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Interventions for promoting booster seat use in four to eight year olds travelling in motor vehicles (Review)

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[Intervention Review]

Interventions for promoting booster seat use in four to eight year olds travelling in motor vehicles

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ABSTRACT

Background

Public health and traffic safety agencies recommend use of booster seats in motor vehicles for children aged four to eight years, and various interventions have been implemented to increase their use by individuals who transport children in motor vehicles. There is little evidence regarding the effectiveness of these interventions, hence the need to examine what works and what does not.

Objectives

To assess the effectiveness of interventions intended to increase acquisition and use of booster seats in motor vehicles among four to eight year olds.

Search methods

We searched the Cochrane Injuries Group's Specialized Register, the Cochrane Central Register of Controlled Trials, MEDLINE (January 1966 to April 2005), EMBASE (1980 to April 2005), LILACS, Transport Research Databases (1988 to April 2005), Australian Transport Index (1976 to April 2005), additional databases and reference lists of relevant articles. We also contacted experts in the field.

Selection criteria

We included randomized and controlled before-and-after trials that investigated the effects of interventions to promote booster seat use.

Data collection and analysis

Two authors independently assessed trial quality and extracted data. Study authors were contacted for additional information.

Main results

Five studies involving 3,070 individuals met the criteria for inclusion in the meta-analysis. All interventions for promoting use of booster seats among 4 to 8 year olds demonstrated a positive effect (relative risk (RR) 1.43; 95% confidence intervals (CI) 1.05 to 1.96). Incentives combined with education demonstrated a beneficial effect (RR 1.32, 95% CI 1.12 to 1.55; n = 1,898). Distribution of free booster seats combined with education also had a beneficial effect (RR 2.34; 95% CI 1.50 to 3.63; n = 380) as did education-only interventions (RR 1.32; 95% CI 1.16 to 1.49; n = 563). One study which evaluated enforcement of booster seat law met the criteria for inclusion in the meta-analysis, but demonstrated no marked beneficial effect.

Authors' conclusions

Available evidence suggests that interventions to increase use of booster seats among children age four to eight years are effective. Combining incentives (booster seat discount coupons or gift certificates) or distribution of free booster seats with education demonstrated marked beneficial outcomes for acquisition and use of booster seats for four to eight year olds. There is some evidence of beneficial effect of legislation on acquisition and use of booster seats but this was mainly from uncontrolled before-and-after studies, which did not meet the criteria for inclusion in the meta-analysis.

PLAIN LANGUAGE SUMMARY

Interventions for promoting the use of booster seats in four to eight year olds travelling in motor vehicles: how effective are they?

Booster seats are designed for use by children aged four to eight years, while travelling in motor vehicles. They aim to raise the child off the vehicle seat so that the adult seat belt fits correctly and the child can travel in greater comfort and safety. Public health and traffic safety agencies recommend the use of booster seats in children until the vehicle seatbelt fits properly; typically when the child is at least 58 inches tall, has a sitting height of 29 inches and weighs about 80 pounds.

In children aged four to seven years, booster seats are estimated to reduce the odds of sustaining clinically significant injuries during a crash by 59%, when compared to using ordinary vehicle seatbelts. Despite the evidence of effectiveness, many children are not restrained in age-appropriate booster seats.

In light of the strong evidence for the safety benefits of booster seats, interventions specifically aimed at promoting their use have been implemented. To evaluate the effectiveness of such interventions, the authors of this systematic review examined all high quality trials investigating their effect on acquisition and use of booster seats.

The authors found five studies involving a total of 3,070 participants. All interventions investigated by the studies were found to increase the use of booster seats, compared to the group receiving no intervention. The distribution of free booster seats combined with education on their use, had a marked beneficial effect, as did incentives (for example, booster seat discount coupons or gift certificates) combined with education. Education-only interventions also produced beneficial outcomes. One of the studies evaluated the effectiveness of the enforcement of a booster seat law, but did not detect an effect on usage.

The authors concluded that the current evidence suggests that several types of interventions aimed at increasing the use of booster seats among children aged four to eight years, are effective. However, there is still a need for further high quality trials, especially those conducted outside of the USA and Australia, where current research dominates.

BACKGROUND

Road traffic injuries are a major cause of morbidity and mortality globally. They are the 10th leading cause of death and the ninth leading cause of the global burden of disease (Murray 1996). The World Health Organization estimates that over 1.18 million people are killed and as many as 50 million injured or disabled in road traffic crashes annually (WHO 2004). It is projected that without renewed emphasis on implementation of effective preventive interventions, road traffic injuries will become the third leading cause of the global burden of disease by 2020 (Krug 2000; Murray 1996; WHO 2004). Children and young people are at particular risk. The UNICEF Innocenti Report on child deaths by injury in rich nations (UNICEF 2001) showed that traffic crashes are a leading cause of death among children in the Organization for Economic Co-operation and Development (OECD) region, accounting for 41% of all child deaths by injury type. Available evidence shows that the fatality rates for developing countries (measured in terms of deaths per 100,000 population) are about six times as high as the figures for developed nations (Nantulya 2003). Globally, motor vehicle injuries and deaths have been described as "an issue of immense human proportions, an issue of economic proportions, an issue of social proportions, and an issue of equity - a problem that very much affects the poor" (Nantulya 2002; Ross 1999). The estimated direct annual costs of road traffic crashes are enormous, ranging from 0.3% of the Gross National Product (GNP) in Vietnam to almost 5% in the USA (Jacobs 2000).

Motor vehicles injuries affect many young people, resulting in a large number of years lost because of premature death or a large number of years lived with disability (Krug 2000). Children aged four to eight years are especially important since they die more as occupants in motor vehicle crashes than from other forms of unintentional injuries (CDC 2004). As they outgrow safety seats designed for younger children, many four to eight year olds travel unrestrained in motor vehicles, or are placed prematurely in adult seat belts instead of booster seats recommended by public health and transport safety agencies (Am Acad Ped 1996; ATSB 2005; DfT 2004; NHTSA 2004). This increases their risk for serious crash-related injuries (Winston 2001). In addition to mortality and disability, such injuries have been shown to produce enduring negative psychological effects in children (Aitken 2002; Stallard 1998; Stallard 2004). Even relatively minor childhood injuries disrupt parent's ability to work, place significant economic burden on affected families, and on the health system (Osberg 1996). Reducing crash-related deaths and injuries among 4-8 year olds calls for the implementation of effective strategies to get booster seats in cars and make sure they are correctly used (Corden 2005; Mickalide 2002; Winston 2001).

Booster seats

Children outgrow toddler car safety seats generally around 40 lbs (18 kgs) or four years of age and should then transition to booster seats. Booster seats in motor vehicles are designed to raise four to eight year olds off the vehicle seat, allowing them to use adult seat belts more safely and comfortably. Although the benefits of booster seats in protecting children from serious crash-related injuries are well documented, usage rates remain low (Cody 2002; Ebel 2003; NHTSA 2002). Booster seats help to protect children from motor vehicle injuries and deaths by reducing the risk of *'lap belt syndrome'* (Durbin 2001; Mickalide 2002; Thompson 2001) that is a situation in which adult seatbelts can cause injuries to children in car crashes instead of protecting them (Halman 2002; Hingston 1996; Osberg 1992; Pickler 2001). Research has demonstrated that children aged four to eight years have a significantly reduced risk of injury if they are restrained in booster seats rather than adult seatbelts (Durbin 2005; Durbin 2003; Miller 2002; Winston 2001). Thus, it is recommended that children should use booster seat until they are 80 lbs in weight, eight years of age, or reach a height of 58 inches (NHTSA 2004).

There are essentially three types of booster seats:

1. booster seats without shields, also called belt-positioning boosters, designed to be used in vehicles with lap-shoulder belts. Some have a high back that gives head support for children who are transported in vehicles without head rests; there are also backless booster seats for vehicles with head rests;
2. booster seats with removable shields, used without the shield to make lap and shoulder belts fit better;
3. high-back-booster seats- designed for children who have outgrown their child safety seats, but who still weigh less than 40 lbs (18 kgs). Most high back booster seats have a clip or strap to hold the shoulder belt in place; others have a removable harness. This type can be used with the harness for a child weighing less than 40 lbs. Once the child reaches 40 lbs, the harness can be removed and the seat is then used with the adult lap-shoulder belt as a belt-positioning booster seat.

Low- and high-back belt-positioning booster seats have existed in Europe for nearly 20 years but have only been on the market in the United States for about 10 years (Weber 2000). Booster seat cushions were developed in Sweden and Australia in the mid-1970s to allow children to take advantage of the vehicle's built-in upper and lower torso restraint, and they have been used there and elsewhere successfully ever since (NHTSA 2002; Weber 2000). Booster seats are also widely used in Canada. The country has three primary classifications of children's restraint systems regulated by law, namely: rearward facing infant restraints; child restraints; and booster cushions (Dance 2001). Booster cushions are for children who have outgrown their child restraint system and for those who are at least 40 lbs. Booster seats are virtually non-existent in developing countries (UN 2003). Where found, they are almost exclusively sold in stores catering to expatriates or wealthy families. At very exorbitant prices, it could require weeks of earnings for an average family to purchase one (Hendrie 2005). Even in a middle-income country such as Brazil, the cost of a booster seat is far beyond the reach of most average income families. In developing countries, these devices are imported and are thus, subject to tariffs and import taxes.

Need for evidence to inform policy and practice

Although various interventions have been implemented to increase acquisition and use of booster seats use by individuals who transport children in motor vehicles, there is little evidence regarding the effectiveness of these interventions and hence the need to which programs are effective and which are not. Previous reviews of interventions for promoting use of child restraints have targeted children under the age of four years old and there is a clear gap in scientifically based evidence on how to increase booster seat use for older children. Synthesizing evidence of effects of the various approaches will help to inform future research, guide policy and practice, justify use of resources, train health professionals, and facilitate design of community-based prevention programs that are

effective. This review will assess the impact of various legislative, educational, and promotional interventions to promote the use of booster seats among children aged four to eight years and will include studies in which participants are individuals who transport children aged four to eight years in motor vehicles.

OBJECTIVES

To critically assess the effects of interventions for promoting use of booster seats on:

- deaths from motor vehicle crashes among children aged four to eight years travelling in motor vehicles;
- motor vehicle occupant injuries;
- frequency of booster seat use (observed or reported).

Hypothesis

- Interventions to promote use of booster seats among children aged four to eight years who travel in motor vehicles, have no effect on motor vehicle occupant deaths and injuries or on frequency of booster seat use among this age group.

METHODS

Criteria for considering studies for this review

Types of studies

- All randomized controlled studies that investigated the effects of interventions to promote booster seat use;
- Controlled before-and-after trials.

Types of participants

Studies in which participants were children aged four to eight years or individuals who transport children aged four to eight years in motor vehicles.

Types of interventions

Legislative, educational, and promotional measures to increase acquisition and use of booster seats among four to eight year olds travelling in motor vehicles, including:

- primary enforcement of booster seat laws: a driver can be stopped, cited and fined for failure to comply with a booster seat law (Chang 2002);
- community-wide information and enhanced enforcement campaigns: targeted information about booster seats delivered to a community, usually geographic in nature. These campaigns use mass media, information and publicity, booster seat displays in public places, public demonstration of correct use, special enforcement strategies such as checkpoints, dedicated law enforcement officials, or alternative penalties (for example verbal/written informational warnings instead of citations;
- booster seat distribution and education programs: these provide booster seats to parents through loan, low-cost rental, or giveaway. The rationale is that parents who cannot afford booster seats, or with limited understanding of their benefits might be more likely to use them if financial assistance and adequate information are provided;
- incentive and education programs: designed to reward parents for obtaining and using booster seats or to provide direct reward to children for using them. Incentives can also involve the distribution of discount coupons to help offset part of the cost of a booster seat. Incentive programs typically involve educational components of varying intensity, and may include one-to-one counselling (Zaza 2001);
- education-only programs provide information about booster seats and relevant skills to parents or children. Information provides the foundation for moving people toward behavior change, and some experts say this constitutes an essential component of all interventions for increasing booster seat use (Ramsey 2000; Simpson 2002).

Types of outcome measures

- Crash-related death rates in intervention compared to control groups of children aged four to eight years
- Crash-related injury rates in intervention compared to control groups of children aged four to eight years
- Proportion of children aged four to eight years who were observed using booster seats while riding in motor vehicles
- Reported use of booster seats by persons who transport children (this represents a weak evidence of effectiveness)

Search methods for identification of studies

The search was not restricted by publication status, date, or language.

Electronic searches

We searched the following electronic databases (*see* Appendix 1 for the full search strategies):

Health

- Cochrane Injuries Group Specialized Register
- CENTRAL (Cochrane Central Register of Controlled Trials)
- MEDLINE (January 1966 to April 2005)
- EMBASE (January 1980 to April 2005)
- Combined Health Information Database (CHID)
- National Research Register

Road safety

- TRANSPORT (incorporates TRIS, ITRD, TRANSDOC, and NTIS) (1988 to April 2005)
- TRANSDOC (from the European Conference Ministers of Transport)
- NTIS (National Technical Information Service)
- TRIS (Transport Research Information Service)
- ITRD (International Transport Research Documentation)
- Australian Transport Index (formerly ARRB and ATRI) (1976 to April 2005)
- University of Michigan Transport Research Institute (UMTRI)
- Society of Automotive Engineers (SAE)
- The University of North Carolina Highway Safety Research Center (UNHSRC)
- ITE - University of California, Berkeley

Educational/Psychological

- PsycInfo

- ERIC (Educational Resources Information Center) (all years up to April 2005)
- SPECTR (The Campbell Collaboration's Social, Psychological, Educational, and Criminological Trials Register)

General

- Science (and Social Science) Citation Index
- Dissertation Abstracts
- The National Safety Council
- Online Computer Library Center (OCLC)
- Internet
- The Grey Literature [http://www.nyam.org/library/grey.shtml]
- Web of Science

Searching other resources

We contacted injury prevention programs, transport research institutes, safety institutes and other organizations and practitioners with diverse roles in vehicle occupant protection to obtain information on completed and ongoing trials. In addition, reference lists were examined for further relevant studies or reports.

Data collection and analysis

Selection of studies

Two authors screened titles and abstracts of relevant articles to assess their eligibility for inclusion in the review, using pre-defined selection criteria. Hard copies of trials that were potentially relevant to the review were retrieved for further assessment. Two authors assessed the methodological quality of the trials that met the selection criteria. Decision on inclusion was reached by consensus among all authors. The following criteria were used to assess the methodological quality of potentially eligible studies:

Randomized controlled trials

(1) Concealment of allocation (According to Section 6 of Cochrane Reviewers' Handbook - http://www.cochrane.dk/cochrane/handbook/handbook.htm):

- adequate
- unclear
- inadequate

(2) Comparability between intervention groups with respect to baseline characteristics such as injury rates, death rates, and frequency of booster seat use:

- adequate, if no substantial differences were present
- unclear, if not reported or not known whether there were substantial differences
- inadequate, if a substantial difference existed

Masking of participants and outcome assessors may be difficult to achieve in cluster or group-randomized studies; thus, this aspect was taken into consideration in our assessments.

Controlled before-and-after studies

We used the quality criteria adopted from the Cochrane Effective Practice and Organization of Care (EPOC) methods available at http://www.abdn.ac.uk/hsru/epoc/.
(1) Baseline comparability between study and control sites with respect to injury rates, death rates and frequency of booster seat use:

- adequate, if the answer was 'yes'
- unclear, if not reported or not clear from report
- inadequate, if the answer was 'no'

(2) Contemporaneous data collection (data collected at similar time periods) for both control and study sites:

- adequate, if the answer was 'yes'
- unclear, if not reported or not clear from report
- inadequate, if the answer was 'no'

Data extraction and management

We extracted data from eligible studies using a standardized data extraction form. Data that were extracted included:

- type of study design;
- types of participants and settings;
- interventions;
- outcome measures.

We requested missing information from included studies from the study authors or relevant contact individuals, groups, or organizations.

Data synthesis

RevMan version 4.2.7 (RevMan 2000) was used for statistical analysis. To determine the effects of the different types of booster seat promotion interventions, we categorized and analyzed data by type of intervention and compared each intervention type to no intervention. Four intervention types were identified and examined:

1. education versus no intervention;
2. distribution + education versus no intervention;
3. incentives + education versus no intervention;
4. enforcement versus no intervention.

We calculated relative risks (RRs) with 95% confidence intervals (CI) in the analysis of the effects of each intervention type, using the fixed-effect model. To estimate the combined effect of all booster seat promotion interventions as compared to no intervention, we analyzed data from all four intervention types as one large group versus no intervention, using the random-effects model. The random-effects model accounts for heterogeneity inherent in combining studies with differing interventions and gives a much more conservative estimate of effect. Data from uncontrolled before-and-after studies were presented in a tabular format.

RESULTS

Description of studies

Results of the search

The search strategy identified 1,350 reports (published and unpublished), that were topically related to child motor vehicle occupant protection. These were later narrowed down to 62 that dealt with strategies to promote use of child restraints. Twelve studies specifically dealt with booster seat interventions. Of these, only five met the criteria for inclusion in the review. A total of 3,070 individuals were involved in the five studies. Four of the five were conducted in the United States: (Ebel 2003; Johnston 2000; O'Neil 2005; Stevens 2000); one was conducted in Australia (Bowman 1987). A description of these studies is presented below. Further details of each study are presented in the characteristics of included studies table. The remaining seven did not qualify for inclusion (see table: characteristics of excluded studies). Six potentially eligible studies were identified as ongoing (see table: characteristics of ongoing studies).

Included studies

Stevens 2000 relied on individuals as the unit of allocation. Bowman 1987 used both individuals (parents of preschool children) and preschools as the units of allocation. The remaining three studies (Ebel 2003; Johnston 2000; O'Neil 2005) used a clustering based on communities, (pre)schools, or day care centers. All five studies were controlled trials; three were non-randomized (Bowman 1987; Ebel 2003; Johnston 2000). Three of the studies relied on observed booster seat use as the outcome measure (Bowman 1987; Ebel 2003; O'Neil 2005); Johnston 2000 and Stevens 2000 used self-reports as the outcome measure. Stevens 2000 corroborated self-reports with actual purchase of booster seats by examining the number of discount coupons used at the store. The length of follow-up ranged from two weeks to 15 months. Detailed discussion of the characteristics of each study is presented below.

Bowman 1987 *(Newcastle, Australia)*
The purpose of this study was to implement and compare the effectiveness of two interventions to increase the safety restraint use of preschool children aged three to five. Bowman 1987 did not specifically mention booster seats in their report, but recommendations in Australia at the time of the study (as now) was for children in the three to five age group to move into booster seats as an intermediary step to seat belts alone. Confirmation that the study evaluated booster seats was obtained from the author, Dr Jenny Bowman, Associate Professor in the School of Behavioral Sciences, University of Newcastle, Australia. In this study, one intervention was an enforcement strategy aimed at parents; the other was an educational intervention for preschool children. The educational intervention was designed to address two issues: children's resistance to the use of restraints and passive acceptance by children of being unrestrained. Children were taught by their teachers to insist on wearing a restraint when travelling in the car. If not restrained by parents, children were taught to persist until the parents took action to ensure that they were suitably restrained.

Study participants were children attending 45 preschools randomly selected from the telephone directory. Trained observers recorded restraint status of the children before the interventions and immediately after. Restraint information was recorded on one morning at each preschool by a single observer. For each preschool, percentage restraint use was calculated. Preschools were then assigned randomly to a control or intervention group, after matching for restraint use. Fifteen preschools were assigned to each of the control, educational intervention, and legislative intervention groups.

Research assistants visited the preschools in the two intervention groups to deliver and explain the use of the intervention materials. The legislative intervention used threats of random police checks and fines to attempt to increase children's restraint use. Letters from the Chief Inspector of Police in the Newcastle District were handed individually to parents by the preschool director. The letter outlined legislation concerning the wearing of safety restraints by children. It warned parents that police would be conducting random checks in the area and that parents whose children were not adequately restrained would be fined. Police were not conducting checks but had agreed to include the warning in the letter to increase parents' perceptions of threat. The letter also included information regarding the types of child restraints available and their approximate cost. An accompanying pamphlet supplied general information regarding the use of child restraints. Posters and reminder cards, with the same warning of police checks and possible fines, were also used. Each preschool was supplied with three posters, which were displayed prominently. Reminder cards were pinned to the children's clothing or placed in their lunch boxes on the intervention days in both weeks.

The educational intervention was presented to preschool directors in kit form, and included the intervention material and a detailed explanation of its use. The material supplied to the preschools included: copies of six different drawings featuring cartoon characters; two brief songs, written to well-known tunes; a rubber stamp, which read "seat belt safety"; and two modified lap seat belts, which were fitted to preschool chairs. Suggestions were made for ways in which the supplied materials might be used, but it was left to the individual preschool teachers to create their own programs.

Ebel 2003 *(Seattle Washington, USA)*
This study assessed the effectiveness of a multifaceted community booster seat campaign in increasing observed booster seat use among child passengers in motor vehicles, using a prospective, non-randomized, controlled community intervention design. The campaign was initiated in four communities in the greater Seattle, Washington area between January 2000 and March 2001. Eight communities in Portland, Oregon, and Spokane, Washington, served as control sites. The study utilized community-based multiple intervention strategies that included:

- the formation of community coalition of agencies and organizations to promote the use of booster seats;
- citizen advisory group of parents and caregivers to provide feedback on campaign messages and materials and to develop strategies to ensure community involvement;
- broad-based community education program to increase knowledge and awareness of the importance of booster seat use (through newspaper articles, organization and group newsletter articles, booster seat web site, tip sheet, brochures, and flyers in multiple languages, telephone information line where parents can call for materials and with questions about booster seats and car seats, resource kits for preschools and health

care providers, radio public service announcements, television public service announcements, local news reports);

- educational programs to address barriers to booster seat use, including defining types of booster seats, identifying where devices are available, and providing alternatives for automobiles with lap-only belts;
- discount booster seat coupons;
- car seat training programs and in-services for health care providers, child care providers and educators, law enforcement, emergency medical service personnel, and child passenger safety advocates.

The outcome measure was observed booster seat use rates at 83 child care centers and after school programs, 15 months after the start of the campaign. Booster seat use rates were adjusted for child's age, driver's seat belt use, and driver's gender.

Johnston 2000 *(Washington State, USA)*
This trial assessed the effects of an injury prevention program delivered by school-based home visitors to low-income families whose children were attending preschool enrichment programs in Washington State, USA. Study participants were the families of children in a defined geographic area aged four to five years and enrolled in Head Start or ECEAP between January and June 1998. Of the 258 families enrolled in the intervention sites, 213 (82.5%) completed both baseline and post-intervention assessments. Of the 160 families in the comparison sites, 149 (93.1%) completed both baseline and post-intervention assessments. Analysis was restricted to those families that completed both assessments. Case workers administered a baseline home safety assessment to participating families and recorded availability of booster seats in motor vehicles owned by the family. Intervention families were offered educational materials and free child safety equipment including age appropriate car safety restraints to 195 families, based on results of the home inspection. Families in the comparison group received only written information encouraging them to purchase needed safety equipment including booster seats. Outcome data were obtained by the same case worker who had enrolled families and was back to repeat the home safety assessment at three months post enrolment. Outcome measure was self-reported use of booster seats. Availability of booster seat was confirmed at the home visit by the case worker.

O'Neil 2005 *(Indianapolis, Indiana, USA)*
This was a blinded, randomized, controlled trial conducted in daycare and preschools to evaluate methods to increase booster seat use for four to six year old children. The study selected nine facilities and assigned the facilities to one of the following three arms; distribution + education, incentive + education, or a control group. The education component was the same in both intervention groups and was based on the Health Belief Model of behavioral change (Glanz 2002). Parents in the distribution + education group were taught how to correctly install and use a booster seat in their vehicle. At the end of the session the parents were offered a free booster seat. Their children received a separate educational presentation on why children need to be buckled-up in a booster seat and sit in the rear-seating position of the vehicle. Educational information and materials were based on the Boost America© program using Blues Clues© format with songs, coloring activities and a brief question and answer period.

The incentive + education group was similarly taught about the importance (and use) of booster seats, but was not offered free booster seats. They were informed that if they were observed using a booster seat at the one and six-month observation they would be entered into a drawing to win a gift certificate. The control group received educational materials through an informed consent that related information typically transmitted during a primary care health maintenance visit. On the day of the baseline observation and survey, certified child passenger safety technicians and their assistants were stationed at the entrance and in a specially marked off area of the parking lot of each participating facility. As a vehicle approached the facility for the morning drop off, they were stopped and identified as a potential study participant, and asked if they would be interested in participating in the study. If interested, informed consent was obtained and the driver filled out a survey collecting personal demographic data and knowledge, attitudes and beliefs in the use of booster seats, seat belts and seating position in the vehicle. While the driver completed the survey, the observer noted the type and use of child safety seats, booster seats, seat belts and seating position in the vehicle.

The child passenger's height and weight were measured and recorded. One and six months after the intervention program was completed, observations were conducted and surveys repeated in a similar manner at intervention and control sites. None of the sites knew in advance when observers would be present. Observers remained blinded to which sites was intervention or control. Main outcome measure was observed use of booster seat at one or six months post-intervention follow-up. Our analysis was restricted to six month post-intervention data. Two hundred and seven (207) children aged four to six years were enrolled and observed at baseline. Only 136 of these were observed post intervention, thus a loss to follow-up of 34.3%.

Stevens 2000 *(Virginia, USA)*
Stevens conducted a field study with a volunteer sample of 128 participants made up of customers walking into a retail toy store in a Southwest Virginia community. All participants had a child who was aged 3.5 to 8 years of age and weighed between 35 to 80 lbs (16 to 36 kgs). The hypotheses tested were that: (i) booster information pamphlets and *"dollars off"* coupon would reduce booster seat use compliance cost and thus, encourage purchase of booster seats; and (ii) that the pamphlets would increase risk perception. None of the participating children were using booster seats in the primary vehicle at baseline. The participants were randomized into four groups as follows: pamphlets and booster discount coupons, pamphlet only, booster seat discount coupon only, and no intervention. The pamphlet contained a warning label, a true story of a child who was killed because he was restrained in an adult seat belt instead of a booster seat, statistics and consequences of non-use. The coupon's value of $30.00 represented 30 to 60% discount off the cost a high back booster seat. Outcome measures were participants' change in risk perception and whether or not they purchased a booster seat.

Risk of bias in included studies

Comparability of sociodemographic characteristics

Few of the studies reported a thorough comparison of demographics and other possible confounders between the control and intervention arms. Ebel 2003 matched the intervention communities (n = 4) with the control communities (n = 8) using per

capita income and population size. She used statistically methods to adjust for such variables as the child's age, the driver gender and seat belt use. Bowman 1987 did not report the sociodemographic characteristics of the study population, but only indicated that preschools were matched for restraint usage to ensure that no group was biased with a disproportionate number of high or low restraint rates. Johnston 2000 compared the intervention and control communities on the basis of child age, sex, race/ethnicity, parental employment, primary language, single or dual-parent home, child's educational disability, and median household income. O'Neil 2005 compared the demographics of the control versus intervention group and noted a difference in race (P = 0.002; the education + incentive had a higher African-American population); WIC participation (P = 0.006; control group had a higher WIC participation) and age (P = 0.010; slightly younger control group). Stevens 2000 did not discuss the demographics of the population, but noted that the retail store was in an affluent area. There was also no comparison of the two intervention arms, although age and gender of the parents were noted.

Blinding

In Bowman 1987 observation was recorded on one morning by at each preschool by a single observer. She discussed reliability of observations but did not report whether the observers were blinded. Ebel 2003 had two observers per vehicle, so inter-observer variation was not an issue. The observers were unaware of the allocation status. Johnston 2000 did not report whether case workers were blinded, but it was noted that one case worker was assigned to one family for both pre- and post-intervention assessments. O'Neil 2005 indicated that observers were blinded to the intervention type received by the centers they were examining. Stevens 2000 was both the investigator and the observer; thus, blinding was not feasible.

Interviewee bias

Social desirability bias can be introduced in a study when self-report is relied upon for the outcome measure (Adams 2005). Respondents, eager to please their interviewer, may give answers they believe the interviewer would like to hear in order to prove that the activity was effective. Thus, Johnston 2000, and Stevens 2000 should be interpreted in this context since they relied on self-reports. It should however, be noted that Stevens corroborated booster seat purchase by confirming redeemed coupon numbers with the purchase report of the participant. In Johnston 2000 also, the case worker confirmed availability of booster at the home visit. Bowman 1987, Ebel 2003 and O'Neil 2005 used observation and so interviewee bias was not an issue.

Loss to follow-up

Loss to follow-up for the post-intervention assessment was variable among the studies. In Johnston 2000, a high proportion of intervention-eligible families enrolled and completed the study; the authors however did not conduct a comparative analysis of those who dropped out of the study or those who chose not to participate versus those who completed the study. Participants could have self-selected to remain in the program due to any number of confounding factors. O'Neil 2005 had a significant loss to follow-up of 34.3%; 20% of the children moved from the facilities, and a number of participants lost interest. Ebel 2003 involved two entirely different sets of children that were observed at baseline and follow up; thus, loss to follow-up was not an issue. The same was the case for Bowman 1987 who observed 740 preschool children and baseline and 751 post-intervention. Post-intervention observations were made on the same day of the week as the pre-intervention observations. For this reason, Bowman 1987 asserted that "the sample of children observed was basically homogenous pre- and post-intervention". However, no evidence was provided to support this claim. Stevens 2000 had no loss-to-follow-up.

Separation of interventions

Stevens 2000 distinguished between two factors together (pamphlet plus coupon), pamphlet only, coupon only, and one group lacking any intervention at all. Johnston 2000 compared information and distribution of seats to participants who received only information. Bowman 1987 used two intervention arms; education for preschool children, enforcement of law for parents, and non-placebo control group. They provided the educational intervention kits to preschools and made suggestions on ways in which the supplied materials might be used. It was left to the individual preschool teachers to create their own programs. Although it was noted that preschools were visited twice during the two week intervention to ensure that interventions were being implemented correctly, implementation strategies across the 45 preschools may have varied. O'Neil 2005 utilized two intervention arms that compared: (i) distribution + education with (ii) incentives + education with (iii) a non-placebo intervention control. Ebel 2003 was a community-based intervention that utilized multiple intervention strategies, including community mobilization and involvement. The purpose was to evaluate what the overall impact of a community-based campaign was on booster seat use rate. Thus, the study did not isolate the effects of one factor from others due to the design of the study. The distribution of seats might have been more effective than the brochures and flyers for instance, but the analyses could not reveal such distinctions.

Measurement issues

Over-estimation of effectiveness of the specific interventions studied may have occurred in both the Indianapolis study (O'Neil 2005) and the Washington community study (Ebel 2003). Study participants likely received non-intervention-related messages regarding the passage of new booster seat laws, which could conceivably increase awareness and lead to purchase and use of booster seats in experimental group and/or control group.

A complicating factor in the measurement of booster seat use is that the only objective way to ensure 'age-appropriate child restraint' is to physically measure the weight and height of the child. Few campaigns perform this activity, as it is seldom feasible under field study conditions and can lead to attrition of participants due to time constraints. Only O'Neil 2005 measured height and weight for participating children. The others relied on parents' or caregivers' report of the child's age, height, and weight as a proxy for appropriate size for a booster seat. It is questionable whether such reports represent actual age, height, and weight of the children.

Theoretical framework

Two of the studies clearly relied on strong behavior change theories to influence the design of their studies. Ebel 2003 utilized the PRECEDE-PROCEED model, which attempts behavioral change by identifying predisposing, enabling, and reinforcing factors (Green 2004). O'Neil 2005 was designed based on the Health Belief Model,

which establishes leverage points that can be influenced, such as perceived susceptibility, perceived severity, perceived benefits of taking action, perceived barriers to action, cues to action, and self-efficacy (Glanz 2002). Stevens 2000 relied on a vague combination of theories derived from the hazard and warnings literature as well as the concept that increased risk perception (in this case, perceived risk of injury severity), will motivate behavior change. Johnston 2000 and Bowman 1987 did not indicate integration of theory into their design or implementation.

Effects of interventions

All five studies reported outcomes on frequency of booster seat use (observed or reported) post intervention. Results of the meta-analysis are presented in the following section.

Booster seat use (reported or observed)

Education versus no intervention

In Bowman 1987, 173/231 (75%) of participants in the education only arm used booster seats at two weeks compared to 161/268 (60%) of participants in the no intervention group. Stevens 2000 also showed that participants in the education arm of her study were more likely to purchase booster seats 12/32 (38%) than were those in the control group 1/32 (3%) at 30 days. Combined results from both studies showed a beneficial outcome in favor of education, RR 1.32; 95% CI 1.16 to 1.49 (n = 563).

Distribution + Education versus no intervention

In Johnston 2000, 42/195 (22%) participants in the education and distribution arm had obtained child safety seats at three months compared to 7/132 (5%) in the no intervention group. In O'Neil 2005, slightly more participants 20/30 (67%) in the combination group used booster seats at six months compared to 12/23 (52%) participants in the control group but the difference was not marked, RR 1.28; 95% CI 0.80 to 2.04. However the combined results from both studies show a beneficial effect for combining distribution and education compared to no intervention RR 2.34; 95% CI 1.50 to 3.63 (n = 380).

Incentive + Education versus no intervention

In Stevens 2000, more participants in the combined intervention group 11/32 (34%) had purchased booster seats at one month compared to 1/32 (3%) in the no intervention group. In Ebel 2003, 184/705 (26.1%) participants in the combined group used booster seats compared to 215/1065 (20.2%) in the no intervention group. O'Neil 2005 however showed no difference in the use of booster seats at six months among participants in the treatment arm 20/41 (48.8%) and the participants in the no intervention group 12/23 (52.2%). The combined results from the three studies indicate a beneficial effect of incentive + education in increasing booster seat use compared to no intervention RR 2.75, 95% CI 2.41 to 3.13 (n = 1898).

Enforcement of law versus no intervention

Only one study (Bowman 1987) compared enforcement of booster law with no intervention. This study showed no marked difference in use of booster seats among the intervention 158/252 (63%) and control groups 161/268 (60%), RR 1.04; 95% CI 0.91 to 1.20 (n = 520).

Any booster seat intervention versus no intervention

A meta-analysis of five studies (Bowman 1987; Ebel 2003; Johnston 2000; O'Neil 2005; Stevens 2000) in which any intervention aimed at promoting booster seat use was compared with no intervention, showed a marked beneficial outcome for booster seat use RR 2.18; 95% CI 1.12 to 4.23 (n = 3,070).

DISCUSSION

The benefits of using booster seats by children who are too big for safety seats designed for toddlers, but too small to use adult seat belts have been widely discussed in the literature (Corden 2005; Mickalide 2002; Winston 2001). Also, constraints which families have in acquiring and using booster seats have been examined and documented (AED 2001; Ramsey 2000). Finding effective ways to translate available knowledge into increased age-appropriate booster seat use remains a challenge for traffic safety and public health agencies. Opportunities to increase booster seat acquisition and use fall into four categories: legislation requiring booster seat use, enforcement of booster seat laws, distribution of booster seats (or incentives), and education. Our initial search revealed a total of 1,350 reports that were related to child restraint promotion. These were later narrowed to 12 studies. Of these, only five good to excellent quality studies met the criteria for inclusion in the meta-analysis.

Results obtained from our analyses show that interventions which combine education with either incentives (discount coupons for purchase of booster seats) or distribution of free booster seats have a beneficial effect on acquisition and use of booster seats. Ebel 2003 and Stevens 2000 provided booster discount coupons, which displayed an effect on purchase and use of boosters. Distribution of free booster seats was influential for both Johnston 2000 and O'Neil 2005. Only O'Neil 2005 compared distribution of free booster seats with incentives, noting that distribution was more effective than incentives. Results of the analyses can have significant implications on the establishment of future interventions, as program planners want to be as effective as possible but have limited budgets within which to work. Education demonstrated an effect for Bowman 1987.

Uncontrolled before-and-after studies

Although many reports have been published on interventions to increase child restraint use, very few programs involved rigorous evaluation of impact. We identified several studies that used the uncontrolled before-and-after design (Table 1). Of the studies that dealt with booster seat laws, only one qualified for inclusion in the meta-analysis. However, all but one of the five uncontrolled before-and-after studies that assessed the impact of legislation demonstrated a positive effect. In the absence of a comparison group, drawing conclusions becomes difficult since any observed differences between pre- and post-intervention measures could have resulted from chance or simply the passage of time. Although these studies did not strictly meet the criteria for inclusion in the meta-analysis, a reference is made to these quasi experimental studies in order to capture the totality of evidence regarding booster seat laws albeit lower level of evidence.

Limitations

It is important that readers interpret the results of this review in the context of a number of limitations that are discussed hereunder. This review involved extensive search of relevant databases and contacts with public health and transport safety agencies and experts from around the world. The literature

search was not restricted by language or status of publication. Nevertheless, eligible studies identified were from developed countries, notably the US and Australia. We found no indication of eligible studies from other countries. This has implication for international generalizability of our findings. On another hand, it is doubtful that the populations involved in the included studies can be regarded as representative of the general populations of the US and Australia. For example, the middle class Seattle area communities in Ebel 2003 study seem quite different from the Head Start population studied by Johnston 2000. Even within Ebel 2003, the per capita income of the study population ranged from $15,260 (20% living in poverty) to $54,000 (3% living in poverty). It is important to note that given the resources needed to conduct interventions such as those implemented by Johnston 2000 and O'Neil 2005, replication may not be possible in many countries. Equally, the level of community involvement in Ebel 2003 may be difficult to achieve in some poor countries that have fewer resources or more social problems. It was noteworthy that most of the Head Start families in Johnston 2000 did not have cars with rear seat lap-shoulder belts suitable for booster seats. This may be the case in many parts of the world.

While the five studies included in the meta-analysis had sufficiently rigorous deign, two were based on observations and three on self-reports. We recognize the challenges involved in collecting observational data, and although corroboration of booster seat availability was obtained, self-reports generally constitute weak evidence of effectiveness.

Some of the included studies suffered from significant attrition rates, and follow-up duration varied significantly. This may imply different implications for the different studies analyzed. For example, there is a marked difference between the experimental day care intervention of two week duration by Bowman 1987 when compared to Ebel 2003, a large multi-intervention, community-based trial of 15 month duration.

Notwithstanding these limitations, this review has considerable implications for research and practice related to efforts to increase use of booster seat for four to eight year olds.

AUTHORS' CONCLUSIONS

Implications for practice

The science of booster seats and the strategies to increase its acquisition and use by families with young children is still an evolving field in many settings. The limited results shown suggest that multiple intervention approaches can be used to ensure increases in booster seat acquisition and use. Incentives + education, distribution + education, and education-only interventions produced varying degrees of beneficial effects. For studies that demonstrate the effect of incentives and distribution of free booster seats, the question arises with regard to funding and sustainability. It is possible that some socially minded governments or local health departments might decide to fund booster seat distribution or coupons. However, with limited resources, very few governments or local councils in many resource-poor countries are likely to be able to provide incentives or free booster seats to all deserving families. In such situations, local health departments and traffic safety programs can identify and foster participation and contribution of material resources by the private sector, including but not limited to the auto industry, child advocacy organizations, foundations, and private voluntary organizations (PVOs) with interest in child health. Private-public partnership strategies are successfully being advocated and applied in other areas of population health promotion (Goodman 2004; Muraskin 2004; Wertheimer 2004) and may be relevant to the promotion of booster use. Result obtained with regard to the effect of laws on booster seat use should to be interpreted with caution.

Implications for research

We found only five good to excellent quality studies. Given the dearth of evaluation studies currently available globally, future endeavors to increase booster seat use must include rigorous assessment of impact, using well designed approaches that minimize bias and ensure the validity and reliability of results. There is a need for randomized controlled trials but there is also a need for prospective controlled trials, especially community-based interventions that are readily replicable, and which may provide some indication of sustainability under normal field conditions. A useful focus for future research would be a demonstration of the individual effects of the different available interventions (education, incentives, distribution, legislation). None of the studies included in our review compared for example, distribution of booster seats versus no distribution (that is, without education included in the intervention), or legislation versus no legislation. It will be important to know whether a multiple intervention strategy such as the one used by Ebel 2003, which involved significant community mobilization and participation is more effective than incentives only. We do not know how incentives-only programs compare with either distribution-only or education-only interventions, neither do we know what effect community mobilization and participation has on program effectiveness. Evidence in these areas will be needed to determine generalizability of the results. The need to investigate what works best in different populations settings (for example, affluent and poor neighborhoods) is also important since it is possible that differences would be found between the behaviors of low-income parents as compared to the more affluent, or between urban and rural parents. Ascertainment of such differences is important to ensure proper targeting of future campaigns. Other important areas for future research include evaluation of the effect of legislation, cost-effectiveness analyses, studies of interventions in high risk populations, and the issue of outcome measurement. We acknowledge the practical challenges of collecting observational data, including time constraint and cost. However, such measures are critical to ensure reliability of data. Larger population studies of longer-term duration should be implemented to facilitate adequate assessment long term impact and effect size.

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CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Bowman 1987

Methods	Randomized trial. Method of randomization: unknown. Concealment of allocation: unknown.
Participants	Preschool children 3 to 5 years old in Newcastle, New South Wales, Australia.
Interventions	1. Enforcement intervention based on letters to parents or guardians reinforcing existing child restraint law. 2. Education aimed at modifying the behavior of preschool children with regard to child restraint use. 3. Control group (no intervention).
Outcomes	Restraint use of children in the educational intervention group increased 15% points from 60.6% to 75.0%.
Notes	Booster seats not specifically mentioned, but booster seat use confirmed by author. Follow-up interval very brief at two weeks. Study is quite old (1987).

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Ebel 2003

Methods	Non-randomized prospective controlled community trial. Allocation concealment was adequate. Had two observers per vehicle, so inter-observer variation was not an issue. The observers were unaware of the outcome status.
Participants	Parents of children 4 to 8 years old and the children themselves, residing in four intervention communities.
Interventions	Educational efforts included educating physicians and other health providers on the need for child restraint counselling. Educational messages were provided to the target population through TV, radio, newsletters, brochures and flyers, and classes. Coupons for discounted booster seats were distributed. Controls received no intervention.
Outcomes	Observed booster seat use increased 58%.
Notes	Multiple intervention strategies.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Low risk	A - Adequate

Johnston 2000

Methods	Non-randomized trial (clustered). Allocation concealment unclear. Blinding unclear.
Participants	Parents of children 4 to 5 years old enrolled in Head Start programs.
Interventions	Home visit by Head Start staff to educate families on booster seat use, smoke alarms, and storage of household chemicals. Intervention participants received supplies.
Outcomes	Observed booster seat presence from 0 to 21.5%. Self-reported "always" used booster seat.
Notes	Mostly low-income families.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

O'Neil 2005

Methods	Randomized trial (clustered). Blinded observers.

O'Neil 2005 *(Continued)*

Participants	Parents of children 4 to 6 years old and the children themselves attending nine day care centers and preschools in Indianapolis, Indiana.
Interventions	Children received age-appropriate educational classes in the centers and schools. Interventions for parents were either distribution of booster seats and education/skills training; incentive to purchase a seat and education/skills training; or no information (control group).
Outcomes	After six months, observed booster seat use increased: from 42.6% to 66.7% in distribution+education group; from 34.7% to 48.8% in the incentive+education group; from 39.4% to 52.2% after 6 months in the control group.
Notes	Insufficient statistical power because of high attrition.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Low risk	A - Adequate

Stevens 2000

Methods	Randomized trial. Allocation concealment adequate (different days). Not a blinded observer.
Participants	Parents of children 3.5 to 8 years old and weighing 35-80 pounds entering a retail toy store in Virginia.
Interventions	Participants either given pamphlet (P) and coupon (C) for seat, just a pamphlet, just a coupon, or no intervention (control group).
Outcomes	Purchase of booster seat increased 34% for the C+P group, 38% for P, 41% for C, and 3% for the control group. All respondents self-reported using the booster seat every time child travelled.
Notes	Relatively brief follow-up interval of 30 days. Unclear whether study had sufficient statistical power.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Low risk	A - Adequate

A= adequate; B= unclear.

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Apsler 2003	No control group.

Study	Reason for exclusion
Browning 2000	No control group.
Cooper 2004	No control group.
Douglass 2005	Lack of information to adequately assess the separate effects of a community intervention that utilized multiple strategies on intervention and control groups.

Characteristics of ongoing studies *[ordered by study ID]*

Aitken

Trial name or title	Strike out child passenger injury
Methods	
Participants	Parents of t-ball participants
Interventions	education distribution
Outcomes	Increase in booster seat use
Starting date	Spring 2005
Contact information	Mary Aitken AitkenMaryE@uams.edu
Notes	

CDPHE

Trial name or title	Cluster randomized control trial at child care centers to increase possession and use of booster seats
Methods	
Participants	Parents of children attending child care centers
Interventions	education distribution incentive
Outcomes	Increase in booster seat use
Starting date	October 2003
Contact information	Sallie Thoreson sallie.thoreson@state.co.us
Notes	Expected to be completed in 2007

Ebel

Trial name or title	A Controlled prospective community trial to increase booster seat use among Latino families
Methods	
Participants	Latino families in urban and rural communities
Interventions	-Development and dissemination of culturally-tailored intervention materials based on extensive qualitative research -incorporation of behavior change messages into radionovelas, television PSA, posters and brochures -critical involvement of Latino Advisory Councils partnerships with community organizations developing culturally-specific law enforcement partnerships
Outcomes	Change in observed booster seat use
Starting date	2004
Contact information	Ebel, Beth bebel@u.washington.edu
Notes	Expected to be completed in 2006

Eby

Trial name or title	Statewide booster seat use survey
Methods	
Participants	Parents of booster-age children
Interventions	legislation?
Outcomes	Increase in booster seat use
Starting date	2005
Contact information	David Eby eby@umich.edu
Notes	Survey of booster seat; not an intervention

Johnston

Trial name or title	A prospective community intervention to increase booster seat use in high-risk urban population using community based program; component of Injury Free Coalition for Kids program
Methods	
Participants	Families in urban communities at high risk of occupant injury
Interventions	-Development and dissemination of low-literacy, multi-language materials;

Johnston *(Continued)*

	-capacity building to increase booster seat availability at urban retail outlets -outreach education to ethnically diverse head start programs, churches, community service providers -low-cost booster seat sales in targeted communities
Outcomes	Primary measure: Change in observed booster seat use
Starting date	2004
Contact information	Brian Johnston, (bdj@u.washington.edu) USA
Notes	Expected to be completed in 2006

Kostyniuk

Trial name or title	"Boost'em Up" - set of interventions (a demonstration project sponsored by NHTSA)
Methods	
Participants	To provide an independent evaluation of the Think First Foundation for Injury Prevention.
Interventions	
Outcomes	
Starting date	
Contact information	lidakost@umich.edu
Notes	

Nebraska DMV

Trial name or title	Statewide booster seat use survey
Methods	
Participants	Parents of booster-age children
Interventions	legislation education distribution
Outcomes	Increase in booster seat use
Starting date	2004
Contact information	Cathy Chochon cathy.chochon@dmv.state.ne.us
Notes	Not necessarily an intervention.

Nebraska DMV *(Continued)*	
	Will conclude in 2005

NHTSA	
Trial name or title	"Think First" Four-Site Demonstration Project
Methods	
Participants	Parents of booster-age children
Interventions	education
Outcomes	Increase in booster seat use
Starting date	September 2003
Contact information	Alexander Sinclair Sandy.Sinclair@nhtsa.dot.gov
Notes	Will conclude in 2006

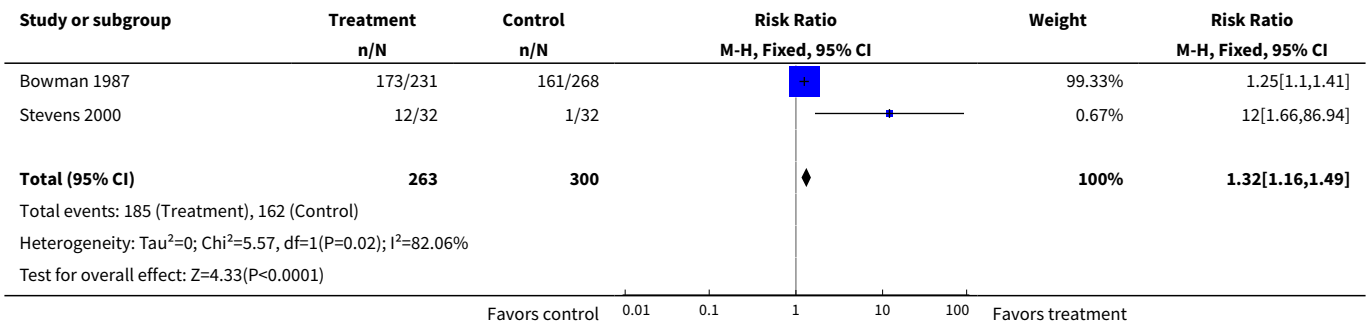
Rhode Island DOT	
Trial name or title	
Methods	
Participants	
Interventions	
Outcomes	
Starting date	
Contact information	
Notes	

DATA AND ANALYSES

Comparison 1. Education versus No Intervention

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Booster seat use (reported or observed)	2	563	Risk Ratio (M-H, Fixed, 95% CI)	1.32 [1.16, 1.49]

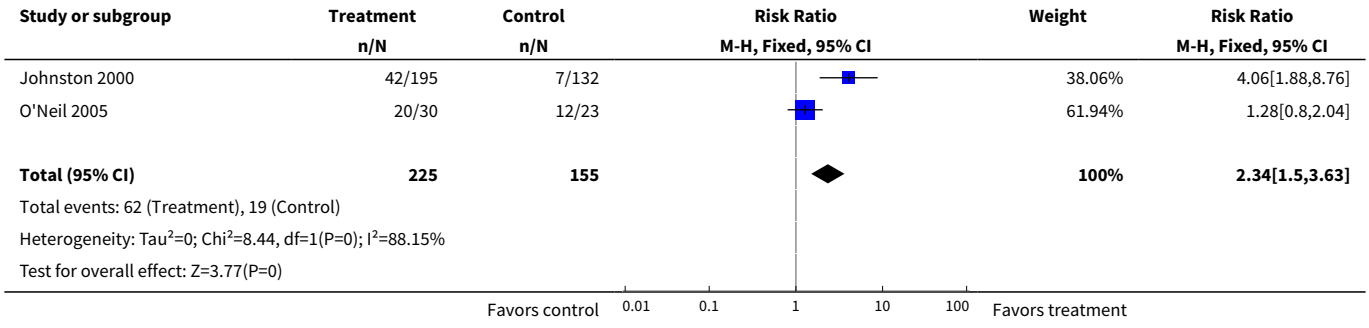
Analysis 1.1. Comparison 1 Education versus No Intervention, Outcome 1 Booster seat use (reported or observed).



Comparison 2. Distribution + Education versus No Intervention

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Booster seat use (reported or observed)	2	380	Risk Ratio (M-H, Fixed, 95% CI)	2.34 [1.50, 3.63]

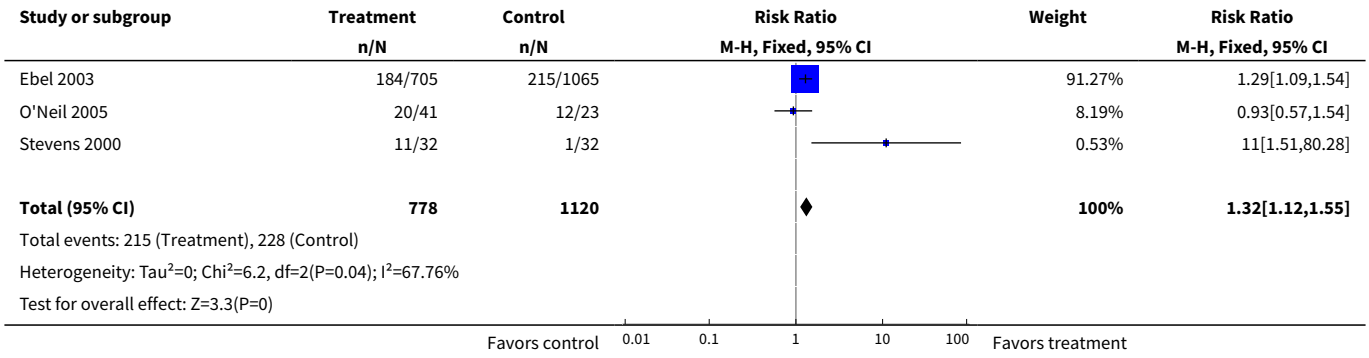
Analysis 2.1. Comparison 2 Distribution + Education versus No Intervention, Outcome 1 Booster seat use (reported or observed).



Comparison 3. Incentive + Education versus No Intervention

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Booster seat use (reported or observed)	3	1898	Risk Ratio (M-H, Fixed, 95% CI)	1.32 [1.12, 1.55]

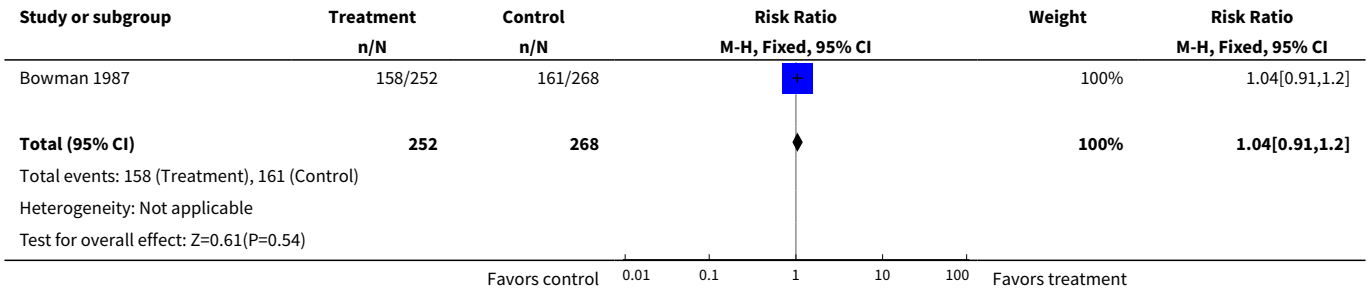
Analysis 3.1. Comparison 3 Incentive + Education versus No Intervention, Outcome 1 Booster seat use (reported or observed).



Comparison 4. Enforcement of law versus No Intervention

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Booster seat use (reported or observed)	1	520	Risk Ratio (M-H, Fixed, 95% CI)	1.04 [0.91, 1.20]

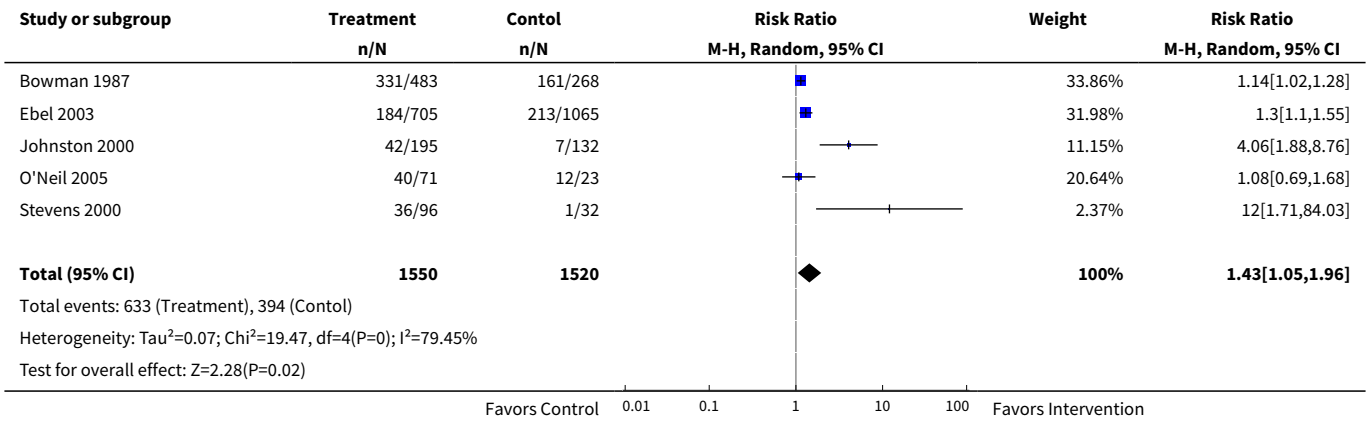
Analysis 4.1. Comparison 4 Enforcement of law versus No Intervention, Outcome 1 Booster seat use (reported or observed).



Comparison 5. Any booster seat promotion campaign versus No Intervention

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Booster use (reported or observed)	5	3070	Risk Ratio (M-H, Random, 95% CI)	1.43 [1.05, 1.96]

Analysis 5.1. Comparison 5 Any booster seat promotion campaign versus No Intervention, Outcome 1 Booster use (reported or observed).



ADDITIONAL TABLES

Table 1. Uncontrolled before-and-after studies

Study	Objectives	Study design	Study population	Intervention	Outcomes measured	Key results
Apsler et al., 2003 (USA).	To increase booster seat use among low-income parents.	Uncontrolled pretest/posttest. Used focus groups, surveys, and observation.	Low-income parents with children 4 to 8 years old enrolled in nine day care centers in Providence, Rhode Island.	Three-level intervention. 1. Education: trained day care staff and parents about risks of not using booster seats and distributed pamphlets in multiple languages. 2. Policy: day care center policies changed to recommend use of booster seats. 3. Incentive: gift certificate to local grocery store. All families were given free booster seats. Follow-up done 4 to 8 weeks after baseline.	Percentage of children 4 to 8 years old seen riding in booster seats.	Booster seat use All ages; pre 3%, post 38%. Age 4-5; pre 5%, post 63%. Age 6; pre 2%, post 19%. Age 7-8; pre 0%, post 0%. No restraint All ages; pre 56%, post 26%. Age 4-5; pre 54%, post 13%. Age 6; pre 57%, post 36%. Age 7-8; pre 59%, post 46%. Changes were significant at P<0.01. 1. Substantial increase in booster seat use after intervention. 2. Booster seat use decreased with age. 3. No differences between levels of intervention and use of booster seats.
Browning et al., 1999 (Australia)	To increase appropriate child car re-	Uncontrolled	Rural school-children 4	School-based intervention.	Observed use of child restraints.	Overall child restraint Pre 79%, post 90% (P=0.002).

Table 1. Uncontrolled before-and-after studies *(Continued)*

	straint use among 4 to 6 year old rural schoolchildren.	pretest/ posttest. Used observation, self-report, and Questionnaire.	to 7 years old enrolled in kindergarten, pre-primary or year 1 in five schools in Brunswick, Harvey, and Yarloop, Australia, and the children's parents.	Parents received educational materials, vouchers for free booster seats for eligible families, free checking of child restraints. Children received rewards in school for reporting restraint use. Follow-up done 3 months after baseline.	Percentage of children 4 to 6 years old seen using age-appropriate restraints Parents' attitudes. Percentage of parents using offer of free child restraints check.	Age-appropriate restraint Pre 45%, post 69% (P<0.0009). 40% thought child restraints were too expensive. 85% believed not everyone can tell if a child restraint is properly installed. Despite 85% of parents believing not everyone could tell if a child restraint is properly installed, less than 3% used the free checking of child restraints.
Cooper at al., 2004 (USA)	To evaluate the impact of the Child Passenger Safety Initiative on parents' knowledge, use, and misuse of child safety seats.	Uncontrolled pretest/ posttest. Used interviews and observation. Quasi-experimental.	Families with children aged 0 to 6 belonging to vulnerable groups (minorities, low-income) and attending seven public hospitals and health systems in California.	Child Passenger Safety Initiative. Education of parents/caregivers on proper child restraints, distribution of free and low-cost seats, trained physicians/nurses to teach patients about proper car seat use, outreach component educated foster parents and child welfare workers about child passenger safety. Follow-up done approximately 1 year after baseline.	Knowledge of booster seat safety law. Reported use of booster seats for children aged 4 to 6. Observed use of booster seats.	Drivers with a knowledge of child passenger safety law; Pre 79.4%, post 74.6% (P<0.05). Drivers who reported always using booster seats; Pre 57.3%, post 55.5%. Observed booster seat use decreased between pre- and posttest (P<0.05) [no data reported].
Decina et al., 1994 (USA)	To evaluate the effect of locally funded education and enforcement programs aimed at increasing child restraint use. To increase proper child restraint use.	Pretest/ posttest with control group. Used observation and self-report.	Target: Residents of Tredyffrin and Haverford, Pennsylvania. Control: Residents of Abington, Pennsylvania.	One year educational and enforcement intervention. Included kickoff events, distribution of print materials and promotional items through community, school visits, and citations.	Percentage of toddlers 3 to 5 years old observed using child restraint. Percentage of "fully protected" toddlers.	Child restraint use in toddlers aged 3 to 5: Tredyffrin; pre 40.6%, post 49.4%. Haverford; pre 30.5%, post 39.4%. Abington; pre 38.7%, post 38.6%. "Fully protected" toddlers aged 3 to 5: Tredyffrin; pre 36.5%, post 45.1%. Haverford; pre 27%, post 37.5%. Abington; pre 33.2%, 33.6%.

Table 1. Uncontrolled before-and-after studies *(Continued)*

						These findings were not statistically significant
Griffin, 2003 (USA)	To conduct community-based interventions to increase booster seat use. To develop an observational survey to collect accurate booster seat data. To assess the effectiveness of the interventions.	Pretest/ posttest; observation; interview.	Target: Children aged 4 to 7 in California. Control: None.	Give Kids a Boost! Community-based assessments of resources; checkup events; mass media and educational print materials; free and low-cost booster seat programs. Follow-up done 1 year after baseline.	Percentage of children aged 4 to 7 observed riding in booster seats.	Booster seat use; Pre 26%, post 53%.
Foss, 1989 (USA)	To assess the impact of a community-wide incentive campaign on seat belt use.	Pretest/ posttest; telephone survey; observation.	Target: Children aged 0 to 12. Control: None.	Five month incentive campaign aimed at parents and children; radio spots; flyers.	Percentage of children aged 0 to 12 observed using seat belts.	Observed seat belt use: Age 0-5; pre 26.8%, post 36.4%. Age 6-12; pre 10.4%, post 11.9%. Findings showed short-term improvements in seat belt use in response to radio spots
Murrin, 2004 (USA)	To compare before-law and after-law use of booster seats in California.	Uncontrolled pretest/ posttest (before and after law). Used data gathered during child restraint inspection events. Cross-sectional.	Children up to age six or weighing less than 60 pounds.	Enactment of California law requiring children under age six, or less than 60 pounds to ride in a booster seat.	Percentage of all seats inspected that were boosters.	Booster seat inspections; Pre 5.6%, 11%. Proportion of booster seats being inspected increased after passage of law.
Hemmo-Lotem, 2004 (Israel)	To evaluate parents' knowledge and attitudes about child passenger and booster seat use for chil-	Uncontrolled pretest/ posttest. Used telephone surveys.	Parents with children under 15, including Russian-speaking subset.	Enforcement component, media campaign; details not provided.	Awareness of what a booster seat is. Ability to provide correct de-	Awareness; Pre 38%, post 44%. Providing correct details Pre, 32%, post 39%. Russian-speaking parents knew less about booster

Table 1. Uncontrolled before-and-after studies *(Continued)*

	dren 4 to 9 years old. To evaluate an intervention program initiated by BETEREM. To identify groups and factors that influence booster seat use.				tails regarding nature and use of booster seats.	seat use than other parents. 57% of parents of children aged 4 to 9 were unaware of the requirement that their children should use booster seats.
Philbrook et al., 2005 (USA)	To test the effectiveness of three school-based booster seat intervention methods to increase booster seat use in a public school system. To determine the feasibility of three school-based interventions. To determine differences in attitudes and behaviors in the different intervention groups.	Uncontrolled pretest/posttest. Used surveys.	Children in kindergarten in three public school systems in Minneapolis, Minnesota, and their parents.	Three school-based intervention groups. Group 1: information on booster seats for parents sent home with children. Group 2: parent classes (in Spanish and English), videos, free booster seats. Group 3: kindergarten presentation on booster seat use and literature sent home to parents. All parents who participated in evaluation received free booster seat. Follow-up done 3 and 6 months after intervention.	Booster seat use.	Booster seat use: Group 1; pre 50%, post 42%. Group 2; pre 16%, post 39%. Group 3; pre 30%, post 55% Increase for Group 2 was significant (P=0.011). Increase for Group 3 was significant (P=0.025). Solely sending information home to parents was not an effective means of increasing booster seat use.
Pless et al., 1986 (Canada)	To assess the impact of a media campaign on use of child restraints in Montreal.	Uncontrolled pretest/posttest (before and after campaign). Used observation.	Parents with young children in four areas of Montreal.	Media campaign aimed at parents in English and French. Discussions of campaign on television and radio shows, pamphlets and posters placed in health settings and retail stores. Follow-up done six months after baseline.	Percent of children aged 0 to 12 years seen properly restrained.	Properly restrained: Age 5-11; pre 7.2%, post 8.6%. Increases were not significant for children aged 5-11 years. Greater increases seen at sites with higher proportions of English-speakers.
Rock, 1996 (USA)	To assess the impact of the 1983 Illinois	Pretest/posttest; ARIMA techniques	Target: Children aged 0-9.	Enactment of law requiring children under age 4 to ride in approved safety seat and	Fatalities and injuries among chil-	Aged 0-4: Law resulted in 10% decrease in number killed or injured, 17% decrease in rate injured per

Table 1. Uncontrolled before-and-after studies *(Continued)*

	child restraint law.	(autoregressive integrated moving average).	Control: None.	children aged 4 to 5 to ride in safety seat or use seat belt.	dren aged 0 to 9.	accident, and 14% decrease in percentage of all fatalities and injuries. Age 5-9: No significant reductions.
Sheese, 1998 (USA)	To increase use of child safety seats among children 3 to 4 years old.	Pretest/posttest (before and after campaign); survey; observation.	Target: Children aged 3 to 4 in Indiana. Control: None.	Statewide media campaign aimed at parents and children; included visits to kindergarten classes.	Percentage of children aged 3 to 4 observed using any child restraint.	Any child restraint; Pre 25%, post 41%.

APPENDICES

Appendix 1. Search strategy

MEDLINE (1966 to April 2005)

1. "Infant-Equipment" / all SUBHEADINGS
2. child seat* or infant seat* or (child near restraint*)
3. "Seat-Belts" / all SUBHEADINGS or "Protective-Devices" / all SUBHEADINGS
4. booster seat* or safety seat* or car seat* or (vehicle near restrain*) or (car near restrain*) or (automobile near restrain*) or (automotive near restrain*)
5. #1 or #2
6. #3 or #4
7. "Automobiles-" / all SUBHEADINGS
8. motor vehicle* or car or cars or automobile*
9. #7 or #8
10. explode "Child-" / all SUBHEADINGS
11. child* or infant*
12. #10 or #11
13. #9 and #5
14. #12 and #9 and #6
15. #13 or #14
16. promot* or train* or educat* or counsel* or legislat*
17. #16 and #15

EMBASE (1980 to April 2005)

1. *Protective Equipment/
2. ((child adj seat$) or (infant adj seat$) or (child adj3 restrain$)).ti,ab.
3. 1 or 2
4. exp SEATBELT/
5. ((booster adj seat$) or (safety adj seat$) or (car adj seat$) or (vehicle adj3 restrain$) or (car adj3 restrain$) or (automobile adj3 restrain$) or (automotive adj3 restrain$)).ti,ab.
6. 4 or 5
7. exp CAR/
8. ((motor adj vehicle$) or car or cars or automobile$).ti,ab.
9. 7 or 8
10. Child/
11. (child$ or infant$).ti,ab.
12. 10 or 11
13. 3 and 9
14. 6 and 12
15. 13 or 14

16. Clinical Trial/
17. Controlled Study/
18. (randomi$ or (controlled adj trial$) or (double adj blind$) or (single adj blind$) or (clin$ adj3 trial$) or placebo$ or review$).ti,ab.
19. Review/
20. 16 or 17 or 18 or 19
21. 15 and 20
22. 21
23. limit 22 to human

Web of Science (April 2005)

1. (booster seat* OR safety seat*) AND (promot* OR train* OR educat* OR counsel* OR legislat*)
2. (car seat* OR vehicle restrain* OR car restrain* OR automobile restrain* OR automotive restrain*) AND (child* OR infant*) AND (promot* OR train* OR educat* OR counsel* OR legislat*)
3. (child seat* OR infant seat* OR child restraint*) AND (car OR cars OR automobile* OR motor vehicle*) AND (promot* OR train* OR educat* OR counsel* OR legislat*)
4. #1 OR #2 OR #3

ERIC (no dates; all years up to April 2005)

1. booster seat* or safety seat* or car seat* or vehicle restrain* or car restrain* or automobile restrain* or automotive restrain* or child seat* or infant seat* or child restrain*

TRANSPORT (1988 to April 2005) / ATI (1976 to April 2005)

1. CHILD-RESTRAINT-SYSTEMS
2. CHILD-RESTRAINT-SYSTEMS-IN-AUTOMOBILES
3. BOOSTER-SEATS
4. #1 or #2 or #3
5. seat?belt*
6. child seat* or infant seat* or child restrain* or #5
7. car or cars or automobile* or (motor adj vehicle*)
8. #6 and #7
9. booster seat* or safety seat* or car seat* or (vehicle adj restrain*) or (automobile adj restrain*) or (automotive adj restrain*)
10. (child* or infant*)
11. #9 and #10
12. #4 or ##8 or #11
13. promot* or train* or educat* or counsel* or legislat*
14. #12 and #13

UMTRI

1. Booster* & Child*
In subject headings: DGEORF & (YCO/RCCEC/YCO/QD) & NHKL:
a. DGEORF - Child Restraints / Child Seats
b. YCO - Campaigns
c. QD Training
d. NKHL - Effectiveness

National Safety Council

1. booster! - keyword
2. child seats ! booster* AND restraint* & (education / program* / information / campaign*)

Society of Automotive Engineers

1. booster* & child*

WHAT'S NEW

Date	Event	Description
20 August 2008	Amended	Converted to new review format.

HISTORY

Protocol first published: Issue 3, 2003
Review first published: Issue 1, 2006

Date	Event	Description
1 September 2005	New citation required and conclusions have changed	Substantive amendment

CONTRIBUTIONS OF AUTHORS

John Ehiri conceived the idea for the review. John Ehiri and Henry Ejere wrote the protocol. Lesley Magnussen coordinated the literature search, obtained copies of published and unpublished reports and summarized potentially eligible studies. John Ehiri, Henry Ejere, Donath Emusu, Bill King and Scott Osberg reviewed identified studies and assessed their quality. John Ehiri, Henry Ejere and Donath Emusu extracted data from eligible studies and drafted the review. Scott Osberg and Bill King edited the review.

DECLARATIONS OF INTEREST

None known.

SOURCES OF SUPPORT

Internal sources

- School of Public Health, University of Alabama at Birmingham, USA.

External sources

- Cochrane Health Promotion and Public Health Field, Australia.
- AAA Foundation for Traffic Safety, Washington, DC, USA.

NOTES

The authors are currently working on the update which will be published soon.

INDEX TERMS

Medical Subject Headings (MeSH)

*Automobiles; Body Weight; Protective Devices [*statistics & numerical data]; Randomized Controlled Trials as Topic; Seat Belts [statistics & numerical data]

MeSH check words

Child; Child, Preschool; Humans