvist 1993), or the awarding of gift certificates or prizes to parents who complied with child restraint legislation (Foss 1989; Will et al. 2009). Negative incentives included tickets or citations for persons who were not compliant with child restraint laws in their jurisdiction or the use of high-threat messages to show the parents the dangers of not properly restraining their children (Will et al. 2009).

For some studies involving the use of infant car seats, participants were given an infant car seat (Lindqvist 1993, Ekman 2001, Tessier 2010). However, in the Lindqvist study, the infant seats were merely on loan whereas in the other two studies the parents were able to keep the car seat at the conclusion of the study. Findings from this study showed that once the loan period ended, parents were not always inclined to go out and purchase an infant seat. Similarly, with the 'Boosting Restraint Norms' campaign in Pennsylvania, booster seats were given away to the first 250 participants who watched a 3-minute educational video (Bryant-Stephens et al. 2013).

In a Vermont study which observed restraint use in general among child occupants aged 13 and under prior to and after the intervention campaign, adults that were observed to have buckled up their children were eligible for a lottery prize. Monthly prizes ranged from $50-$200, and there was a grand prize awarded at the end of the campaign for a family trip to a Florida theme park. In order to be eligible, parents as well as children had to be buckled up. Although there were some improvements observed among children, adult seat belt use did not vary much (Foss 1989).

In Canada, an eight-province study reported on factors associated with parents' use of booster seats. Parents attending child care facilities were asked by the study team to complete a 15-minute questionnaire and were given a gift certificate at a local bookstore for taking the time to do so (Bruce et al. 2011). Similarly, in a U.S. study, drivers with forward-facing child restraints installed in their vehicles were offered a $10 cash or gift card incentive for taking part in a 10-minute car seat survey and this resulted in a 90% response rate (Eichelberger et al. 2014).

Conversely, the 'Boost 'em in the Back Seat Program' included a video which included high-threat messages. For example, the six-minute video used crash-test footage and computer-generated simulations to show the consequences of the force of a crash. Although no graphic footage was presented, there were internal ambulance shots showing paramedics attending to a conscious child strapped to a backboard (Will et al. 2009).

Another strategy to encourage child restraint use is an enforcement campaign that prompted parents to properly secure their children so that they were not subject to citations. By not sufficiently enforcing existing laws or at least launching an occupant protection blitz campaign, efforts to increase child restraint delivered at three First Nations communities in the Pacific Northwest did not appear to be achieved (Smith and Berger 2002).

In summary, evidence suggests that positive incentives that reward either child restraint use in general, or specifically the correct use of child restraints, can have some benefits. In addition, given that negative incentives (e.g., citations, fines) were delivered by police, this may have cast the study observers in a more favourable light among the target group.

4.4 Limitations

There are several factors which inhibit a comprehensive comparison of the effectiveness of child restraint campaigns. These limitations are briefly described below.

Lack of awareness. It should not be assumed that all parents are aware of the required use of appropriate child safety restraints, or the need for them. To illustrate, a study involving families of lower socio-economic status revealed an initial lack of awareness about child restraints, particularly those types of restraints best suited for children of a particular age group. A booster seat study of parents in Hamilton County, Ohio who admitted their 4-7 year old children to a hospital revealed that 16.4% of respondents had never heard of a booster seat (Gittelman et al. 2006). Similarly, two months after booster seat legislation was introduced in Washington State, over half of focus group participants in a focus group involving the Latino community were unaware of this legislation (Lee et al. 2003).

In a Canada-wide study evaluating the Safe Kids Week 2004 booster seat program, post-test respondents were divided into 'exposed' and 'unexposed' parents based upon whether or not they were aware of the campaign (Howard et al. 2006). In a subsequent analysis of the article by the authors it was suggested that the unexposed subset of parents was not truly unexposed and that these parents were among the 63% of the target population that the awareness campaign failed to reach (Mytton and Pilkington, 2007). Thus, it may not be wholly accurate to categorize unexposed subjects as a distinct group from exposed subjects.

More importantly, if the target group in the pre-campaign evaluation is unaware of child restraints, the correct use of these devices, or their benefits, post-campaign scores may appear somewhat inflated. And if the target group in the post-campaign surveys are still unaware, then the campaign does not appear to have wholly resonated among its intended audience.

Methodological design issues. Several gaps in the respective studies can be attributed to a variety of limitations associated with study designs and these are briefly summarized here. First, some studies did not include a control group (Dabrowska-Loranc & Wacowska-Slezak 2008; Markl 2013; Foss 1989; Snowdon et al. 2009) comprised of individuals who were not exposed to the campaign. In other words, there was no group with whom the results could be compared to measures changes between the two populations and determine whether these changes were a result of the intervention. This inhibited measurement of whether the change in the intervention group was due to the intervention compared to other factors. Among these studies were those conducted in Slovenia and Poland (Dabrowska-Loranc & Wacowska-Slezak 2008; Markl 2013), Ontario (Snowdon et al. 2009) and West Virginia (Foss 1989). In a study comparing childhood injuries in two communities in New York City, it was discovered that 29% of program participants actually lived in the area which served as the control group (Davidson et al. 1994) which meant that the control group was not necessarily comprised of participants who were not exposed to the study.

Secondly, other studies relied upon a relatively short interval between the pre- and post-test periods that were used for measurement (Howard et al. 2006; Pierce et al. 2005). This makes it difficult to measure a

change during this time frame, particularly if changes are small in size, and can make it difficult to gauge the longer-term effects of a campaign and whether the changes are sustained over time. To illustrate, in the evaluation of the Strike Out intervention, the post-intervention surveys were conducted only four to six weeks after the intervention had concluded. Thus, the longer-term effects of the intervention beyond the 4-6 week post-test could not be determined from the current study (Aitken et al. 2013).

Thirdly, in other studies, the design was poorly constructed and did not provide sufficient time for the presenter to complete the presentation being given to a parent (Nansel 2002) which detracted from the quality of the intervention that was delivered. For example, the first phase of the Baby Be Safe educational program was administered to parents of children aged six to 20 months who were in a hospital waiting room. In some cases, there was a lack of time for participants to be included as part of the survey sample since one of the conditions of being allowed to conduct the study was that it was not to interfere with clinic appointments (Nansel et al. 2002).

Lastly, there were studies in which subjects took the initiative to volunteer for the study (i.e. self-selection bias), and this may have yielded a sample that was less heterogeneous than the target populations (Snowdon et al. 2009; Tessier 2010) of the intervention. This can detract from the generalizability of the results to a broader population. In addition, some studies examined a study group that may have been more demographically homogeneous than the general population. For example, in an Ontario study, the subjects were predominately married, Caucasian and highly educated (Snowdon et al. 2009) and in Hawaii, the majority of participants who volunteered to participate in the study were well-educated, urban dwellers aged 30-39 with above average incomes (Tessier 2010). In both of these studies, it can be argued that there was a self-selection bias which resulted in study groups that did not necessarily reflect the broader demographic profile of the target populations at large such the outcomes of the intervention may have been more or less effective with that specific demographic as compared to a more diverse population.

Obstacles that inhibit data collection. There are a wide range of issues that can be barriers to data collection and some of the issues associated with the reviewed studies are briefly described below. First, the collection of data related to child restraint campaigns may be complicated by activities undertaken by some of the partners who are involved in the campaign itself. For example, in an evaluation of child restraint use that included two intervention communities, it was revealed that the police in one community were more diligent in ticketing child restraint use violators than the police in the second intervention community. This development potentially biased the threat of punishment for non-compliance in one community more than the other (Decina et al. 1994). Secondly, is some studies, there may be a diminished number of potential observations within a target group. Subjects who are poorly compliant with attending appointments are less likely to be observed in studies that occur at or near clinics (Grossman and Garcia 1999). For the Strike Out study, the baseball teams observed remained largely consistent during the season. However, there was a 25% reduction in subjects from pre-intervention to post-intervention as there is often attrition in participation in the baseball program over the season. In a telephone follow-up one month after initial enrolment, 34.7% of respondents could not be contacted (Gittelman et al. 2006). Not only can participants

be lost due to attrition, but some community-based programs can be adversely affected by a high rate of turnover among staff that occurs at child care centres. This means that parents may not receive consistent, complete messages about a particular program (Thoreson et al. 2009).

Thirdly, sometimes the data that are collected can be compromised by 'acquiescence bias'. For instance, families that received a free booster seat as part of the campaign may over-emphasize how much their child uses the device (Gittelman et al. 2006). For observational surveys, inclement weather can reduce the number of potential observations. Given that the Strike Out campaign coincided with baseball games, adverse weather which resulted in the cancellation of some games played a negative role (Aitken et al. 2013). Fourthly, another potential limitation of data collected for observational studies occurred when observers made visual observations since some of the children observed may not have been in the target age group (St. Louis et al. 2008). Finally, a study of program effectiveness in terms of injury reductions was complicated by changes in admission policies and amendments to the injury coding system in Sweden during the study period (Ekman et al. 2001).

Lack of data specificity. Deficiencies in data specificity are often related to a lack of control in relation to the intervention group being studied (Gittelman et al. 2006; Bruce et al. 2011; Snowdon et al. 2006), a lack of specificity in terms of the components being evaluated (Ebel et al. 2003a), and a lack of quality control over the data which are received (Smith and Berger 2002).

Several community interventions were based on broad campaigns which featured several components (e.g., radio ads, flyers, newspaper articles, discounts for infant or booster seats, training programs for seating). Unfortunately, several of the studies were not designed to allow the researchers to disaggregate (i.e., to separate) the effects of individual intervention components (Ebel et al. 2003a). As a consequence, it was not possible to evaluate which particular components were most effective, or was responsible for much of the effectiveness associated with the intervention.

In some studies, the follow-up (post-campaign) data used in the study was self-reported by the respondents where 98% of parents reported that they always seated their child in a booster seat (Gittelman et al. 2006). In jurisdictions where booster seat use is mandated by law, self-reported use may have been higher in the sample than in the general population (Bruce et al. 2011). Similarly, in an Ontario study about parents' knowledge of child restraint use, those who claimed to properly secure their children (68% of those who were surveyed) could be a 'best-case' scenario since the data were based on self-reported practices (Snowdon et al. 2006). Lastly, although many studies examined the frequency of child restraint use, other studies did not assess whether or not the child was restrained with an age-appropriate device (Smith and Berger 2002).

As a consequence, a lack of data specificity can leave those evaluating child restraint programs with an inaccurate or incomplete picture of the effectiveness of a program in whole or in part.

5. CONCLUSIONS

Given that restraint use among children in motor vehicles results in fewer injuries and fatalities than non-use, and that the correct use of restraints and the use of age-appropriate restraints enhance safety for person in the vehicle, efforts are needed to encourage consistent and proper usage. Educational campaigns are one tool that can be used to promote such usage, and successful campaigns should aim not only to improve restraint usage in general, but also the correct use of age appropriate restraints in particular.

Overall, there is some evidence of the effectiveness of educational campaigns on child restraints, at least in the short period of time immediately following an intervention. While some studies show much more substantial increases in knowledge and usage than others, it is important to acknowledge that methodological limitations with studies may have artificially inflated these results. As context for the results regarding the effectiveness of child restraint and child safety campaigns, generally speaking, evaluations from a wide range of road safety campaigns (e.g., drinking and driving, speeding, seatbelt use) reveal that typical effectiveness varies between 9% and 16% in terms of reducing road incidents (Phillips et al. 2009).

There is also evidence to show that the effectiveness of these campaigns erodes over time as is the case with other road safety campaigns. Results from longer follow up periods reveal much smaller increases in usage or correct usage are sustained over time. This suggests that despite initial evidence of effectiveness following campaigns in the short-term, there remains a critical need to reinforce usage in the longer term for changes in behaviour to be maintained. To this end, several studies have indicated that the use of child restraints was positively related to the drivers' use of seat belts (Decina et al. 1994; Istre et al. 2002; Lee et al. 2003). In other words, such campaigns can positively increase belt use among adults. In addition, it appears that post-intervention observations can be more informative when they occur at multiple points following exposure to the intervention as this can help to gauge whether positive behaviours among participants have regressed and to determine how long any positive behaviours are sustained after exposure to a child restraint use program. This information can help inform decisions regarding the most efficient frequency to deliver messages to reinforce the change in knowledge and/or behaviour.

This review also underscores the importance of using a reliable control group to properly evaluate the degree to which the attitudes and behaviours of the intervention group have changed as the result of a child restraint campaign. In other words, efforts must be taken to ensure that the control group has not been inadvertently influenced by the campaign, and that although they are similar to the target group, they must be distinct from the latter group.

It has also been suggested that prevention strategies developed for urban populations may not necessarily work among rural populations and this should be a consideration in designing campaigns in different jurisdictions. In addition, strategies to increase motor vehicle safety that rely more on local resources than traditional public agencies may be better received in rural communities where there may be a greater

mistrust of governmental interventions among rural residents. This is particularly important since motor vehicle collision-related trauma is disproportionately higher in rural areas (Aitken et al. 2013).

Looking forward, there are some important lessons learned from research that can be drawn to assist road safety stakeholders aiming to develop a road safety campaign to increase the use of child restraints. These lessons include:

- Parents may be completely unaware of the required use of appropriate child safety restraints, or the need for them. They also may not know what type of car seat system is actually age appropriate for their child. An Ohio study of families of lower socio-economic status revealed an initial lack of awareness about child restraints, particularly those types of restraints best suited for children of a particular age group. In this study, 16.4% of respondents who admitted their 4-7 year old children to a hospital had never heard of a booster seat (Gittelman et al. 2006).
- Positive, incentive-based campaigns such as those involving the distribution of free infant or child car seats and include educational programs for children and parents may be more beneficial than campaigns which focus primarily upon enforcement (Ehiri et al. 2012; Ekman 2001, Tessier 2010). Other incentive-based strategies to consider may include the free loaning of infant or booster seats (Lindqvist 1993), or the awarding of gift certificates or prizes to parents who complied with child restraint legislation (Foss 1989; Will et al. 2009).
- Campaigns that involve multiple strategies that both educate pre-school children and parents in combination with coercive techniques can increase the use of child restraints in motor vehicles. It particular, it was noted that using a 'carrot' approach may be beneficial to increase compliance and to help reduce situations in which children resist the car seat and parents are reluctant to require it be used (Klassen 2000)
- Some studies have suggested a strong association between child restraint use and driver seat belt use as demonstrated by the Dallas study. In fact, this association remained strong after results were stratified according to year, setting, age of the child, and type of vehicle. In other words, there is some evidence that targeting driver seat belt use may be an essential component in relation to increasing child restraint use, although it is not the sole determinant (Istre et al. 2002).
- Longer term campaigns that are delivered repeatedly over a period of months or years may contribute to changing social norms and sustaining as well as enhancing initial increases in child restraint usage (Dabrowska-Loranc & Wacowska-Slezak 2008).

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