

## REVIEW

## Updating the evidence. A systematic review of what works in preventing childhood unintentional injuries: Part 1

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In the last 10 years there has been considerable progress in the science and art of injury prevention. The scientific study of what works in different fields of health care and health promotion has expanded, and evidence-led policy development has dominated health planning. We have collected evidence on evaluated intervention studies related to childhood injury prevention since 1992, and published reviews in 1993 and 1996.<sup>1,2</sup> This paper updates this evidence. We attempt to answer three questions:

(1) Have there been any changes in the evidence relating to the effectiveness of childhood injury prevention?

(2) What additions have been made to the literature, relating to the target groups and implementation strategies of interventions?

(3) What additions have been made to the literature, relating to the ways interventions have been evaluated?

### Methods

A database of primary studies has been built up over the years in the Department of Child Health in the University of Newcastle. We identified the relevant literature by a search of computerised databases (for example, BIDS, Medline, Excerpta Medica, the DHSS database, the Social Science Research Index, Web of Science, Transport Research Laboratory databases). This was supplemented by consulting with "key informants" in the field and hand searching of relevant journals, such as the journal *Injury Prevention* and *Accident Analysis and Prevention* and the reference lists of recently published books and articles.

The criteria for inclusion of studies were:

(1) They related solely or in part to the prevention of unintentional injuries.

(2) They targeted children aged 0-14 years.

(3) They described (a) primary prevention measures designed to prevent accidents, or (b) secondary prevention measures designed to reduce the impact of accidents.

(4) They had been evaluated using some outcome measure. This could include changes in mortality or morbidity, observed or reported behaviour, change in hazard, or change in knowledge.

Violence prevention studies were excluded.

Two reviewers extracted the data from each study, using a standard data extraction form (available if required). This form included sections on the aims and objectives and content of the intervention. The aims and description of the evaluation were also summarised; study design, sample size, outcome, impact, and process measures were documented. Using these extraction sheets, three reviewers independently assessed the quality of evidence for each of the studies. Studies were graded on a five point scale: good, good/reasonable, reasonable, reasonable/weak, and weak. Thus a well designed randomised controlled trial could be rated as "good" but a randomised controlled trial with a small sample size or high attrition rate of subjects, could be rated as "good/reasonable" or "reasonable". The British National Health Service Centre for Reviews and Dissemination review guidelines were used to assess the quality of the evidence.<sup>3</sup> Using the data extraction forms, the tables were developed; the quality rating and level of effectiveness of studies were consensus decisions by the three reviewers and a fourth member of the team was called on for additional advice.

We have summarised the key features of the studies in tables relating to the road environment,<sup>4,21</sup> and in part 2 the home environment,<sup>22-32</sup> the leisure environment,<sup>33-37</sup> community based studies,<sup>38-42</sup> and general/mass media interventions.<sup>43-45</sup>

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Table 1 The road environment: traffic calming

Author, date, and country	Injury target group and setting	Aims and content of intervention	Study type and sample size	Outcome measures	Key results
Webster and Mackie (1996), <sup>4</sup> UK	General population	20 mph zones in 200 residential areas	Before and after study	(A) Accidents (B) Speed data (C) Attitudes	(A) 61% reduction in total injuries. 70% reduction in child pedestrian injuries 48% reduction in child cyclist injuries
	Road environment	Traffic speed reduced by physical measures	(A) 72 schemes: accidents (B) 32 schemes: speed data (C) 6 schemes: public acceptability to 16 mph		(B) Speeds reduced by 9 mph from 25 mph (C) Public reaction favourable <b>Effective Good/reasonable</b> evidence

Table 2 The road environment: skills training

Author, date, and country	Injury target group and setting	Aims and content of intervention	Study type and sample size	Outcome measures	Key results
Hazinski <i>et al</i> (1995), <sup>5</sup> USA	5–7 years School based	<b>Children's Traffic Safety Program</b> 10 week programme by teachers	Controlled trial without randomisation I=6 schools (2 high, 4 low income) C=1 school	Observed seat belt use: all occupants	C: increased belt use: 48.2% to 54.7%. In I, 2 low income schools with good programme implementation: 13.4% before 25% after <b>Inconclusive Reasonable/weak</b> evidence
Burke <i>et al</i> (1996), <sup>6</sup> USA	5–11 years Road environment	Education on safe bus boarding I bus stops: designated safe areas painted on pavements	Randomised controlled trial I: 5 bus stops C: 4 bus stops	Observed behaviour	Children in C twice as likely to exhibit unsafe behaviour (75/174) as compared with children in I (38/145) <b>Effective Reasonable</b> evidence
Savill <i>et al</i> (1996), <sup>7</sup> UK	9/10 years assessed at age 12. School/road environment	Cycling skills and road safety knowledge by playground and roadside training	Controlled trial without randomisation. (A) Skills test I=805, C=761 (B) Knowledge I=977, C=977 (C) Cycling logs I=442, C=366	(A) Observed behaviour (B) Knowledge (C) Exposure to cycling	(A) 75% of I and 53% of C rated "safe" (B) Knowledge scores of I=8.8, C=7.7 Reported helmet use of I=32%, C=-20% (C) Cycling exposure similar for I and C <b>Effective Good/reasonable</b> evidence
Thomson and Whelan (1997), <sup>8</sup> UK	Children 5–7 years Low income School based Road environment	<b>Drumchapel Road Safety Initiative</b> Practical roadside pedestrian training of children by local volunteers. 3 key skills taught 4–6 training sessions	Randomised controlled trial Approx 50 children per year in I and C for 3 specific behaviours	Observed behaviour of children	I: children's choice of "very unsafe" places to cross fell from 47% (pre-tests) to 12% C: children from 50% to 30% <b>Effective Good/reasonable</b> evidence
Macarthur <i>et al</i> (1998), <sup>9</sup> Canada	9/10 year old children based High, medium, and low income schools	<b>"Kids CAN-BIKE" Festival</b> Playground cycle skills training. Single session 90 minutes	Randomised controlled trial I = 73 children in 3 schools C = 68 children in 3 schools	Observed behaviour Attitudes Knowledge	No significant differences between I and C. <b>Ineffective Good/reasonable</b> evidence

C = control; I = intervention.

### Results

We identified 42 publications for the period 1995 to 1999 which were not included in our previous systematic reviews.<sup>4–45</sup> Of the 42 recent publications, 18 related to interventions in the road environment, 11 the home environment, five the leisure environment, five broader community based studies, and three mass

media or general training studies. We rated the quality of the evidence as good/reasonable in 12 of the studies, as reasonable in 13 studies and reasonable/weak in 17 studies. The publications reviewed included eight randomised controlled trials, five of which were rated as good/reasonable evidence<sup>8 9 23 25 29</sup> and three as reasonable.<sup>6 14 16</sup>

Table 3 The road environment: promotion of bicycle helmets

Author, date, and country	Injury target group and setting	Aims and content of intervention	Study type and sample size	Outcome measures	Key results
Mock <i>et al</i> (1995), <sup>10</sup> USA	5–15 years Community-wide	Mass media campaign discount schemes. School based educational activities and bicycle events	Prospective observational study (A) 8860 observations (B) 466 admissions	(A) Observed helmet use at 150 sites (B) Hospital admissions	(A) Helmet wearing when riding: 5% (1987) to 57% (1993) (B) Severe head injuries (all ages) 29% of all admissions to 11% <b>Partly effective Reasonable</b> evidence
Parkin <i>et al</i> (1995), <sup>11</sup> Canada	5–14 years Low income areas School based	<b>"Be Bike Smart" Week</b> Educational and promotional activities. Helmets available at discounted price	Controlled trial without randomisation I=3 low income schools C1 not clear C2 (educated in previous year) 2 schools	(A) Observed helmet use (B) Self report helmet ownership use in I (C) Helmets sold	(A) Observed helmet use in I: 4% to 18% C1: 3% to 19% C2: 1% to 26% (B) Reported helmet ownership in I: 10% to 47% (C) 910 helmets sold in I schools <b>Inconclusive Reasonable</b> evidence
Farley <i>et al</i> (1996), <sup>12</sup> Canada	5–12 years Elementary school Community-wide	Promotional activities over 4 years. Helmet discounts and free helmets	Controlled trial without randomisation I=6087 observations C=2025 observations	Observed helmet use in variety of locations	Observed helmet use in I: 9.6% (1st year) to 32.5% (3rd year) In C: 3.9% to 14.3% <b>Partially effective</b> —less effective in poor municipalities <b>Reasonable</b> evidence
Ekman <i>et al</i> (1997), <sup>13</sup> Sweden	0–14 years Community-wide	Series of local, regional, nation-wide campaigns	Time series: I <sub>1</sub> , I <sub>2</sub> , I <sub>3</sub> , 3 communities; C <sub>1</sub> , C <sub>2</sub> , 2 communities; C <sub>3</sub> =Sweden overall	Hospital discharge data for cycling injuries	Over 15 year period. In I <sub>1</sub> : 48% decrease in bicycle injuries and 59% in head injuries Sweden (C <sub>3</sub> ): 32% decrease in bicycle injuries and 43% in head injuries <b>Effective Reasonable</b> evidence
Kim <i>et al</i> (1997), <sup>14</sup> USA	6–12 years. Primary health care	Free helmet distribution (I) or helmet discounts (C) along with educational intervention at public health clinics (I and C)	Randomised controlled trial I=3 clinics (n=243) C=3 clinics (n=180)	(A) Reported use of helmets	(A) Reported helmet use: 76% in I and 82% in C <b>Partially effective for some groups Reasonable</b> evidence
Britt <i>et al</i> (1998), <sup>15</sup> USA	3–4 years. Low income	Multifaceted promotion programme	Controlled trial without randomisation I=14 sites, 680 children C=4 sites, 200 children	(A) Observed helmet use (B) Reported behaviour	(A) I: 43% to 89% C: 42% to 60% (B) Reported helmet use I: 26% to 58% C: 36% to 37% <b>Effective Reasonable</b> evidence
Henrickson and Becker (1998), <sup>16</sup> USA	10–12 year old children attending schools. Low income families	I <sub>1</sub> school intervention + telephone parental counselling I <sub>2</sub> school only intervention	Randomised controlled trial I <sub>1</sub> =142 children 3 schools I <sub>2</sub> =163 children 3 schools C=102 children 3 schools	Self report of helmet use	Reported helmet use I 25% to 39% C: 17% to 20% <b>Partially effective Reasonable</b> evidence
Logan <i>et al</i> (1998), <sup>17</sup> USA	5–13 year old children. Rural town School based	Education, helmet provided, and incentive scheme	Before and after study. No controls I=2 schools 403 children	Observed helmet use. Self report surveys	Observed use 3% baseline, 25% one day after giveaway, and 5% at 9 months <b>Inconclusive Reasonable/weak</b> evidence

C = control; I = intervention.

Table 4 The road environment: bicycle helmet legislation

Author, date, and country	Injury target group and setting	Aims and content of intervention	Study type and sample size	Outcome measures	Key results
Abularrage (1997), <sup>18</sup> USA	Children 1–14 years Multiracial community	I (1) Legislation—helmet use for children 1–14 years (2) Campaign in month before legislation. Discount coupons	Controlled trial without randomisation I=14 schools C=12 schools	Observed helmet use	Observed helmet use: I: 4.7% to 13.9%, C: 5.6% to 4.2% Increased use in girls, 5–9 age group Education and legislation effective Legislation alone no effect on C <i>Effective for some groups</i> <b>Good/reasonable</b> evidence
Ni <i>et al</i> (1997), <sup>19</sup> USA	Under 16 years Community-wide	Statewide legislation in Oregon (July 1994)—all children under 16 years to wear cycle helmets when riding on public property \$25 fine for non-compliance. Statewide promotional campaigns	4: (i) Statewide observation before: 1610. After: 1703 (ii) Observations: 33 schools (iii) Survey in 16 schools (iv) Telephone survey	(A) Observed helmet use in (i) and (ii) (B) Reported helmet use and knowledge in (iii) and (iv)	(A) Statewide (i) Observed use. 25% to 49% Schools (ii) Observed helmet use 20% to 56% Schools (iii) Reported use 15% to 39% Helmet ownership 51% to 76% Telephone survey (iv) Reported helmet use 37% to 66% <i>Effective</i> <b>Good/reasonable</b> evidence

C = control; I = intervention.

Table 5 The road environment: seat belt legislation

Author, date, and country	Injury target group and setting	Aims and content of intervention	Study type and sample size	Outcome measures	Key results
Margolis <i>et al</i> (1996), <sup>20</sup> USA	4–15 years	North Carolina Child Passenger Safety Law (Oct 1985). Children 4–15 years required to use safety belts when front seat passengers	Time series data 1990–95	Police reports mortality and morbidity data	42% decline in deaths and serious injuries <i>Effective</i> <b>Reasonable</b> evidence
Williams <i>et al</i> (1997), <sup>21</sup> USA	Day care and elementary schools	<b>“Click it or Ticket”</b> program Statewide enforcement of seat belt laws. Education at schools	Controlled trial without randomisation I=2 schools 2 day care centres C=1 elementary school 1 day care centre	(A) Observed seatbelt use (B) Child restraint violations	(A) I schools correct restraint use 36% to 64% and 49% to 71%. C schools 36%–43%. I day care 71%–76%, 60%–75%. C day care 52%–70% (B) 1025 child restraint violations <i>Partially effective</i> <b>Reasonable</b>

C = control; I = intervention.

### Summary of findings related to effectiveness

#### INTERVENTIONS TO REDUCE INJURES IN THE ROAD ENVIRONMENT

One new study evaluated the effect of area-wide environmental change on traffic speeds and cyclist and pedestrian injuries (table 1). This study evaluated the impact of traffic speed reduction zones (20 mile per hour (mph) zones) in 200 residential areas in the UK.<sup>4</sup> This study did not include control data but it did report on a large range of schemes and included a long period of data collection. It strengthens the evidence related to reducing accidents to vulnerable road users provided by earlier urban safety schemes.<sup>46</sup>

Five articles examined the issue of pedestrian and cyclist training as a means of increasing knowledge and promoting behavioural change (table 2). These additions to the literature mean that there is now increased, but still limited, evidence that bicycle training schemes can improve safe riding behaviour and that education on safe bus boarding can achieve some positive effect. Thomson and Whelan's study suggests that children's choice of safe places to cross can be improved by intensive roadside training.<sup>8</sup>

The promotion of bicycle helmets was addressed in a relatively large number of papers. Eight studies evaluated the effects of educational campaigns (table 3) and two examined the impact of legislation on helmet use by children (table 4). These studies suggest that educational campaigns and legislative change can achieve some positive effect on behaviour. There is more limited evidence relating to the effect of such interventions on injury rates.

There is increasing evidence that legislation requiring the restraint of children in cars has a positive effect. Two papers addressed this issue (table 5).

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