

# Safety education of pedestrians for injury prevention: a systematic review of randomised controlled trials

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## Abstract

**Objectives** To quantify the effectiveness of safety education of pedestrians.

**Design** Systematic review of randomised controlled trials of safety education programmes for pedestrians of all ages.

**Main outcome measures** Effect of safety education on pedestrians' injuries, behaviour, attitude, and knowledge and on pedestrian-motor vehicle collisions. Quality of trials: methods of randomisation; and numbers lost to follow up

**Results** We identified 15 randomised controlled trials of safety education programmes for pedestrians. Fourteen trials targeted children, and one targeted institutionalised adults. None assessed the effect of safety education on the occurrence of pedestrian injury, but six trials assessed its effect on behaviour. The effect of pedestrian education on behaviour varied considerably across studies and outcomes.

**Conclusions** Pedestrian safety education can change observed road crossing behaviour, but whether this reduces the risk of pedestrian injury in road traffic crashes is unknown. There is a lack of good evidence of effectiveness of safety education for adult pedestrians, specially elderly people. None of the trials was conducted in low or middle income countries.

## Introduction

Each year about one million people die and about 10 million are seriously injured on the world's roads.<sup>1</sup> For people aged 3-35 years, road traffic crashes are now the leading cause of death and disablement, and the global economic burden of road traffic crashes is estimated at \$500bn (£300bn, €500bn).<sup>2</sup> Most of the casualties are in low and middle income countries, and most are vulnerable road users: pedestrians, cyclists, and riders of two wheeled motor vehicles. Elderly pedestrians and children are particularly vulnerable.<sup>3</sup> Pedestrian injuries account for most of the 280 000 childhood road deaths each year.<sup>1 3 4</sup>

The aim of this systematic review of randomised controlled trials was to quantify the effectiveness of safety education programmes for pedestrians in improving their knowledge, attitudes, and behaviour and, most importantly, in preventing pedestrian-motor vehicle collisions.

## Methods

### Identification of trials

We aimed to identify all randomised controlled trials of road safety education programmes for pedestrians of all ages.

We identified trials by computerised searches of the Cochrane Injuries Group specialised register, Cochrane Controlled Trials Register, Transport, Medline, Embase, ERIC, PsychLit, Spectr, and the

World Health Organization's database on the internet; by checking the reference lists of relevant reviews, books, and articles; by contacting authors of relevant papers; by use of the citation analysis facility of the Science Citation Index and Social Sciences Citation Index; and by contacting relevant professionals, organisations, and voluntary agencies. We made no language restrictions and repeated searches with key words translated into French, German, Italian, Spanish, Dutch, and Danish.

### Outcome measures and data extraction

Two reviewers independently extracted data on pedestrians' injuries, behaviour, attitude, and knowledge; pedestrian-motor vehicle collisions; and trial quality.<sup>5</sup>

### Data analysis and statistical methods

Wherever possible we performed an intention to treat analysis. Meta-analysis was not considered appropriate because of the differences across studies in the types of interventions and the types of outcomes. We report effect estimates as relative risks (95% confidence intervals) for dichotomous outcomes and as standardised mean difference (95% CI) for continuous outcomes. A relative risk of > 1 and a standardised mean difference of > 0 represent a beneficial effect of the intervention programme.

## Results

We identified 13 899 studies, of which 674 (5%) were potentially relevant based on the title or abstract of the report. After a full text review, we identified 15 trials that met our inclusion criteria.<sup>6-19</sup> The basic characteristics of these trials are given on [bmj.com](http://bmj.com) and in the *Cochrane Library*.

The methodological quality of the included trials was generally poor. The method of allocation concealment was adequate in only three trials, outcome assessment was blinded in eight, and in most of the studies large numbers of participants were lost to follow up. The participants were children in 14 of the studies and institutionalised adults in one. No trial focused on elderly people. All trials were conducted in high income countries. Eight studies involved the direct education of study participants, and seven involved the use of parents or teachers as educators. None of the trials assessed the effect of safety education on the occurrence of pedestrian injury, but five assessed the effect on observed behaviour, one assessed reported behaviour, six assessed attitude, and five assessed knowledge.

Each research group used different tools to measure outcomes, and the delay for the post-test measurement varied from less than one month to eight months. Six trials measured the effect of safety education at different times after the intervention. The effect of the intervention was lower in the later follow up period for 18 of the 24 behavioural outcomes, for

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two of the four attitude outcomes, and for the two knowledge outcomes.

In some studies, the post-test conditions varied and influenced the results. For example, Limbourg and Gerber<sup>10</sup> reported that 5-6 year old children given safety education were, at five months after intervention, more likely to stop and look at the line of vision when crossing roads than controls (relative probability 1.79 (95% confidence interval 1.18 to 2.72) for children without distraction). However, when the children were distracted by racing with another child the relative probability increased to 2.80 (1.39 to 5.64).

The table shows the most pertinent outcomes and only the longest period to post-test measurements. Overall, the effect of safety education on pedestrian behaviour varied considerably.

## Discussion

Despite a thorough search, we could not identify good evidence of effectiveness of safety education for adult pedestrians and only limited evidence for child pedestrians. None of the included trials assessed the effect of safety education on the occurrence of pedestrian injury. Some of these trials showed evidence of behavioural change after safety education, but for various reasons it is difficult to predict what effect this might have on pedestrian injury risk.

Firstly, we cannot be sure that the observed behaviour is causally related to the occurrence of pedestrian injury. Secondly, assuming that the measured behaviours are causally related to risk of pedestrian injury, we have no reliable information about the size of this effect, and so we cannot predict how much a given behavioural change will reduce the risk of injury.

Finally, there is uncertainty about the extent to which the observed behavioural changes persist over time, although the apparent declines may have been due to chance alone.

## Limitations of review

Publication and other selection biases may have resulted in the over-representation of studies showing promising intervention effects. This is especially likely in the context of road safety, where a large proportion of the available research information is published in the grey literature of road safety research organisations. Most of the statistical methods that can be used to assess the possibility of publication bias require the use of meta-analysis and so could not be used in this systematic review.

Inadequate allocation concealment, lack of blinding of outcome assessment, and large losses to follow up can result in the overestimation of intervention effects in randomised controlled trials,<sup>5</sup> and many of these methodological weaknesses were present in the included trials.

Several included studies were conducted more than 10 years ago, and so their relevance to the current situation is open to question. Walking habits and the pedestrian environment have dramatically changed during the past two decades. All the included trials compared groups that were in the same surroundings, allowing the effect of the intervention to be isolated. Another limitation of this study is that we could not identify any randomised controlled trial conducted in low and middle income countries.

## Implications of results

The Global Road Safety Partnership strongly recommends road safety education of children worldwide.<sup>20</sup>

Selected outcomes of randomised controlled trials of safety education of pedestrians

Population	Injuries, deaths, collisions	Behaviour	Attitude	Knowledge
Children and adolescents:				
<5 years old	No RCT found	Trained children more likely to stop and look at line of vision than controls (RR 1.71 (95% CI 0.62 to 4.70)) <sup>10</sup>	No RCT found	Trained children knew slightly more often that they had to "walk or stay on pavement" than controls (RR 1.05 (0.79 to 1.39)) <sup>9*†</sup>
5-9 years old	No RCT found	Trained children more likely to stop and look at line of vision than controls (RR 1.79 (1.18 to 2.72)) <sup>10</sup> Trained children more likely to stop at line of vision when crossing between parked cars than controls (RR 1.73 (1.39 to 2.14)) <sup>18*</sup> Trained children more likely to "always cross in crosswalks" according to their parents than controls (RR 1.63 (0.89 to 3.00)) <sup>15*</sup> Trained children more likely to exhibit "safe behaviour" than controls (RR 2.13 (1.01 to 4.47)) <sup>14*</sup> Trained children had better "post-test transfer score" than controls (SMD 0.83 (0.31 to 1.35)) <sup>15</sup>	Trained children had greater proportion of routes categorised as "safe" at post-test than controls (SMD 1.28 (0.30 to 2.26)) <sup>6</sup> Change between pretest and post-test in proportion of routes categorised as "safe" greater in trained children than controls: (SMD 0.80 (-0.12 to 1.72)) <sup>17‡</sup> (SMD 0.17 (-0.21 to 0.55)) <sup>18‡</sup> (SMD 0.92 (0.39 to 1.46)) <sup>19‡</sup> Trained children had better "post-test attitude score" than controls (SMD 0.85 (0.35 to 1.35)) <sup>15</sup> Trained children more likely to apply "concept of speed" than controls (RR 1.27 (1.07 to 1.50)) <sup>8</sup>	Change between pretest and post-test scores of "crossing the street" test slightly greater in trained children than controls (SMD 0.16 (-0.13 to 0.45)) <sup>11</sup> Change between pretest and post-test in score of "traffic safety knowledge" test was greater in trained children than controls (SMD 0.81 (0.60 to 1.02)) <sup>12‡</sup> Change between pretest and post-test scores of "cognitive" test greater in trained children than controls (5-7 year olds, SMD 0.47 (0.36 to 0.57); 7-9 year olds, 0.96 (0.85 to 1.08)) <sup>16‡</sup>
10-14 years old	No RCT found	No RCT found	No RCT found	Change between pretest and post-test scores of "cognitive" test greater in trained children than controls (SMD 0.57 (0.46 to 0.68)) <sup>16‡</sup> Trained children had better post-test score of "conspicuity, mass, speed and control" test than controls (SMD 2.39 (1.46 to 3.33)) <sup>1</sup>
15-20 years old	No RCT found	No RCT found	No RCT found	No RCT found
Adults	No RCT found	Trained institutionalised adults had higher "post-test mean proportion of steps correctly performed" than controls (RR 5.17 (3.48 to 7.67)) <sup>12*</sup>	No RCT found	No RCT found
Elderly people	No RCT found	No RCT found	No RCT found	No RCT found

RCT=randomised controlled trial (only most relevant outcomes are reported here with longest period to post-test measurements). RR=relative risk. SMD=standardised mean difference  
\*Intervention groups pooled. †Control groups pooled. ‡Variance of change between pretest and post-test measurements ascribed.

## What is already known on this topic

Road traffic crashes are a leading cause of death and disablement, and pedestrians are particularly vulnerable road users

Several organisations strongly recommend road safety education

As resources are limited, a key question concerns the relative effectiveness of different prevention strategies, including road safety education of pedestrians

## What this study adds

This systematic review showed safety education for pedestrians could improve children's knowledge and change their observed road crossing behaviour

However, effects on pedestrian injury were unknown

There is a lack of good evidence of effectiveness of safety education for adult pedestrians, especially elderly people, and in low and middle income countries

Our review indicates that there is no reliable evidence supporting the effectiveness of pedestrian education for preventing injuries in children and inconsistent evidence that it might improve their behaviour, attitudes, and knowledge. While the value of safety education of pedestrians remains in doubt, environmental modification and the enforcement of appropriate speed limits may be more effective strategies to protect children from road traffic.

## Conclusions

Pedestrian safety education can improve children's knowledge of the road crossing task and can change observed road crossing behaviour, but whether this reduces the risk of pedestrian-motor vehicle collision is unknown. No trial focused on the other vulnerable road users, elderly pedestrians. None of the trials was conducted in low and middle income countries.

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## Corrections and clarifications

### *Synergism between allergens and viruses and risk of hospital admission with asthma: case-control study*

The wrong table 3 was published in the print version of this paper by Rosalind Green and colleagues (30 March, pp 763-6). The correct table shows the univariate analysis of potential risk factors for admission to hospital in two groups of patients with asthma. It can be accessed in the full version of the paper as table 5 on [bmj.com/cgi/content/full/324/7340/763](http://bmj.com/cgi/content/full/324/7340/763). We apologise for this error.

### *Was it a heart attack?*

In this editorial by Charles J McKenna and J Colin Forfar (16 February, pp 377-8) we mistakenly referred to the enzyme creatine kinase as creatinine kinase. The existence of an enzyme called creatinine kinase has not been reported yet.

### *Influence of direct to consumer pharmaceutical advertising and patients' requests on prescribing decisions: two site cross sectional survey*

A wrong value slipped through in the table in this paper by Barbara Mintzes and colleagues (2 February, pp 278-9). Among patients who had not requested drugs before, the number who requested at least one drug that had been advertised direct to consumers was in fact 42 [not 52], and the percentage was 3.9% [not 4.8%].

### *France's birth rate matches high Irish levels*

We should have said in this News article by Alexander Dorozynski (16 February, p 385) that it was women's total fertility [not birth rate] that reached 1.89 children in 2000. The fertility value refers to the number of children per woman during childbearing age.