
Evaluating Interventions That Promote the Use of Rear Seats for Children

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- Objective:** To evaluate interventions that promote the use of the rear seat among children riding in motor vehicles.
- Search Strategies:** Using the Cochrane Collaboration search strategy, we searched in electronic databases and reference lists of past reviews and review articles. We also searched among studies from government and research agencies in the United States and abroad, and contacted experts in the field.
- Selection Criteria:** Studies for selection had to be evaluations of interventions in defined populations, with a clear description of the program and the outcomes evaluated. Outcomes had to be measured in an objective manner, and there needed to be a comparison group.
- Data Collection and Analysis:** Six studies met the selection criteria. Changes in the proportion of observed children traveling in the rear seats before and after the implementation of the intervention were the main outcome of interest.
- Main Results:** Two studies evaluating the effectiveness of educational campaigns promoting the use of the rear seat found increases in the proportion of children riding in the rear seats, but only in one study were the increases statistically significant (from 86% to 91%). The four remaining studies reported changes in seating location as a side effect of legislation requiring child restraint use among children traveling in the front seats. In two of these four studies, the percentage of children riding in the rear seats significantly increased from 49% to 62% and from 88% to 98%. In the remaining two studies there were small, but not statistically significant, changes in the proportion of children riding in the rear seats, with percentages remaining around 60% and 85%.
- Conclusions:** Interventions aimed at promoting the use of rear seats by children traveling in motor vehicles have been rare. Only one educational program whose only objective was to promote rear seating location was found and this 1973 Danish study had a positive impact. The other educational campaign, a pilot program that also focused on improving child restraint use, had no significant impact in promoting seating of children in the rear. We did not find any evaluation of legislation prohibiting children to sit in the front seats. Legislation requiring proper child restraint use in the front seats (and thus, compelling unrestrained children to seat in the rear) has produced, for the most part, a nonsignificant increase in the proportions of children sitting in the rear.
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For decades, it has been well accepted that the rear seat is safer than the front seat for both children and adult occupants.^{1,2} Studies conducted using fatality and/or morbidity data from the United States, Sweden, and Australia have demon-

strated the protective effect of rear seats for all ages.²⁻¹³ Specifically, studies show that both restrained and unrestrained children are safer in the rear seat than unrestrained in the front seat. Whether an unrestrained or improperly restrained child in the rear seat is safer than a properly restrained child in the front seat remains controversial,¹³⁻¹⁷ although two recent analyses show a reduction in mortality among improperly restrained children in the rear when compared to restrained children in the front seat.^{13,18} Overall, the

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reported reduction in crash-related mortality and morbidity among children associated with seating in the rear ranges from 25% to 50%, depending on the particular age group of the children and the method of evaluation used.²⁻¹⁸

Promoting the use of the rear seat has been one of the strategies used to reduce the burden of injuries due to motor vehicle crashes among children. In the mid-1970s, most European countries and several states in Australia passed legislation requiring children to ride in the rear seat.^{19,20} Several other countries (such as the UK) debated passing such laws.²¹⁻²⁴ Despite the fact that, since the early 1990s, most of these regulations have been modified to allow properly restrained children in front seats,¹⁹ recent roadside observations reveal significantly higher percentages of children seated in rear seats in U.S. cities than in European cities.²⁵

Another (complementary) strategy to reduce the number of fatal and non-fatal injuries among children is the use of child restraints. Proper child restraint use greatly enhances the safety of children in all seating positions.^{26,27} Promoting child restraint use has been the historically favored strategy in the United States. Since 1978, all states have passed some form of regulation requiring child restraint.²⁸ Numerous educational campaigns have focused on this issue as well. Despite these legislative and educational efforts, child restraint use in the United States is still low. Proper child restraint use as low as 21% has recently been reported.²⁹ (The effectiveness of some of these legislative and educational interventions is reviewed in accompanying papers in this issue of the journal.^{30,31})

The adverse impact of passenger-side airbags on children in the United States^{32,33} together with the fact that proper child restraint use remains low, has renewed interest in interventions that also promote the use of rear seats for children traveling in motor vehicles. In a recent recommendation, the U.S. National Transportation Safety Board urged states to issue regulations to require children age 13 or under to ride in the rear if a rear seat is available.³⁴ The U.S. National Highway Traffic Administration and the American Academy of Pediatricians are also recommending the use of rear seats for children and numerous educational campaigns are currently reinforcing this message (e.g., Safe Kids).^{35,36}

In light of the relevance of the topic, we wanted to investigate which (if any) types of interventions actually increase the number of children riding in rear seats. Additionally, since some safety experts have expressed concerns regarding the possible lesser restraint use among children seating in rear seats than children seated in the front,³⁷ we sought to evaluate the effect that different interventions promoting the use of the rear seat might have had on the restraint use rates among those children seated in the rear.

Materials and Methods

Search Strategy for Identification of Studies

A detailed description of the search strategy used is provided in the introductory paper by Rivara and colleagues.³⁸ The methods used followed, to the extent possible, the guidance offered by the Cochrane Collaboration. We searched the following electronic databases from 1966 to the present: MEDLINE, ERIC, CINAHL, PSYCLit, and DIALOG (which includes EMBASE, NTIS, Sport, BIOS, and dissertation abstracts). Additionally, we searched reference lists of reviews and studies from the Cochrane International Register of randomized controlled trials, the Consumer Product Safety Commission, the National Safety Council, the National Highway Traffic Safety Administration, the National Transportation Safety Board, and the Insurance Institute for Highway Safety. We also searched for abstracts of national and international conferences and contacted organizations, agencies, and researchers knowledgeable in seating location and child restraint use, including members of the International Society for Child and Adolescent Injury Prevention, the World Injury Network, and the Centers for Disease Control and Prevention-funded Injury Control and Research Centers. Staff from injury research agencies around the world, specifically European and Australian motor vehicle regulatory agencies, were also contacted.

Inclusion Criteria

Since we sought to examine the best available evidence, studies had to evaluate the effectiveness of a clearly defined intervention (e.g., educational, legislative) that directly (e.g., legislation addressing seating position) or indirectly (e.g., legislation addressing child restraint use only in the front seat and compelling the use of the rear seat for unrestrained children) promoted the use of rear seats by children. The intervention had to take place in a defined population and the evaluation had to provide an objective outcome (i.e., the proportion of children observed riding in the rear) and a comparison group.

Types of Participants

Since our goal was to evaluate interventions that promoted the use of rear seats among children, interventions had to target either children, their parents, or both.

Types of Interventions

Any intervention that sought (directly or indirectly) to modify behavior among children and/or their parents regarding the children's seating location.

Outcome Measures

The primary outcome of interest for our review was the proportion of children observed traveling in rear seats

Table 1. Selected characteristics of included studies

Study	Design and location	Intervention	Selected outcomes	Selected results and comments
Jorgesen and Steen-Petersen (1973) ³⁹	Ecologic time study; Copenhagen, Denmark	Educational campaign targeting children and parents to encourage children <12 years old to ride in rear seats.	(1) Percentage of children riding in rear seats.	The intervention significantly promoted the use of rear seats for children although whether some other issues were partly responsible for this effect is unknown.
Williams and Wells (1981) ⁴⁰	Ecologic mixed study. Intervention group: Providence and metropolitan area (Rhode Island), U.S. Control group: New Bedford and Worcester (Massachusetts), U.S.	Legislation in Rhode Island requiring use of restraint systems among children <4 years old when riding in front seats.	At each location: (1) percentage of children in rear seats, and (2) percentage of children properly restrained in the rear.	The implementation of this legislation increased the percentage of children traveling in rear seats and the restraint use among children traveling in rear seats.
King (1981) ⁴¹ and Wadley and Cantemessa (1984) ⁴²	Ecologic time studies; Brisbane (Queensland), Australia.	Legislation in Queensland requiring use of restraint systems among children <8 years old when riding in front seats.	By type of day (week or weekend days): (1) percentage of children riding in rear seats, and (2) percentage of children restrained in the rear	The implementation of this legislation had no effect on the proportion of children traveling in rear seats but significantly increased restraint use among children seated in rear.
Lowne et al. (1984) ¹⁷	Ecologic time study; United Kingdom	Legislation in the UK requiring use of restraint systems among children <14 years old when riding in front seats.	Per each age group: (1) percentage of children riding in rear seats, and (2) percentage of children properly restrained in the rear.	The implementation of the law significantly increased the percentage of children, especially younger children, in the rear seats and the restraint use among children <1 year old seated in the rear.
Williams et al. (1997) ⁴³	Ecologic mixed study; Durham (North Carolina), US	Pilot educational program targeting parents and children to increase proper child restraint use and to promote the use of the rear seat.	By type of school: (1) percentage of children in rear seats, and (2) percentage of children properly restrained in the rear.	There was no effect on child seating position. Although the authors concluded that the pilot program increased child restraint use in the rear seat this was only true among children from elementary schools.

of motor vehicles. A second outcome measure in our study was the proportion of children who were observed to be using restraint systems while riding in rear seats. Studies that used self-reported behaviors were not included in this review.

Included Studies

Six studies met the inclusion criteria: Jorgesen and Steen-Petersen (1973),³⁹ Williams and Wells (1981),⁴⁰ King (1981),⁴¹ Wadley and Cantemessa (1983),⁴² Lowne et al (1984),¹⁷ and Williams et al (1997).⁴³

Two studies evaluated educational campaigns to promote rear seating. One was a campaign conducted in

Denmark³⁹ and the other was a North Carolina pilot program to also encourage child restraint use.⁴³ The other four studies evaluated legislation requiring child restraint use only when children were seated in the front seats. In particular, two studies evaluated Australian legislation that required children less than 8 years old to use child restraints when sitting in the front and compelled unrestrained children to sit in the rear.^{41,42} The two other studies evaluated similar legislation in the U.K. and Rhode Island (U.S.) which mandated adequate restraint use for children less than 14 and 4 years old, respectively, when seated in the front seats.^{17,40} Table 1 summarizes the year and location of the intervention, the target population,

the type of intervention, the outcomes evaluated in our review, and selected results and conclusions.

All but one³⁹ of the studies addressed other issues related to motor vehicle safety, such as adult or child restraint use in the front seats. These other findings are beyond the scope of this review paper and are not discussed here.

Statistical Analysis

In order to compare the six studies, information was abstracted using standard data collection forms. Using the data reported in the studies, we computed: (1) the percentages of children seated in rear seats before and after the intervention (and their 95% confidence intervals), (2) the percentages of rear-seated children using restraints before and after the intervention (and their 95% confidence intervals), and (3) the differences between the after and before percentages. Statistical significance was defined at the $P < 0.05$ level. Stata[®] was used for the computations.⁴⁴ Pooled analyses (i.e., meta-analysis) were not done because all six studies had ecologic designs, differed in the nature of the intervention, did not use similar populations, and did not collect data over comparable time periods.

Methodologic Quality of Studies

None of the reviewed studies was a randomized controlled trial. All six studies used an ecologic design in which populations exposed to the intervention were, at least, compared to the same population in a previous time period (i.e., ecologic time design). In all six studies, at least two sets of roadside observations were taken (i.e., before and after the program). In two studies the population exposed to the intervention was also compared to a population without the intervention (i.e., ecologic mixed design).^{40,43} All studies targeted for observation any vehicle carrying at least one child. Although the number and representativeness of the locations chosen for observation varied across studies, each study used the same locations, days of the week, and times for the before and after recordings to guarantee consistency across measurements. Observers in different locations obtained the number and age of occupants in the vehicle and the seating location of each occupant. For their analyses, all six studies simply present unadjusted proportions or raw numbers.

The studies differed in a variety of ways, including: the location of the intervention (county, state, or country), the age group targeted (e.g., parents, children, or both), the definition of children (e.g., less than 4 years old, less than 10 years old, or less than 12 years old), the characterization of children (e.g., as reported by the driver, by the appearance), whether the location for observation was conveniently or randomly selected (only one study used a representative sample of locations), the type of motor vehicles included (e.g.,

minivans were not included in one study), and the number of observations recorded for analysis (e.g., 217 vs. 7,931). They also varied regarding the time interval between observations. For example, some observations were taken six months, one month, or a week prior to the implementation of the intervention. Only one study performed two sets of observations after implementation of the program to evaluate the shorter- and longer-term effects of the intervention.³⁹ All but one study³⁹ recorded information on the “appropriateness” of the child restraint system (as defined by the standards used at the time). Additionally the studies differed in their ascertainment of exposure or outcome and the measurement of potential confounders. Despite the fact that three studies recorded information on potential confounders such as the gender of the child or the number and seating location of adults in the vehicle,^{17,39,41,42} only one paper used standardization techniques to control for possible confounders.¹⁷ No study used multivariate analysis.

Results

The effectiveness of interventions regarding promotion of rear seat use (our primary outcome of interest) was defined by comparing the proportions of children traveling in rear seats before and after the implementation of the intervention (and when available, by comparing to the proportions of children traveling in rear seats in the control populations) (Table 2).

Overall, all six studies found increases in the proportion of children riding in the rear, but only in three studies were these changes statistically significant: the Danish educational campaign,³⁹ and the Rhode Island (U.S.)⁴⁰ and U.K.¹⁷ legislation.

Two of the six studies were evaluations of educational campaigns regarding seating location. The Danish program,³⁹ which focused solely on child seating location, found a significant increase in the proportion of children traveling in rear seats (from 86% to 92%) and that was sustained for at least one year after the campaign had ended. The North Carolina (US) program,⁴³ a pilot program that primarily emphasized restraint use and only secondarily promoted rear seating, found a non-significant increase in the proportion of children traveling in the rear in both the control and intervention populations (Table 2).

Four of the studies evaluated the effects of legislation specifically implemented to increase the use of child restraints in front seats. The Rhode Island (U.S.) observations⁴⁰ confirm a significant increase in the proportion of children riding in rear seats (from 49% to 62%), but the data also suggest an increase in rear seat use (although not significant) among children in the control population. The UK legislative mandate¹⁷ statistically significantly increased the proportion of children riding in rear seats, but only for children younger than 5 years old (from around 88% to 98%).

Table 2. Effect of interventions on child seating position and child restraint use in the rear seats^a

Study	Subgroup	Children in rear seat [% (95% CI)]			Difference (after- before)	Child restraint use in rear seat [% (95% CI)]		
		Before	After			Before	After	Difference (after- before)
Jorgensen and Steen-Petersen (1973) ³⁹		86% (85, 87)	91% (90, 92)	+5%*		NA		
Williams and Wells (1981) ⁴⁰	Rhode Island	49% (45, 52)	62% (52, 65)	+19%*	23% (20, 28)	37% (33, 41)	+14%*	
	Massachusetts (control)	53% (50, 55)	56% (53, 59)	+3%	20% (17, 23)	32% (28, 35)	+12%*	
King (1981) ⁴¹	School days	80% (76, 83)	82% (79, 85)	+2%	73% (69, 77)	85% (81, 88)	+12%*	
	Non-school days	78% (75, 81)	81% (78, 84)	+3%	75% (71, 79)	88% (80, 86)	+13%*	
Wadley and Cantemessa (1983) ⁴²	Shopping center	79% (74, 83)	79% (75, 83)	0%	42% (36, 48)	59% (54, 64)	+17%*	
	School/kindergarten	70% (66, 73)	74% (70, 77)	+4%	25% (21, 30)	36% (32, 41)	+11%*	
Lowne et al (1984) ¹⁷	<1 years	88% (85, 90)	97% (95, 98)	+9%*	30% (26, 33)	46% (43, 50)	+16%*	
	1-4 years	96% (95, 96)	98% (98, 99)	+2%*	36% (35, 38)	26% (25, 28)	-10%*	
	5-9 years	88% (86, 89)	84% (83, 86)	-4%*	12% (10, 13)	9% (7, 10)	-3%*	
	10-14 years	76% (73, 79)	74% (71, 77)	+2%	3% (2, 4)	3% (2, 5)	0%	
Williams et al. (1997) ⁴³	Daycare	58% (49, 67)	65% (56, 75)	+7%	71% (59, 81)	84% (72, 90)	+13%	
	Daycare (control)	57% (46, 68)	62% (49, 74)	+5%	52% (38, 66)	68% (51, 83)	+16%	
	Elementary	42% (37, 46)	43% (39, 48)	+1%	26% (20, 33)	56% (49, 62)	+30%*	
	Elementary (control)	39% (32, 46)	44% (38, 50)	+5%	18% (11, 29)	30% (22, 40)	+12%	

^aPercentages may not match exactly the numbers reported in the original papers due to rounding.

* $P < 0.05$.

The UK data indicate a small reduction in the proportion of children older than 10 years seated in the rear (from 76% to 74%) as well as among 5 to 9 year olds (from 88% to 84%). The remaining two studies were independent evaluations of the same Australian legislation and both indicate non-significant increases in the proportion of children riding in rear seats (Table 2).^{41,42}

The effectiveness of interventions to increase restraint use among rear-seated children (our secondary outcome measure) was defined as the difference in the observed proportions of children properly restrained while traveling in the rear seat before and after implementation of the interventions (and when available, by comparing these proportions with those among children from control populations).

Three of the five studies with data on this outcome indicate statistically significant increases (ranging from 23% to 37% and from 75% to 88%) in the proportion of children using restraints in the rear seat (Table 2).⁴⁰⁻⁴² Interestingly, the evaluation of the UK legislation also reports significant increases in the proportion of restraint use for children less than 1 year, but significant decreases of restraint use among children aged 1 to 9 (from around 30% to 26%).¹⁷ The North Carolina (US) educational campaign data found an

increase in the proportion of child restraint use among rear-seated children in both the control and intervention groups, but the increase is only significant (from 26% to 45%) among children from the elementary schools where the intervention took place.⁴³

Discussion

Despite the fact that, for years, the injury prevention community has acknowledged that rear seats are safer, that several educational campaigns have included messages promoting rear seating for children, and that many countries issued legislation requiring children to ride in the rear seat of motor vehicles, we could only find one evaluation of an intervention specifically aimed at promoting seating children in the rear. This intervention had a positive impact in increasing the proportion of children riding in the rear. However, relevance of these findings is not clear given that the study is now 25 years old and the high rate of children sitting in the rear before the intervention took place.

The other reviewed educational campaign had as a primary goal the promotion of child restraint use; promoting seating location was a secondary goal. This campaign was a pilot intervention to complement to a well-publicized statewide enforcement program to in-

crease seat belt use and reduce alcohol impaired driving. That child restraint use in the rear and child rear seating increased in both the intervention and control populations raises issues regarding the effectiveness of the campaign on these two outcomes.

The four evaluations of legislation reviewed here involved interventions whose primary target was not seating position, but restraint use among front-seated children. By requiring the children in the front to use restraint systems but explicitly mentioning the possibility of riding with no restraint systems in the rear, such legislation may have been promoting, indirectly, the use of rear seats. Indeed, these interventions did have some effect on seating location by increasing the proportion of children seated in the rear.

An encouraging finding is that, for the most part and contrary to some safety experts' beliefs, moving children to the rear seat did not have a negative impact on the rates of restraint use among rear-seated children.

Comparison of the results among the six papers summarized here should be done with caution, since the studies differed in substantial ways, including the goal of the intervention (with most studies dealing with seating position as a side issue). Furthermore, all but one study⁴³ were conducted more than a decade ago and may not be directly applicable today.

It is interesting to note the very different proportions of children riding in the rear seats among locations, even before the implementation of the interventions. For example, in Denmark in 1973, 86% of the children were riding in the rear whereas only 62% of Rhode Island children younger than 4 years did so in 1981. Contrary to other European countries, Denmark had no legislation regarding seating position at that time.¹⁷ A recent roadside observation in selected European and US cities reports similar differences; with about twice as many children riding in front seats in Boston and New Orleans compared to children in Paris, Brussels, and Frankfurt.²⁵ Even within the United States, analysis of crash data shows different proportions of children traveling in the front seats, ranging from 40% in Massachusetts to 24% in Hawaii.⁴⁵ More information is needed about current seating position patterns changes over time, and factors influencing seating position.

Legislation regarding child seating position and restraint use is currently being revised and/or updated in many states in the United States and abroad. At least one state (Rhode Island) has already adopted legislation mandating that children sit in the rear. The Rhode Island legislation requires all children less than six years old to ride in the rear seat unless no rear seat is available or the child has a medical contraindication.⁴⁶ Several other states in the United States are now considering similar legislation. In the past year, several educational campaigns promoting rear seating and proper child restraint use have been initiated. These

recent changes provide unique opportunities for further evaluation. It is in the best interest of the injury prevention community to learn about the effectiveness of different strategies aimed at promoting safer behaviors for children.

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