

# Preventing unintentional injuries to children under 15 years in the outdoors: a systematic review of the effectiveness of educational programs

Mark Pearson, Harriet Hunt, Ruth Garside, Tiffany Moxham, Jaime Peters, Rob Anderson

► Additional materials and tables are published online only. To view these files please visit the journal online (<http://injuryprevention.bmj.com/content/18/2.toc>).

Peninsula Technology Assessment Group (PenTAG), Peninsula Medical School, University of Exeter, Exeter, UK

## Correspondence to

Mark Pearson, Peninsula Medical School, University of Exeter, Veysey Building, Salmon Pool Lane, Exeter EX2 4SG, UK; [mark.pearson@pms.ac.uk](mailto:mark.pearson@pms.ac.uk)

Accepted 12 July 2011  
Published Online First  
2 September 2011

## ABSTRACT

**Introduction** Unintentional injuries to children in the outdoors have a significant impact on child mortality, development and healthcare costs. This paper presents the findings of a systematic review about the effectiveness of programs that provided information, advice or education about the prevention of unintentional injuries to children under 15 years during outdoor play and leisure.

**Methods** A structured search strategy was conducted in a range of databases. All report titles and abstracts were screened using pre-defined criteria. Included reports were quality appraised using a modified Graphical Appraisal Tool for Epidemiological studies (GATE) tool. All quality appraisals and data extraction were checked by a second reviewer. If not provided in the original reports, ORs and mean differences were calculated, where sufficient data were available.

**Results** Twenty-three studies met the inclusion criteria. There was a paucity of robust study designs. The majority of studies only reported a short-term follow-up of intermediate outcome measures. Only two studies measured injury rates; both reported a reduction, but both studies also had considerable methodological weaknesses. The five studies that measured the use of protective equipment reported mixed results, although there is some evidence that suggests that more extensive educational programs (such as health fairs and media campaigns) increase their use. The 20 studies that measured behaviour, attitude or knowledge outcomes reported highly mixed results.

**Discussion** Methodological weaknesses of the included studies limit support for a particular course of action. To better inform policy and practice, future research should (1) use robust study designs and (2) not rely on short-term proxy outcome measures.

## INTRODUCTION

Unintentional injuries to children have a significant impact on child mortality, morbidity and healthcare costs. Globally, unintentional injury contributes to the top 15 causes of death across all age groups of children aged 0–19 years.<sup>1</sup> The most common causes of death due to unintentional injury in Europe are road traffic injuries (37%), drowning (15%), poisoning (8%), falls (5%) and fires (4%).<sup>2</sup> In England and Wales, unintentional injury is the leading cause of death in children aged 1–14 years. Annually, more than two million children aged 0–14 years are taken to the accident and emergency departments of UK hospitals after being unintentionally injured, although numbers are

steadily decreasing.<sup>3</sup> About half of these occur in the home, with those under 5 years most likely to be injured at home. As they get older, children are increasingly at risk for injury outside the home.<sup>3–4</sup> Data about injuries sustained in outdoor environments while at play or leisure activities are available but are not broken down in ways that fully illuminate our focus. However, we do know that most injuries to children under 15 years during outdoor play and leisure are caused by falls, both in the home and outside the home, with crushing or striking injuries as the next most common causes. More than 33 000 children under 15 years were injured in public playgrounds in 2002.<sup>5</sup> Other potentially dangerous outdoor leisure activities relate to fireworks, roller blading, skateboarding, caving, climbing and water sports, and locations include playgrounds and farms.<sup>5–7</sup>

It is known that higher levels of injury morbidity and mortality are found among those from more deprived backgrounds, although, to date, there has been little robust research about the impact of interventions to decrease 'general leisure' injuries in different socioeconomic groups.<sup>8</sup> Previous systematic reviews in the field have focused on interventions to improve children's safety in outdoor environments when working on farms<sup>9–10</sup> or have been limited to one type of educational intervention (eg, group education) where little evidence was located relating to children.<sup>11</sup> A further systematic review (with a broad focus across road, home and leisure environments) included studies published between 1975 and 2000 but identified only what the authors defined as 'some' evidence about the effectiveness of interventions to decrease unintentional injuries to children in leisure environments.<sup>12</sup> To address these identified gaps in synthesised evidence and provide an up-to-date synthesis of the effectiveness of interventions, this paper presents the findings of a systematic review about the effectiveness of programs that provided information, advice or education about the prevention of unintentional injuries to children under 15 years during outdoor play and leisure. The review was conducted as part of a series of reviews on the prevention of unintentional injuries to children on the road and in the home (reported elsewhere<sup>13–14</sup>) in accordance with a review protocol (see supplementary file #1) agreed upon by the commissioning body (Centre for Public Health Excellence, National Institute for Health and Clinical Excellence). The review's focus on outdoor environments reflected the outcome of a stakeholder consultation process



This paper is freely available online under the BMJ Journals unlocked scheme, see <http://injuryprevention.bmj.com/site/about/unlocked.xhtml>

used by the commissioning body in the development of the project's scope.<sup>15</sup> The review's inclusion and exclusion criteria are shown in table 1.

## METHODS

### Identification of evidence

A search strategy using text words and thesaurus headings relating to the provision of information, advice and education to children about the prevention of unintentional injuries during outdoor activities was used in a range of databases (box 1). Filters for publication year (from 1990 to September 2009) and English language were applied. Websites and the citations of included studies were also searched. The full search strategy, which was also designed to locate studies for potential inclusion in a parallel cost-effectiveness review and review of qualitative research on barriers and facilitators to implementation, is shown in supplementary file #2.

### Screening and quality appraisal

All report titles and abstracts (where available) were screened independently by one reviewer (MP, RG or LC) for inclusion according to a pre-defined checklist of criteria. A sample of 20% was screened independently by a second reviewer (MP, LC or HH). Uncertainty over inclusion was resolved by discussion. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow chart (including the studies identified for the cost-effectiveness review and review of qualitative research) is shown in figure 1.

Included reports were quality-appraised independently by one reviewer (MP or HH), and 100% of these appraisals were checked by a second reviewer (MP, RG or HH) using a checklist based on the GATE quality appraisal tool.<sup>15 16</sup> Each criterion was rated as '++' (minimal risk of bias), '+' (potential sources of bias remained) or '-' (significant sources of bias persisted). The overall validity of each study was also rated using a similar system: '++' (all or most of the quality criteria were fulfilled), '+' (some of the quality criteria were fulfilled but judged as being unlikely to have altered the study's conclusions) or '-'

(few or none of the quality criteria were fulfilled). The results of the quality appraisal in full are shown in supplementary file #3.

### Data extraction

All included reports were read independently by one of two reviewers (MP or HH), and data were extracted into evidence tables. All data extractions were checked by a second reviewer (MP, RG or HH), and any discrepancies were discussed and addressed to ensure consistency. In addition to data on the core outcomes of interest, research methods used and statistical analyses conducted, data about sample characteristics and the components of programs were extracted.

### Data analysis and synthesis

ORs and mean differences (with 95% CIs) comparing intervention and control groups are either taken directly from those reported by authors or calculated by the review team where sufficient data were available. In many reports, the limited data prevented calculation of a common metric across studies. Effect sizes are shown wherever these were reported or were calculable.

### Pooling of outcomes *within* studies

There was a large number of similar outcomes reported within some individual reports (eg, different measurements of attitudes towards the supervision of toddlers in water). These risked becoming overwhelming to the reader. Therefore, where we judged outcomes to relate to the same aspect, we pooled these within that study. We judged this to be a better approach than selecting a single outcome on any topic, as this was likely to be an arbitrary selection. For outcomes to be pooled within a study in this way, we assessed the direction (to ensure that it was the same) and magnitude of the ORs (to ensure that it was not a large difference), and 95% CIs were checked to ensure that there was overlap between the outcomes to be pooled within a study. If these conditions were not met, ORs were reported individually. If they were met, ORs were pooled within studies using a random-effects model to maintain any heterogeneity.

**Table 1** Review inclusion and exclusion criteria

Included	Excluded
Children and young people aged under 15 years, particularly those living in disadvantaged circumstances (eg, with families on a low income or with a lone parent)	Anyone 15 years or older (unless they are the parents of targeted children)
Parents and carers of children and young people aged under 15 years, particularly those living in disadvantaged circumstances, where their children are the focus of research or where they are targeted by interventions aimed at reducing unintentional injury in their children	
Interventions aimed at reducing injuries in:	Interventions aimed at reducing injuries in:
Designated outdoor play and leisure spaces (eg, playgrounds and skateboard parks)	Play and leisure activities at home
Other non-designated external environments (eg, canals, construction sites, fields and farmyards)	Play and leisure activities on roads or pavements (including any bicycle helmet mass-media campaigns already covered by studies in a linked review)
	Design or modification of the physical environment, including environmental or engineering solutions to improve safety
Interventions that involved the provision of information, advice and education (in the above environments) on:	Safety education that does not cover unintentional injury prevention related to play and leisure activities
Safety and risk (including risk assessment)	Formal, competitive sports (where supervising adults are likely to be present)
Safety clothing and protective equipment	Workforce training, support and capacity-building in relation to preventing unintentional injuries in children and young people under 15 years
(information could be delivered via one-to-one or group-based verbal information, print media (eg, leaflets, posters), new media (eg, internet-based social networking sites), email and text messaging or mass-media campaigns)	Policy and legislation covering safety education, equipment and inspection standards
	Any interventions that involve the provision of safety clothing and protective equipment (unless they are delivered alongside information, advice and education)
	National, regional or local media campaigns that focus on implementing or enforcing safety legislation, regulation and standards

**Box 1 Database searches performed**

Medline  
 PsycINFO  
 ISI Web of Knowledge Social Science Citation Index (SSCI)  
 Science Citation Index Expanded (SCI-EXPANDED)  
 Health Management Information Consortium (HMIC)  
 CINAHL  
 Applied Social Science Index and Abstracts (ASSIA)  
 The Cochrane Library database of systematic reviews  
 EconLit  
 EMBASE  
 EPPI-Centre  
 ERIC  
 TRoPHI  
 DoPHER  
 Bibliomap  
 Centre for Reviews and Dissemination databases  
 Database of Abstracts of Reviews of Effects (DARE)  
 National Health Service Economic Evaluations Database (NHSEED)  
 NHS Economic Evaluation Database (HTA)  
 SPORTDiscus

For *use of protective equipment*, there was a reasonable homogeneity of outcomes measured and sufficient data in three of the five studies to allow pooling of ORs within studies. Similarly, for

*behaviour, attitude and knowledge* outcomes, homogeneity between outcomes measured allowed pooling of ORs within 5 of the 19 studies.

**Pooling of outcomes across studies**

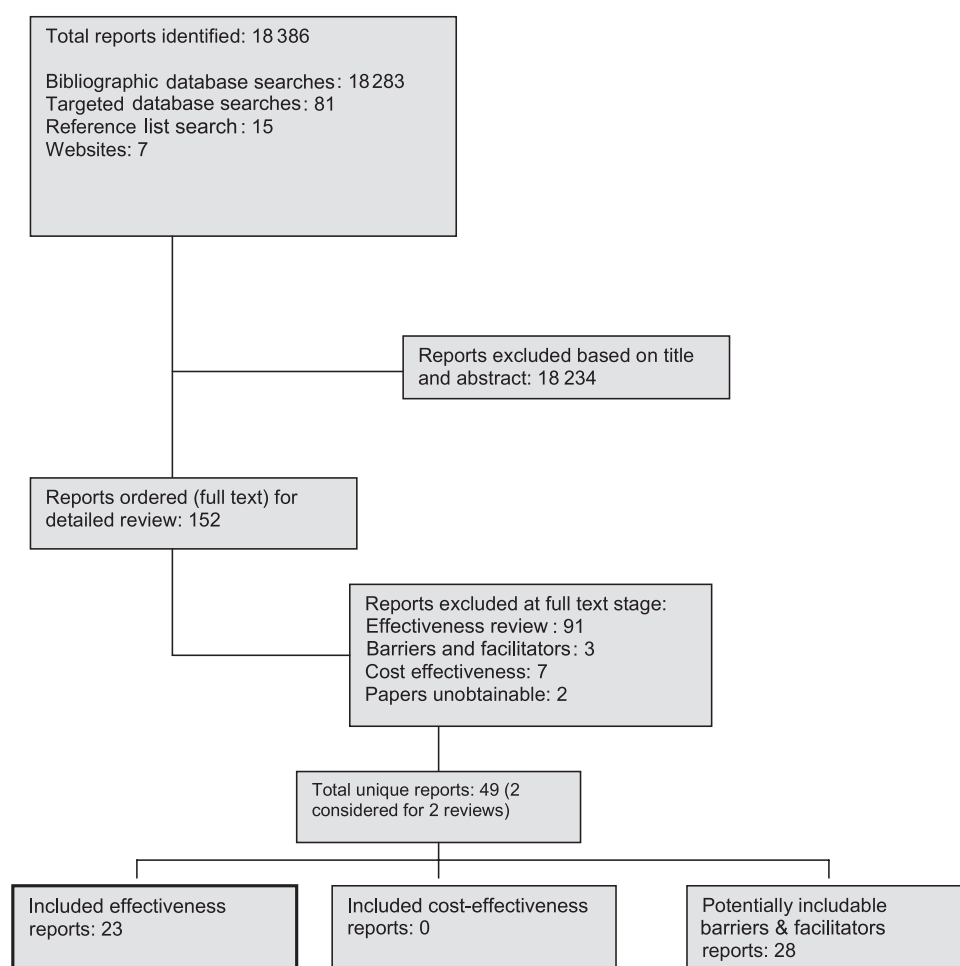
The reporting of *injury outcomes* was insufficient to allow any form of statistical pooling across studies. In meta-analysis, it is assumed that individual ORs are independent of one another; however, this is not the case with some outcomes, as the same participants are included in the calculation of a number of ORs from pooling within studies (see above). Therefore, ORs for *behaviour, attitude and knowledge* outcomes and *use of protective equipment* outcomes were not pooled across studies. The large amount of heterogeneity between study outcomes would also have hindered synthesis across studies. In particular, the heterogeneity in the outcome measures used and insufficient reporting of data meant that a graphical summary of *behaviour, attitude and knowledge* outcomes across studies was not feasible.

All ORs and mean differences are reported as either 'intervention versus control' (where a study's design included a control group) or 'after versus before' (where a study's design did not include a control group). Thus, an OR above 1 shows that a desirable outcome occurred following the intervention. This effect is considered to be statistically significant (at  $p < 0.05$ ) if the 95% CI does not include 1. A mean difference above zero shows a desirable direction of effect.

**Characteristics of included reports**

Twenty-three reports met the inclusion criteria. Two reported randomised controlled trials (RCTs), three reported cluster

**Figure 1** PRISMA flow chart.



RCTs, seven reported controlled before and after (CBA) studies and 11 reported before and after (BA) studies. Two studies were rated '++', eight were rated '+' and 13 were rated '-'. Table 2 provides the details of the study design, quality appraisal rating, program components (eg, safety topics covered and the mode of delivery) and study context. Programs included in the review used a range of methods to provide information, advice and education about injury prevention. Figure 2 provides an overview of these program components and their use, either alone or in combination.

Included studies predominantly used intermediate outcome measures such as knowledge or attitudes. Twenty studies measured behaviour, attitude and knowledge outcomes, while only five measured the use of protective equipment, and only two measured injury rates.

The diversity of approaches to providing information, advice and education in the included programs, together with differences in the extent of the programs and measurement of outcomes in different studies, provided a significant challenge for synthesis. Reporting our synthesis rigorously has therefore meant that we have had to report 'mixed results' for many of the outcomes of interest.

## FINDINGS

The synthesis of the effectiveness of programs is presented under five headings: injury rates; use of protective equipment; and safety behaviour, attitude and knowledge. An overview of the direction and strength of the effect of programs and whether outcomes were observed or self-reported is shown in table 3. Similar programs are reported together (those with the shortest follow-up time reported first) to aid understanding of the effectiveness of different types of programs. Key details about the context in which the programs were implemented are also reported in order to inform understanding of the applicability of programs in local contexts.

### Injury rates

Only two studies, both of which were BA studies rated '-', measured the impact of programs on injury rates. The total number of paediatric head and neck injuries (both absolute and proportional) was reduced in the county in which a head and spinal cord injury education program ('Think First for Kids') was delivered in schools to children aged 6–9 years. In the first year of the program, 47 (73%) of 64 paediatric trauma admissions were due to a head and/or back injury. This proportion fell to 42 (65%) of 65, then 29 (51%) of 57, in the subsequent 2 years.<sup>31</sup>

A program designed to reduce the number of firework-related injuries to children over the New Year period ('Capodanno Senza Danno'—'New Year Without Harm') reported firework-related emergency room consultations for children under 15 years in the 18 emergency rooms of the Naples region (43, down from 119 in the previous year).<sup>39</sup> It was reported that 'the most dramatic change occurred in 10–12-year-olds, among whom the rate dropped from 45.9/100 000 residents to 22.3/100 000 residents',<sup>39</sup> but no further data are presented to allow comparison of this claim with other injury rate changes. Confounding events, such as heavy rainfall over the New Year period in the year the study was conducted, may also have accounted for the reduction in injury rates.

### Use of protective equipment

Figure 3 shows a forest plot of the postintervention versus preintervention effect sizes of three of the five studies that evaluated the impact of programs on the use of protective

equipment. Due to heterogeneity, it was not possible to pool ORs across studies for this outcome. Evidence for the effect of these programs suggests that there is a moderate increase in the use of protective equipment; however, for three studies, this finding was not statistically significant.

No statistically significant difference in children's use of knee/elbow pads or helmets (while rollerblading or skateboarding, based on self-reporting of protective equipment use) was reported following a brain and spinal cord injury education program (Think First for Kids) delivered in schools to children aged 11–13 years.<sup>32</sup> A statistically significant increase in the use of life jackets by children when boating (based on parental reporting of protective equipment use) was reported following a statewide drowning prevention campaign ('Stay on Top of It') that was aimed at adults and children.<sup>37</sup> However, an evaluation of a related drowning prevention campaign (based on observation of protective equipment use) reported no statistically significant post-program difference in the use of life jackets,<sup>38</sup> but it is unclear why the outcomes of these two related programs differ.

Two further studies, both of which were BA studies rated '-', did not report sufficient data to allow effect sizes to be calculated (table 4). The effect of a coalition of community organisations (the Waco Traffic Safety District Helmet Promotion Coalition) on protective equipment use (based on observation of protective equipment use) is mixed. A statistically significant increase in the use of helmets by children when skateboarding (in all observed locations) was reported but not when in-line skating or riding a scooter.<sup>35</sup> A statistically significant increase in children's use of helmets when they were skateboarding, in-line skating and riding scooters in car parks was also reported but not when children were engaged in these activities in playgrounds or on cycle paths.<sup>35</sup> A statistically significant increase in children's post-program helmet use when engaged in these activities alone was reported but not when with any other group of either children or adults.<sup>35</sup>

The other BA study, in a rural setting, reported a statistically significant difference post-program (based on self-reporting of protective equipment use) in the use of eye protection and helmets on farms when riding or driving an all-terrain vehicle (table 4). This change followed a program that used oral presentations and activities based on the 'Progressive Farmer' safety lesson plans.<sup>29</sup>

### Safety behaviour

Table 5 (available online only) provides an overview of the impact of programs on safety behaviour in the five studies that measured this outcome. Two of these studies reported water safety outcomes.<sup>22–24</sup> The first reported statistically significant improvements in water safety behaviour and problem-solving skills (to avoid participating in risky behaviours) in 5–11-year-old children who had participated (over the course of 18 weeks) in a series of lessons covering a range of safety issues in the outdoors, on the road and in the home.<sup>22</sup> The second (a randomised study) observed children's poolside behaviour following oral presentations (delivered to children aged 2–4 years during the course of swimming lessons), reporting a minor improvement when the 12-week training group was compared with no intervention but a slight deterioration when this group was compared with the 8-week training group.<sup>24</sup>

Observational data for the effect of a series of classroom oral presentations on playground safety were measured by one BA study.<sup>20</sup> A reduction in unsafe behaviour on climbing frames and slides for 6–8-year-old children was reported, with the exception



**Table 2** Included study characteristics

Authors/study design (quality)/country	Program name and comparator	Age of children (topic)	Delivered by	Intensity/frequency of intervention	Other key elements of intervention	Sample N/n in follow-up (follow-up period)	Outcome measures
<b>Oral presentation</b>							
Frederick and Barlow <sup>17</sup> / BA (–)/UK	'Citizenship Safety Project'—program to increase injury prevention knowledge in children (no comparison group)	6–7 years (outdoors, home and road safety)	Peer-educators in school	A number of 30-min lessons	NA	55/NR (2 months)	Knowledge
Frederick <i>et al</i> <sup>18</sup> / CBA (+)/UK	'Injury Minimisation Program for Schools'—injury risk awareness program for children (vs no intervention)	10–11 years (outdoors, home and road safety)	Teachers in school	Delivered within a 5-month period	Hospital visit to learn basic life support skills	1119/1085 (5 months)	Attitudes, knowledge
Tenn and Lewis <sup>19</sup> / CBA (–)/Canada	Untitled—peer-driven injury prevention program for high-risk adolescents (vs no intervention)	13–17 years (outdoors and road safety)	Peer-educators in school	Presentations in a number of sessions totalling 6 h	Discussion about injury scenarios, linking emotions and risk, decision-making, communication and relationships with friends Obstacle course for 'experiencing the difficulties associated with being disabled' 'Famous sports star' visits class to talk about sport, equipment and protective behaviours Video on safety relating to bike, motorbikes, and driving and cliff jumping and diving	106/NR* (4 months)	Attitudes, knowledge
Heck <i>et al</i> <sup>20</sup> / BA (–)/USA	Untitled—reducing playground risk behaviour through classroom-based safety training (no comparison group)	6–8 years (playground safety)	External trainer in school	One classroom visit every day for five consecutive days	NA	239/239 (1 week)	Behaviour
Morrongiello and Mark <sup>21</sup> / cRCT (+) (randomisation by school class; analysis at level of individual)/Canada	'Safe Play on Playgrounds'—poster-based injury prevention program for children (vs no intervention)	7–12 years (playground safety)	Research assistants in school	Two consecutive exercises to assess changes in risk-taking intentions (unspecified timing).	Children created a radio advertisement about safe playground behaviour	239/222 (1 month (averaged))	Attitudes
Azeredo and Stephens-Stidham <sup>22</sup> / CBA (–)/USA	Untitled—injury prevention curricula for use in elementary schools (vs no intervention)	5–14 years (outdoors, home, and road safety)	Teachers in school	30–45 min lessons delivered over the course of 18 or 27 weeks	Bicycle fair and helmet giveaway Smoke alarm giveaway Within-class focus on seatbelt use Letters home to parents Talks at parent-teacher meetings	'Approximately' 6300/ NR (2 weeks)	Behaviour, attitudes, knowledge
Greene <i>et al</i> <sup>23</sup> / CBA (–)/USA	Think First for Kids—brain and spinal cord injury prevention program for children (vs no intervention)	6–9 years (playground, water, road, and weapons safety)	Teachers in school	Six lessons within 6 weeks	General structure and function of the brain and spinal cord Conflict resolution and weapons safety	1400/NR (1 week)	Knowledge
Asher <i>et al</i> <sup>24</sup> / RCT (+)/USA	Untitled—swimming lessons and water safety instruction (vs no intervention and 8 weeks of swimming lessons and water safety instruction)	24–42 months (water safety)	Swimming instructors (during swimming lessons at a swimming pool)	12 weeks of twice-weekly lessons	NA	162/142 (immediate)	Behaviour
Moran and Stanley <sup>25</sup> / BA (–)/New Zealand	Untitled—parental education program addressing parental misconceptions of toddler safety (no comparison group)	2–4 years (water safety)	Unknown in professional swim school	Parents 'provided with resources on toddler water safety' over 10 weeks	Children were taught to swim Adults received information on child cardio-pulmonary resuscitation	106/105 (immediate)	Attitudes
<b>Oral presentation+promotional materials</b>							
Terzidis <i>et al</i> <sup>26</sup> / CBA (+)/Greece	Untitled—changing water safety knowledge and attitudes through a mandatory schooling intervention (vs no intervention)	5–15 years (water safety)	Health professionals in school	1 full day	Water safety promotional materials	1400/1348 (1 month)	Attitudes, knowledge

Continued

Table 2 Continued

Authors/study design (quality)/country	Program name and comparator	Age of children (topic)	Delivered by	Intensity/frequency of intervention	Other key elements of intervention	Sample N/n in follow-up (follow-up period)	Outcome measures
<b>Oral presentation+ activities</b>							
Richards <i>et al</i> <sup>27/</sup> CBA (—)/USA	Untitled—establishing safe behaviours early on through education about spinal cord injury prevention (vs no intervention)	3–11 years (playground, water, road and weapons safety)	Teachers in school	Up to and including three lessons within a 7-week window	NA	495/NR (1 week)	Knowledge
Kendrick <i>et al</i> <sup>28/</sup> cRCT (+ +) (randomisation by school; analysis at level of individual)/UK	Risk Watch—injury prevention program (vs no intervention)	7–10 years (outdoors, home and road safety)	Teachers in school	NR	NA	459/391 (4 months)	Knowledge
McCallum <i>et al</i> <sup>29/</sup> BA (—)/USA	'Progressive Farmer Farm Safety Day Camp'—farm safety program for children (no comparison group)	8–13 years (farm safety)	Farm safety camp teachers at a farm safety camp	1 full day	NA	1781+/NR (3 months)	Equipment use, behaviour
<b>Oral presentation+ safety village</b>							
Gielen <i>et al</i> <sup>30/</sup> BA (+)/USA	'Children's Village'—children's safety village designed to raise awareness of safety issues (no comparison group)	7–8 years (outdoors, home and road safety)	School teachers and others in a purpose-built children's village	2 full days	Walk-through of a home destroyed by fire Use of child-size battery operated vehicles to drive through the model village	410/281 (immediate)	Knowledge
<b>Oral presentation+ video</b>							
Wehner and Sutton <sup>31/</sup> BA (—)/USA	Think First for Kids—brain and spinal cord injury prevention program for children (no comparison group)	6–9 years (playground, water, road, weapons and sports safety)	Trained volunteer presenters in school	30-min lessons per week for 6 consecutive weeks	NA	6973/6644 (6 weeks (approximate))	Injuries, knowledge
Wesner <sup>32/</sup> CBA (+)/Canada	'Think First'—brain and spinal cord injury prevention program (vs no intervention)	11–13 years (spinal cord safety education)	Trained volunteer presenters in school	1 day	Presentation by a person who had sustained a brain or spinal cord injury	663/392 (2 weeks)	Equipment use, knowledge
<b>Video</b>							
Mayer <i>et al</i> <sup>33/</sup> RCT (+ +)/USA	Untitled—parental education program addressing parents' safety awareness and preventive actions (vs no intervention)	0–10 years (garden safety)	Unknown in children's orthopaedic outpatients clinic	20-min video and pamphlet	NA	80/65 (1 month)	Behaviour
Morrongiello and Mathies <sup>34/</sup> cRCT (+ +) (randomisation by school class; analysis at level of individual)/Canada	Untitled—'risk-taking' poster exercise and video showing moderate- and high-risk playground behaviour (vs risk-taking poster exercise)	6–11 years (playground safety)	Research assistants in school	NR—maximum of two video viewings in 1 day	NA	258/258 (2 months)	Attitudes
<b>Health fairs+mass media</b>							
Forjuoh <i>et al</i> <sup>35/</sup> BA (—)/USA	'Waco Traffic Safety District Helmet Promotion'—campaign to increase children's helmet use (no comparison group)	0–12 years (helmet use)	School teachers and others in the community	A number and range of presentations over a 2-year period	Distribution and fitting of helmets Intervention overseen by community coalition of individuals and organisations	345/NR (at the end of the 2-year intervention period)	Equipment use
<b>Health fairs</b>							
Solis <sup>36/</sup> BA (—)/USA	Untitled—a safety fair designed to improve children's knowledge of and attitudes towards injury prevention (no comparison group)	4–13 years (outdoors, home and road safety)	Various in the community	1 full day	Miniature 'smoke house' 'Safety town'	108/NR (immediate)	Attitudes
<b>Mass media</b>							
Bennett <i>et al</i> <sup>37/</sup> BA (+)/USA	'Stay on Top of It'—media drowning prevention campaign (no comparison group)	1–14 years (water safety)	Various in the community	3 years of multi-media campaign	NA	3251/832 (at the end of the 3-year intervention period)	Equipment use, knowledge

Continued

Table 2 Continued

Authors/study design (quality)/country	Program name and comparator	Age of children (topic)	Delivered by	Intensity/frequency of intervention	Other key elements of intervention	Sample N/n in follow-up (follow-up period)	Outcome measures
Treiser <i>et al</i> <sup>28</sup> / BBA (—)/USA	Untitled—a campaign to increase both Personal Flotation Device usage and safe boating practices in general (no comparison group)	0–15 years (water safety)	Various in the community	3 years of multi-media campaign	Lifejacket loan scheme	424/NR (at the end of the 3-year intervention period)	Equipment use
D'Argenio <i>et al</i> <sup>29</sup> / BBA (—)/Italy	'Capodanno Senza Danno' ('New Year's Without Harm')—fireworks-related injury reduction campaign (no comparison group)	NR (firework safety)	Various in the community	NR	Street cleaners cleared streets of unexploded fireworks on the morning following traditional New Year celebrations.	NR (immediate)	Injuries

\* "n remained almost constant at post-test and follow-up" <sup>19</sup>

+Sample size is taken from outcome measurements, as baseline data were not reported by the authors.

(+ + +), all or most of the quality criteria have been fulfilled; (+), some of the quality criteria have been fulfilled, but where this is judged as being unlikely to alter the study's conclusions; (—), few or none of the quality criteria have been fulfilled. BA, before and after study (with no control group); CBA, controlled before and after study; cRCT, cluster RCT; NA, not applicable; NR, not reported; RCT, randomised controlled trial.

of an increase in unsafe behaviour on climbing frames among 6–7-year-old children.<sup>20</sup>

Evidence for the effect of programs on behaviour in other environments is mixed. There was no evidence of effect in a randomised study of a safety education video designed to improve parents' safety behaviour in the garden.<sup>33</sup> A statistically significant improvement following oral presentations and activities based on the Progressive Farmer safety lesson plans was reported for a range of safety behaviours among children aged 8–13 years on farms.<sup>29</sup>

### Safety attitudes

Table 6 (available online only) provides an overview of the impact of programs on safety attitudes in the eight studies that measured this outcome. A statistically significant difference between intervention and control groups in attitudes towards safety in the outdoors was reported for a program that covered a range of safety issues in the outdoors, on the road and in the home.<sup>22</sup> Similarly, a statistically significant improvement in attitudes in the intervention group was reported following delivery of the Injury Minimisation Program for Schools (covering safety in outdoor, home and road environments) over the course of a school year.<sup>18</sup>

Programs addressing attitudes towards water safety reported mixed results. The Injury Minimisation Program for Schools evaluation<sup>18</sup> and the swimming school intervention aimed at the parents of toddlers<sup>25</sup> reported a statistically significant improvement in attitudes in the intervention groups. However, while an evaluation of a school-based program designed to improve water safety reported improved water safety attitudes in children aged 4–6 years, this improvement was non-significant in children aged 6–11 years.<sup>26</sup>

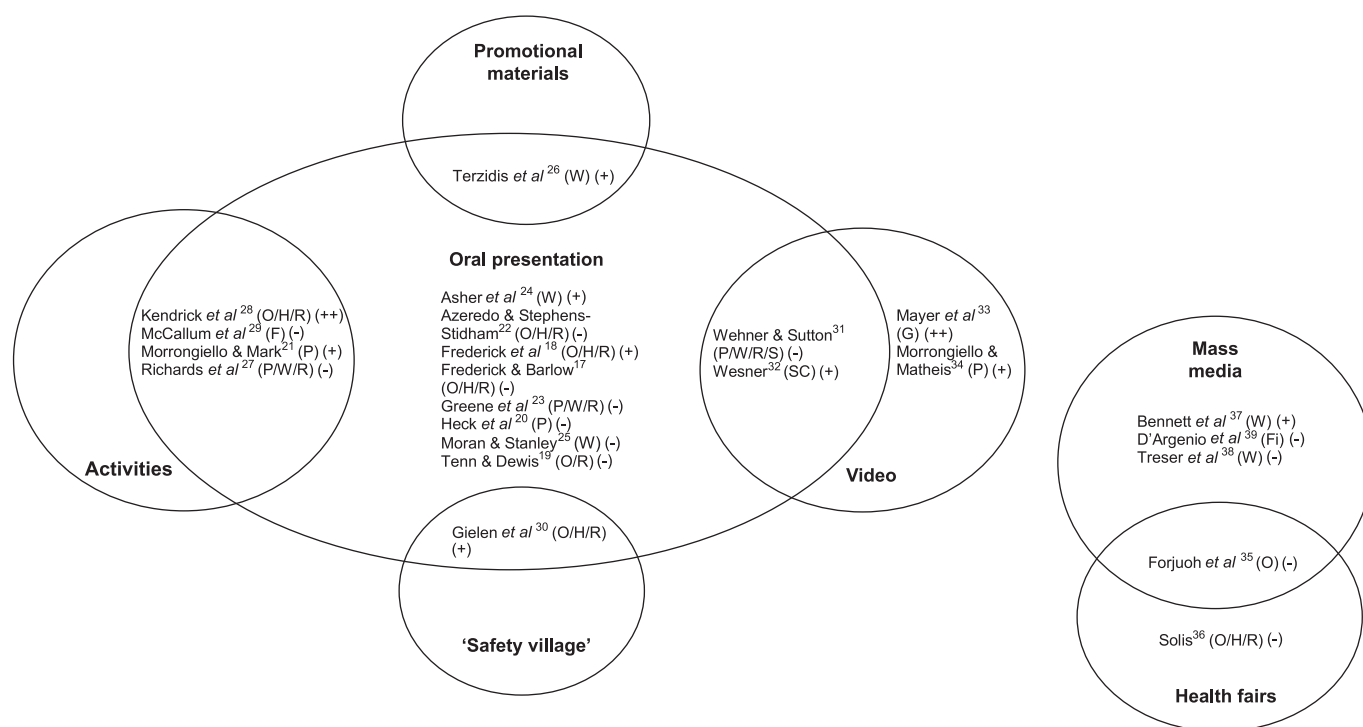
Two studies, both cluster RCTs rated '+', reported the impact of an oral presentation and activities,<sup>21</sup> and a video<sup>34</sup> (both focusing on playground activities) on children's attitudes to playground safety. Statistically significant differences that favoured the intervention group were reported across a range of measures, including a change in one or more safety attitudes<sup>21</sup> and the rejection of behaviours that were both targeted and not targeted by the program<sup>34</sup> (see table 6 online for the full list). Fear and vulnerability regarding high-risk playground behaviours were reported to be statistically significant predictors for decreases in risk taking for both moderate- and high-risk behaviours.<sup>34</sup>

An untitled program covering safety in a range of environments and including both experiential activities and visits from sporting personalities was delivered to children (described as having a combination of social and academic problems) aged 13–17 years. The program was delivered by trained volunteers aged 17–19 years. It was reported that there were no statistically significant differences between intervention and control groups on any attitudinal measures relating to safety.<sup>19</sup>

A BA study (rated ‘-’) of a day-long health fair where 30 community organisations and 10 hospital departments had exhibits reported a slight improvement in safety attitudes when swimming or diving and towards wearing a helmet when taking part in ‘wheeled activities’.<sup>36</sup>

### Safety knowledge

Table 7 (available online only) provides an overview of the impact of programs on safety knowledge in the 12 studies that measured this outcome. Evidence for the effect on water safety knowledge of programs that included an oral presentation component is mixed. Improvements in water safety knowledge are reported by three CBA studies in children aged 5–14,<sup>22</sup> 6–8<sup>23</sup>



**Figure 2** Program components, areas of safety covered and study quality. F, farm safety; Fi, firework safety; G, garden safety; H, home safety; O, outdoor safety; P, playground safety; R, road safety; S, sports safety; SC, spinal cord safety; W, water safety.

and 4–12 years<sup>26</sup> and one BA study in children aged 6–9 years.<sup>31</sup> However, two CBA studies and one BA study also report no improvement in water safety knowledge in children aged 6–7,<sup>17</sup> 10–11<sup>18</sup> and 12–15 years.<sup>26</sup> The use of an oral presentation in conjunction with a specially constructed 'safety village' (designed to raise children's awareness of safety issues) was evaluated by one BA study<sup>30</sup> (rated '+'). In contrast to the results from children in the higher socioeconomic groups, a statistically significant improvement in water safety knowledge in children aged 7–8 years from lower socioeconomic groups was reported following the program.<sup>30</sup>

A statistically significant improvement in parents' knowledge of a statewide media drowning prevention campaign's safety messages was reported by one BA study (rated '+').<sup>37</sup>

Improvements in knowledge of brain and spinal cord anatomy and injuries following oral presentations on the subject were uniformly reported by three CBA studies.<sup>23 27 32</sup> This improvement was statistically significant in the evaluation of the Think First for Kids program, which was the only program of the three studies to also use a video.<sup>32</sup>

Improvements in safety knowledge in relation to a variety of activities in the outdoors are reported in studies of programs that used oral presentations<sup>22 23 30</sup> (see table 7 online for full details). However, a number of studies also reported no improvement in safety knowledge following the program concerned, in relation to fireworks<sup>17</sup> and general outdoor safety.<sup>19</sup> One cluster RCT (rated '++') evaluating the 'Risk Watch' injury prevention program, which was delivered by teachers and covered safety both in the home and outdoors, found no evidence of effect regarding children's (aged 7–10 years) knowledge about preventing falls in the outdoors.<sup>28</sup>

## DISCUSSION AND CONCLUSION

This systematic review, based on explicit and policy-relevant review questions, was conducted according to a pre-defined

review protocol and used explicit search strategies (developed and conducted by an information specialist) of a wide range of electronic databases to identify relevant studies. In considering this review, it is important to keep in mind the limitations of the included studies as summarised by the quality appraisal ratings shown in table 2. It is also important to consider that study designs without a control group (such as BA studies) substantially limit the extent to which program effects can be discerned from outcomes that would have occurred whether or not the program was implemented.

The two studies that measured *injury rates* following a program both reported a reduction in injuries,<sup>31 39</sup> although neither study design supported statistical analysis. Both evaluations were BA studies, making attribution of the outcomes to the programs problematic, especially when the extensive confounding factors reported in one study<sup>39</sup> are considered. The same study also had a very short follow-up period (24 h) that was focused on a particular set of risks from fireworks that were traditionally used over the New Year period.<sup>39</sup>

In the absence of data on injury outcomes, reporting of the *use of protective equipment* is a reasonable proxy. The five studies that measured the use of protective equipment following a program reported mixed results. Use of helmets and knee/elbow pads did not increase following a program using an oral presentation and video,<sup>32</sup> but there is evidence from a weaker BA study that, following health fairs and the distribution of helmets, the use of helmets increases in *some* contexts.<sup>35</sup> Two studies evaluated closely related statewide drowning prevention campaigns as having different outcomes<sup>37 38</sup>; however, the study appraised as methodologically stronger reported a statistically significant increase in children's life jacket use.<sup>37</sup>

*Behaviour, attitude and knowledge* outcomes, although intermediate outcome measures, can still provide useful evidence to inform decision making about the design of unintentional injury prevention programs. The more extensive oral presentation



**Table 3** Overview of study results showing the number of outcomes and the direction and statistical significance of effect

Author(s)	Study type (quality)	Time of follow-up	Injuries	Equipment use	Behaviour	Attitudes	Knowledge
<b>Oral presentation</b>							
Frederick and Barlow <sup>17</sup>	BA (—)	2 months					2↑
Frederick <i>et al</i> <sup>18</sup>	CBA (+)	5 months				3↑↑	1↓
Tenn & Dewis <sup>19</sup>	CBA (—)	4 months				1↑	1↓
Heck <i>et al</i> <sup>20</sup>	BA (—)	1 week			1↑*		
Morrongiello and Mark <sup>21</sup>	cRCT (+)	1 month				3↑↑	
Azeredo and Stephens-Stidham <sup>22</sup>	CBA (—)	2 weeks			3↑↑	1↑↑	4↑↑
Greene <i>et al</i> <sup>23</sup>	CBA (—)	1 week					7↑
Asher <i>et al</i> <sup>24</sup>	RCT (+)	Immediate			1↑* 2↓*		
Moran and Stanley <sup>25</sup>	BA (—)	Immediate				1↑↑	
<b>Oral presentation + promotional materials</b>							
Terzidis <i>et al</i> <sup>26</sup>	CBA (+)	1 month				3↑	2↑ 1↓
<b>Oral presentation + activities</b>							
Richards <i>et al</i> <sup>27</sup>	CBA (—)	1 week					4↑
Kendrick <i>et al</i> <sup>28</sup>	cRCT (+ +)	4 months					1↓
McCallum <i>et al</i> <sup>29</sup>	BA (—)	3 months		2↑↑	1↑↑		
<b>Oral presentation + safety village</b>							
Gielen <i>et al</i> <sup>30</sup>	BA (+)	Immediate					3↑↑ 1↑
<b>Oral presentation + video</b>							
Wehner and Sutton <sup>31</sup>	BA (—)	6 weeks	1↑				3↑
Wesner <sup>32</sup>	CBA (+)	2 weeks		2↑			1↑↑
<b>Video</b>							
Mayer <i>et al</i> <sup>33</sup>	RCT (+ +)	1 months			1↑		
Morrongiello and Matheis <sup>34</sup>	cRCT (+)	2 months				4↑↑	
<b>Health fair + mass media</b>							
Forjuoh <i>et al</i> <sup>35</sup>	BA (—)	At the end of 2-year intervention		3↑↑* 7↑* 2↓*			
<b>Health fair</b>							
Solis <sup>36</sup>	BA (—)	Immediate				3↑↑	
<b>Mass media</b>							
Bennett <i>et al</i> <sup>37</sup>	BA (+)	At the end of 3-year intervention		1↑↑			1↑↑
Treser <i>et al</i> <sup>38</sup>	BA (—)	At the end of 3-year intervention		1↑*			
D'Argenio <i>et al</i> <sup>39</sup>	BA (—)	Immediate	1↑				

The number of outcomes reported by a study (or the summary effect size where this was possible to calculate) is specified before the strength and direction of effect; for example 2↑ indicates that two statistically non-significant effects in the desired direction were reported.

Statistical significance is defined as a (Pooled) OR where the 95% CI does not include 1, or  $p < 0.05$ .

All outcomes were self-reported unless otherwise indicated.

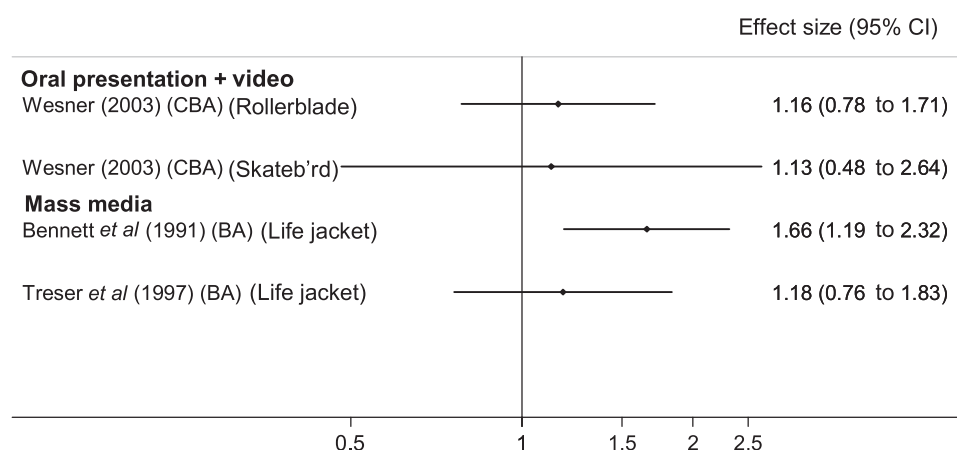
\*Observed outcomes.

↑↑ Statistically significant effect in the desired direction.

↑ Statistically non-significant effect, but in the desired direction.

↓ Statistically non-significant effect, but in the opposite direction to that desired.

BA, before and after study (with no control group); CBA, controlled before and after study; cRCT, cluster RCT; RCT, randomised controlled trial.

**Figure 3** Effect sizes for use of protective equipment (postintervention vs preintervention).

**Table 4** Changes in use of protective equipment following programs

Author(s)/study type (quality appraisal)/country	Outdoors	Farm
<b>Oral presentation+activities</b>		
McCallum <i>et al</i> <sup>29</sup> / BA (-)/USA	—	8–13 years—after versus before Use of eye protection when riding an all-terrain vehicle: $p<0.001$ Use of helmet when riding an all-terrain vehicle: $p>0.001$
<b>Health fair+mass media</b>		
Forjuoh <i>et al</i> <sup>35</sup> / BA (-)/USA	Children (ages NR), helmet use (after vs before) when: Skateboarding ( $p=0.01$ ; increase of 166%) In-line skating ( $p=0.56$ ; decrease of 25%) Scooter riding ( $p=0.15$ ; decrease of 68%) Children (ages NR), helmet use (after vs before) in: Car parks ( $p=0.03$ ; increase of 63%) Playgrounds ( $p=0.09$ ; decrease of 49%) Cycle paths ( $p=0.22$ ; increase of 104%) Children (ages NR), helmet use (after vs before) when: Alone ( $p<0.0001$ ; increase of 179%) With other children ( $p=0.22$ ; decrease of 23%) With adults ( $p=0.66$ ; increase of 30%)	—

BA, before and after study (with no control group); NR, not reported.

programs, delivered over the course of a school year<sup>18</sup> or covering a wide range of injury prevention areas on the road, as well as in the home and the outdoors,<sup>22</sup> reported statistically significant changes in children's behaviour and attitudes towards safety in the outdoors.<sup>18–22</sup> Statistically significant changes in children's playground safety attitudes were also reported following programs that used an oral presentation and activities to focus on particular aspects of risky playground behaviour<sup>21</sup> and by using a video about risky playground behaviour that was designed to evoke fear.<sup>34</sup> Statistically significant changes in a range of safety behaviours on farms were reported following an oral presentation and activities.<sup>29</sup> However, there was no evidence of effect on parents' behaviour following a program that used a video about garden safety.<sup>33</sup>

The effect of programs on changes in children's knowledge about safety in outdoor environments is highly mixed and, unfortunately, does not allow any pattern related to a program type to be discerned. However, it should be noted that, of the 12 studies that measured knowledge outcomes, the study using the most rigorous comparative design (a cluster RCT, rated '+ +') reported no evidence of effect regarding children's knowledge about preventing falls in the outdoors following delivery of the Risk Watch program.<sup>28</sup>

Few outcomes were measured in a manner that would inform decision making about the impact of outdoor injury prevention programs on health inequalities. One study reported a statistically significant improvement in water safety knowledge in the lower socioeconomic groups following a program involving an oral presentation and a safety village.<sup>30</sup> A further study reported no significant difference in attitudinal measures following a peer-delivered education program for children aged 13–17 years who had a combination of academic and social problems.<sup>19</sup> Also, few studies reported any differences in the effect of programs in boys and girls. Given the greater incidence and severity of unintentional injuries in boys, which further increase with age,<sup>3</sup> this is a significant gap in the evidence base.

The paucity of robust study designs used to evaluate the programs included in this systematic review significantly limits the extent to which outcomes can be attributed to the delivery of information, advice or education in the programs concerned. In

this review, 13 of the 23 included studies were appraised as being methodologically weak ('-'). In addition, intermediate outcome measures (such as safety behaviour, attitude and knowledge) were often followed up only a short period after the delivery of the program, limiting the extent to which the evidence base provides robust support for a particular course of action. The heterogeneity of the outcome measures used in the studies included in this review inhibited statistical synthesis of effect size, necessitating a narrative synthesis of the included studies' findings.

The body for whom this systematic review was conducted did not issue final guidance due to the lack of effectiveness evidence and the potential for interventions to decrease physical activity and play (<http://www.nice.org.uk/guidance/index.jsp?action=byID&o=12066>). However, the methodological issues

### What is already known on this subject

There is some evidence from studies conducted up to the year 2000 that suggests that interventions to reduce unintentional injuries to children in leisure environments can be effective. However, up-to-date evidence on the effectiveness of educational interventions that target child injuries in the outdoors has not been systematically reviewed and synthesised.

### What this study adds

There is evidence that suggests that more extensive educational programs (such as health fairs and media campaigns) increase use of protective equipment. However, the methodological weaknesses of relevant studies substantially limit the basis for policy making. To better inform policy and practice, future research should use robust study designs and not rely on short-term proxy outcome measures.

identified in the included studies can inform the design of future studies in the field. Methodological weaknesses, in particular, the high number of studies that did not include a control group (11 of the 23 included studies used BA designs), suggest that researchers in the field either have a limited knowledge of a robust study design or lack the resources to implement them. Furthermore, the prevalence of proxy outcomes (safety behaviour, attitude and knowledge) measured in the short term by the included studies suggests a belief by researchers that these are sufficient for evaluation. The synthesis presented here strongly suggests that proxy outcome measures are not sufficient to inform guidance about the effectiveness of programs. To better inform guidance, future research in the field should

- ▶ adopt an experimental approach, with randomised allocation of participants to intervention and control groups;
- ▶ use primary outcome measures of interest (eg, injury rates, classified according to acknowledged injury classification systems) rather than proxy and self-reported outcomes;
- ▶ measure long-term outcomes (eg, at periods of 6 months or more following the intervention);
- ▶ report results by gender, ethnic group and socioeconomic group so that guidance on interventions that reduce inequalities in health can be better informed.

**Acknowledgements** The authors thank Louise Crathorne (PenTAG) for assisting in abstract screening and Kate Boddy (PenCLAHRC) for conducting the web searches. Feedback from the Centre for Public Health Excellence (National Institute for Health and Clinical Excellence) analysts on the original systematic review was gratefully received.

**Funding** This review was part of a series of reviews on the prevention of unintentional injuries to children commissioned by the Centre for Public Health Excellence, National Institute for Health and Clinical Excellence (UK). The views expressed here are those of the authors and do not necessarily represent those of the National Institute for Health and Clinical Excellence.

**Competing interests** None.

**Patient consent** No human subjects were involved in this study (a systematic review).

**Contributors** M P led and contributed to all stages (screening, quality appraisal, data extraction and synthesis) of the original systematic review and drafted the manuscript. H H conducted screening, quality appraisal and data extraction and contributed to the narrative synthesis of studies. R G conducted screening, checking of quality appraisal and data extraction and provided methodological input. T M developed and conducted the search strategy. J P provided statistical advice and designed and conducted statistical pooling. R A provided methodological input. All authors contributed to the critical revision of the manuscript. M P is a guarantor and has full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the analysis.

**Provenance and peer review** Not commissioned; externally peer reviewed.

## REFERENCES

1. Peden M, Oyegbite K, Ozanne-Smith J, et al. *World report on child injury prevention*. Geneva: WHO, 2008.
2. **European Environment Health Information System**. *Mortality in children and adolescents from unintentional injuries*. Copenhagen, Denmark: World Health Organization, 2007.
3. **Healthcare Commission and Audit Commission**. *Better safe than sorry: preventing unintentional injury to children*. London: Audit Commission, 2007.
4. Mytton J, Towner E, Brussoni M, et al. Unintentional injuries in school-aged children and adolescents: lessons from systematic review of cohort studies. *Inj Prev* 2009;**15**:111–24.
5. **Department of Trade and Industry**. *24th (final) Report of the Home and Leisure Accident Surveillance System: 2000, 2001 and 2002 Data*. London: Department of Trade and Industry, 2003.
6. **Accidental Injury Task Force**. *Preventing accidental injury—priorities for action*. 2002.
7. Cameron D, Bishop C, Sibert JR. Farm accidents in children. *BMJ* 1992;**305**:23–5.
8. Dowswell T, Towner E. Social deprivation and the prevention of unintentional injury in childhood: a systematic review. *Health Educ Res* 2002;**17**:221–37.
9. DeRoo LA, Rautiainen RH. A systematic review of farm safety interventions. *Am J Prev Med* 2000;**18**(4 Suppl):51–62.
10. Hartling L, Brison RJ, Crumley ET, et al. A systematic review of interventions to prevent childhood farm injuries. *Pediatrics* 2004;**114**:E483–96.
11. Bruce B, McGrath P. Group interventions for the prevention of injuries in young children: a systematic review. *Inj Prev* 2005;**11**:143–7.
12. Towner E, Dowswell T, Mackereth C, et al. *What works in preventing unintentional injuries in children and young adolescents: an updated systematic review*. London: Health Development Agency, 2001.
13. Ashton K, Moxham T, Frier J, et al. *Systematic reviews of effectiveness and cost-effectiveness of road and street design-based interventions aimed at reducing unintentional injuries in children*. 2009. <http://www.nice.org.uk/nicemedia/live/11975/44735/44735.pdf>.
14. Pearson M, Garside R, Moxham T, et al. Preventing unintentional injuries to children in the home: a systematic review of the effectiveness of programmes supplying and/or installing home safety equipment. *Health Promotion International* 2011;**26**(3): 376–92.
15. **National Institute for Health & Clinical Excellence**. *Methods for the development of NICE public health guidance*. 2nd edn. London: National Institute for Health & Clinical Excellence, 2009.
16. Jackson R, Ameratunga S, Broad J, et al. The GATE frame: critical appraisal with pictures. *Evid Based Med* 2006;**11**:35–8.
17. Frederick K, Barlow J. The Citizenship Safety Project: a pilot study. *Health Educ Res* 2006;**21**:87–96.
18. Frederick K, Bixby E, Orzel MN, et al. An evaluation of the effectiveness of the Injury Minimization Programme for Schools (IMPS). *Inj Prev* 2000;**6**:92–5.
19. Tenn L, Dewis ME. An evaluation of a Canadian peer-driven injury prevention programme for high-risk adolescents. *J Adv Nurs* 1996;**23**:329–37.
20. Heck A, Collins J, Peterson L. Decreasing children's risk taking on the playground. *J Appl Behav Anal* 2001;**34**:349–52.
21. Morrongiello BA, Mark L. "Practice what you preach": induced hypocrisy as an intervention strategy to reduce children's intentions to risk take on playgrounds. *J Pediatr Psychol* 2008;**33**:1117–28.
22. Azeredo R, Stephens-Stidham S. Design and implementation of injury prevention curricula for elementary schools: lessons learned. *Inj Prev* 2003;**9**:274–8.
23. Greene A, Barnett P, Crossen J, et al. Evaluation of the THINK FIRST FOR KIDS injury prevention curriculum for primary students. *Inj Prev* 2002;**8**:257–8.
24. Asher KN, Rivara FP, Felix D, et al. Water safety training as a potential means of reducing risk of young children's drowning. *Inj Prev* 1995;**1**:228–33.
25. Moran K, Stanley T. Toddler drowning prevention: teaching parents about water safety in conjunction with their child's in-water lessons. *Int J Inj Contr Saf Promot* 2006;**13**:254–6.
26. Terzidis A, Koutroumpa A, Skalkidis I, et al. Water safety: age-specific changes in knowledge and attitudes following a school-based intervention. *Inj Prev* 2007;**13**:120–4.
27. Richards JS, Hendricks C, Roberts M. Prevention of spinal cord injury: an elementary education approach. *J Pediatr Psychol* 1991;**16**:595–609.
28. Kendrick D, Groom L, Stewart J, et al. "Risk Watch": cluster randomised controlled trial evaluating an injury prevention program. *Inj Prev* 2007;**13**:93–8.
29. McCallum DM, Conaway MB, Drury S, et al. Safety-related knowledge and behavior changes in participants of farm safety day camps. *J Agric Saf Health* 2005;**11**:35–50.
30. Gielen AC, Dannenberg AL, Ashburn N, et al. Teaching safety: evaluation of a children's village in Maryland. *Inj Prev* 1996;**2**:26–31.
31. Wehner DE, Sutton L. An interactive, hospital-based injury prevention program for first-, second-, and third-grade students. *J Emerg Nurs* 2005;**31**:383–6.
32. Wesner ML. An evaluation of Think First Saskatchewan: a head and spinal cord injury prevention program. *Can J Public Health* 2003;**94**:115–20.
33. Mayer JP, Anderson C, Gabriel K, et al. A randomized trial of an intervention to prevent lawnmower injuries in children. *Patient Educ Couns* 1998;**34**:239–46.
34. Morrongiello BA, Matheis S. Addressing the issue of falls off playground equipment: an empirically-based intervention to reduce fall-risk behaviors on playgrounds. *J Pediatr Psychol* 2007;**32**:819–30.
35. Forjuoh SN, Schuchmann JA, Mason S. Impact of community efforts to promote helmet use among Central Texas children engaged in four types of wheel-related leisure activities. *Tex Med* 2004;**100**:56–62.
36. Solis GR. Evaluation of a children's safety fair. *Pediatr Nurs* 1991;**17**:255–8.
37. Bennett E, Cummings P, Quan L, et al. Evaluation of a drowning prevention campaign in King County, Washington. *Inj Prev* 1999;**5**:109–13.
38. Treser CD, Trusty MN, Yang PP. Personal flotation device usage: do educational efforts have an impact? *J Public Health Policy* 1997;**18**:346–56.
39. D'Argenio P, Cafaro L, Santonastasi F, et al. Capodanno Senza Danno: the effects of an intervention program on fireworks injuries in Naples. *Am J Public Health* 1996;**86**:84–6.



## Review protocol

### Interventions to prevent unintentional injury to children during outdoor play and leisure

PH Programme or PH Intervention process:	<b>INTERVENTION</b>
Name of Programme or Intervention:	<b>Preventing unintentional injuries among under 15s: outdoor play and leisure</b>
Programme Report No.:	<b>N/A</b>
CPHE Collaborating Centre:	<b>PenTAG</b>
Project led by:	<b>Mark Pearson</b>  <b>Research Fellow</b>  <b>01392 403056</b>  <a href="mailto:mark.pearson@pms.ac.uk">mark.pearson@pms.ac.uk</a>
CPHE Associate Director	<b>Simon Ellis</b>
CPHE Lead Analyst	<b>Peter Shearn</b>
CPHE Support Analyst	<b>Hilary Chatterton</b>
CPHE Technical Advisor	<b>Lesley Owen</b>



## 1. Contents

Title

Review team

Key deliverables and dates

Purpose of this document

Clarification of scope

Review questions

Populations

Interventions/activities that will be covered

Reports

Reviews: Aims, key review questions and key outcomes

## 2. Title

### **Long title:**

A systematic review of the effectiveness and cost-effectiveness of interventions which provide information, advice and education to prevent unintentional injuries among children and young people aged under 15 during outdoor play or leisure outside

### **Short title:**

Preventing unintentional injuries among under 15s: outdoor play and leisure

### 3. Review team

This project will be conducted by a team from PenTAG. The team members, and their roles on the review, will be:

Dr Mark Pearson, Research Fellow	Lead systematic reviewer. Project managing the delivery of the various parts of the project. Making key methodological choices within the systematic review of effectiveness studies, and the review of evidence about barriers and facilitators. Screening, appraisal and data extraction of included studies. Writing and editing drafts and final report.
<i>TO BE APPOINTED IN SEPTEMBER,</i> Associate Research Fellow	Second systematic reviewer. Screening, appraisal and data extraction of included studies. Writing and editing drafts and final report.
Dr Ruth Garside, Senior Research Fellow	Lead systematic reviewer for review of barriers and facilitators. Making key methodological choices within the review of qualitative studies (into barriers and facilitators). Screening, appraisal and data extraction of included studies. Writing and editing drafts and final report.
Tiffany Moxham, Information Specialist	Developing and conducting any formal searches (web-based, grey literature) for relevant reports. Writing up any relevant report methods sections.
Dr Rob Anderson, Deputy Director (PenTAG) and Senior Lecturer in Health Economics	Overall responsibility for delivery to NICE, ensuring report meets agreed protocol, discussing and agreeing with NICE any divergences from protocol. Leading any original economic analysis, and leading the systematic review of cost-effectiveness evidence. Writing and editing drafts and final report.

#### 4. Key deliverables and dates

<b>Deliverable</b>	<b>Date (2009 unless otherwise indicated)</b>	<b>Comments back from NICE CPHE by:</b>
1 <sup>st</sup> Draft review protocol	18 <sup>th</sup> August	25 <sup>th</sup> February
Revised review protocol	27 <sup>th</sup> August	28 <sup>th</sup> August
Draft search protocol & search strategy	1 <sup>st</sup> September	4 <sup>th</sup> September
Signing-off of review protocol	1 <sup>st</sup> September	
Signing-off of search protocol	8 <sup>th</sup> September	
Signing-off of search strategy	11 <sup>th</sup> September	
Interim progress meeting/ teleconference (1) – Including discussion of the feasibility, value and focus of a review of barriers and facilitators and any economic modelling	9 <sup>th</sup> October	
Interim progress meeting/ teleconference (2) – Including discussion of the nature of the emerging evidence and issues to do with how best to summarise and synthesise it	30 <sup>th</sup> October	
Draft Reports (Report 1: Reviews of effectiveness and cost-effectiveness studies, with draft evidence statements)	22 <sup>nd</sup> December	12 <sup>th</sup> January 2010
Draft Report <sup>1</sup> (barriers & facilitators)	22 <sup>nd</sup> December	12 <sup>th</sup> January 2010
Draft Report <sup>2</sup> (economic modelling)	22 <sup>nd</sup> December	12 <sup>th</sup> January 2010
Final Reports (main reviews with final evidence statements)	Midday 26 <sup>th</sup> January 2010	
Final report (Report 2 and Report 3: barriers & facilitators, and economic modelling)	Midday 26 <sup>th</sup> January 2010	

---

<sup>1</sup> Where a review of barriers and facilitators is agreed to be feasible and useful, via discussion between the Collaborating Centre and the relevant lead analyst and associate director at CPHE (see Interim progress meeting (1))

<sup>2</sup> Where an original economic analysis is agreed to be feasible and useful, via discussion between the Collaborating Centre and the relevant lead analyst and associate director at CPHE (see Interim progress meeting (1)). If no economic analysis is deemed to be feasible or useful, the timelines for the other reviews may be renegotiated.

PHIAC 1 <sup>st</sup> meeting	12 <sup>th</sup> February 2010	
-------------------------------	--------------------------------	--

## 5. Purpose of this document

This document describes the aims, scope and main methods of the evidence reviews and economic analyses which will be produced by the Collaborating Centre to support the development of related NICE Public Health Guidance.

Unless otherwise stated in this Review Protocol, these reviews and analyses, and the reports to summarise them, will be conducted according to the 1st Edition of the *Methods for the development of NICE public health guidance* (2006).

## 6. Clarification of scope

This protocol covers evidence reviews of the effectiveness, cost-effectiveness and barriers and facilitators, relating to interventions aimed at preventing unintentional injury to children and young people (aged under 15) during outside play and leisure. In addition, it describes the proposed approach to economic modelling related to this topic.

## 7. Review Questions

**Question 1a:** How effective are the different approaches to providing information, advice and education about safety and risk?

**Question 1b:** How cost-effective are the different approaches to providing information, advice and education about safety and risk?

**Question 2:** What are the barriers to, and facilitators of, the different approaches to providing information, advice and education about safety and risk?

## 8. Populations

### 8.1. Groups that will be covered

- Children and young people aged under 15, particularly those living in disadvantaged circumstances (for example, with families on a low income or with a lone parent).



- Parents and carers of children and young people aged under 15, particularly those living in disadvantaged circumstances, where their children are the focus of research or where they are targeted by interventions aimed at reducing unintentional injury in their children.

## 8.2. Groups that will not be covered

Anyone aged 15 or older (unless they are the parents of targeted children).

## 9. Interventions /activities that will be covered

### 9.1. Activities/measures that will be covered

In parallel with this guidance for outdoor play and leisure, NICE will also be developing public health guidance (also developed using the intervention development process) to prevent unintentional injuries on the road and in the home. There will also be public health guidance (developed through the programme guidance process) focusing on the broader strategies, policies, and regulatory or legal frameworks which aim to prevent unintentional injuries in children.

The present guidance will complement these publications and will focus on:

**Interventions aimed at reducing injuries in designated outdoor play and leisure spaces** (for example, playgrounds and skateboard parks) and **other non-designated external environments** (for example, canals, construction sites, fields and farmyards).

It covers **the provision of information, advice and education on:**

- safety and risk** (including risk assessment), and/or
- safety clothing and protective equipment.**

The provision of information may be delivered via one or more of the following approaches (either separately or combined):

- one-to-one or group-based verbal information (planned or opportunistic)

- print media (for example, leaflets, posters and other printed information)
- new media: such as the Internet (including social networking sites), email and text messaging
- mass-media campaigns<sup>3</sup>

## 9.2. Activities/measures that will not be covered

- Play and leisure activities at home.
- Play and leisure activities on roads or pavements (including any bicycle helmet mass-media campaigns already covered by studies in the PDG 6 Programme review).
- Policy and legislation covering safety education, equipment and inspection standards.
- Design or modification of the physical environment, including environmental or engineering solutions to improve safety.
- Workforce training, support and capacity-building in relation to preventing unintentional injuries in children and young people under 15.
- National, regional or local media campaigns that focus on implementing or enforcing safety legislation, regulation and standards (which should be covered in the PDG 6 Programme review)
- Safety education that does not cover unintentional injury prevention related to play and leisure activities.
- Formal, competitive sports (where supervising adults are likely to be present).

---

<sup>3</sup> Mass media campaigns are considered to be communication plans that use mass media to share messages with target audiences. Several media channels, such as television, radio, print, direct postal mail, and increasingly, the internet and other electronic media, may be used. Those which support strategies, policies and regulatory or legal frameworks, which will be covered by PDG6 of the PUIC Programme, will not be included.

- Any interventions which involve the provision of safety clothing and protective equipment, (unless they are delivered along side information, advice and education as outlined in Section 9.1).

## 10. Reports

It is envisaged that three reports will be produced for this project. The division of resources for the production of each of the reports will be finalised in discussion with the relevant lead analyst and associate director at NICE CPHE in accordance with what is deemed feasible and useful, and this is one of the main purposes of the planned interim progress meetings.

**Report 1.** Systematic reviews of the effectiveness and cost-effectiveness of educational interventions to prevent unintentional injuries among under 15s: outdoor play and leisure.

This will include two systematic reviews (one of effectiveness studies, and one of economic evaluations and cost analyses).

**Report 2.** A systematic review of qualitative studies relevant to understanding barriers to and facilitators of effective interventions to prevent unintentional injuries among under 15s: outdoor play and leisure (if it is to be included as a separate systematic review)

**Report 3.** Modelling to evaluate the cost-effectiveness of educational interventions to prevent unintentional injuries among under 15s: outdoor play and leisure

This will include an economic analysis of one or more types of intervention (again, if deemed feasible and useful).

Methods for these three reports are outlined below.

## **11. Reviews: Aims, key review questions and key outcomes**

### **11.1. Report 1: Systematic review of effectiveness and cost-effectiveness studies**

#### **11.1.1. Aim**

To identify, critically appraise, summarise and synthesise evidence relating to the effectiveness and cost-effectiveness of the specified types of interventions aimed at reducing unintentional injuries in children and young people aged under 15 during outdoor play and leisure.

#### **11.1.2. Key review questions**

##### **Review 1: effectiveness**

- a. What is the effectiveness of the different approaches to providing information, advice and education about safety and risk aimed at reducing injuries to children during outdoor play and leisure?
- b. What are the factors which either enhance or reduce the effectiveness of different approaches to providing information, advice and education about safety and risk aimed at reducing injuries to children during outdoor play and leisure? (examples might include the impact of training, methods and intensity of delivering the intervention, differential impact by class, age, ethnicity etc.)

##### **Expected outcomes**

- Changes in injuries and deaths in children and young people aged under 15.
- Changes in knowledge, attitude, skills and safety/risky behaviour in relation to preventing unintentional injuries among children and young people aged under 15 outside, and their parents/carers.
- Changes in the rates of use of safety clothing or protective equipment among children and young people aged under 15 outside.



**Review 2: cost-effectiveness**

- a. What is the cost-effectiveness of the different approaches to providing information, advice and education about safety and risk aimed at reducing injuries to children during outdoor play and leisure?
- b. What are the main causal relationships which seem to explain how the different combinations of resources (and levels of costs) of these interventions are related to intended outcomes?

In addition to the outcomes for the effectiveness review, the cost-effectiveness review will also report the following outcomes of included studies:

- costs and/or resource use
- cost-benefit estimates
- cost-effectiveness or cost-utility ratios

**11.2. Report 2: Systematic review of evidence about  
'barriers and facilitators'**

Production of a separate review of barriers and facilitators is conditional upon (a) the number of studies identified for inclusion in the effectiveness and cost-effectiveness reviews (the “main reviews”); and (b) the number of qualitative studies eligible for inclusion in a “barriers and facilitators” review. The number, range, and complexity of the identified studies will be discussed at the first interim progress meeting, with regard to the feasibility of producing a separate barriers and facilitators reviews. If the production of a set of high quality reviews under each of these headings is deemed unmanageable given the time and resources available, then a separate review of barriers and facilitators will not be conducted. However, in order to still answer the “barriers and facilitators” review question – it is proposed that relevant observations from the ‘Discussion’ and ‘Conclusion’ sections of all the included effectiveness papers will be extracted as part of that review of effectiveness studies (e.g. where authors try to explain why their evaluated outcomes differed from others, or differed from what they expected).

### **11.2.1. Aim**

To identify, critically appraise, summarise and synthesise qualitative and/or quantitative evidence relating to contextual or other factors which either enhance or reduce the effectiveness of interventions which provide information, advice and education aimed at reducing injuries in designated outdoor play spaces and other external environments (for example, canals, construction sites, fields and farmyards).

### **11.2.2. Key review questions**

What are the factors which either enhance or reduce the effectiveness of different approaches to providing information, advice and education about safety and risk aimed at reducing injuries to children during outdoor play and leisure)?

## **11.3. Methods**

### **11.3.1. Identifying the literature: Overview**

A single electronic search of relevant bibliographic databases, and also selected websites, will be conducted in order to identify relevant primary research (to be supplemented by communication with experts and/or organisations involved in the relevant research or policy areas).

This main search will serve all three planned systematic reviews.

### **11.3.2. Search process and methods**

- To review published literature and relevant unpublished/grey literature in order to identify ineffective as well as effective interventions and approaches, as far as time and other resources allow.
- To include all relevant primary research that meet the inclusion criteria (see section 1.3).
- Databases to be searched and search terms will be detailed separately in the search strategy and protocol.

### 11.3.3. Study selection

Inclusion criteria (common to all reviews):

- Studies published from 1990
- Studies published in the English language
- Studies conducted in OECD countries

### 11.3.4. Criteria specific to the review of effectiveness

**Inclusion criteria:**

- Evaluations (prospective or retrospective) of interventions involving educational interventions (with or without the provision of safety equipment and protective equipment) using comparative designs (randomized controlled trials, non-randomized controlled trials, before and after studies, or natural experiments)
- Studies reporting the relevant outcomes listed in Section 11.1.2 in children (or in both adults and children but with the outcomes for children shown separately), or related to attitudes and knowledge in parents/ carers. This inclusion criteria will only be applied at full-text assessment stage. In other words, no papers will be excluded on the basis of age at the title and abstract screening stage. Where a study reports relevant outcomes related to an age range which overlaps with, but is not restricted to, the focus for this review (for example, aged 5-18 rather than under 15), it will be included only where the majority are of the appropriate age.

**Exclusion criteria:**

- Empirical studies which only document interventions and related outcomes without evidence regarding the outcomes listed in section 11.1.2 prior to or without the intervention.
- Empirical studies which do not separately report relevant outcomes for children or young people aged under 15 or in parents/carers for knowledge and attitudes outcomes (see above – this criteria will be applied at the full text stage only).

### 11.3.5. Criteria specific to the review of cost-effectiveness

#### **Inclusion criteria:**

- Full economic evaluations of relevant types of intervention, and costing studies of the relevant types of intervention conducted in OECD countries (either comparative or single intervention).

#### **Exclusion criteria:**

- Cost-of-illness studies, or other studies which do not involve assessing the costs and related benefits/effectiveness of particular interventions (or class of intervention).

### 11.3.6. Criteria specific to the review of barriers and facilitators:

#### **Inclusion criteria:**

- Primary qualitative research involving the analysis of written or spoken speech/evidence, regarding attitudes towards, or experiences of, the relevant interventions;<sup>4</sup> OR
- Quantitative or qualitative surveys of attitudes towards, or experiences of the relevant interventions.

### 11.3.7. Study selection process

Assessment for inclusion will be undertaken initially at title and/or abstract level (to identify potential papers/reports for inclusion) by a single reviewer (and a sample checked by a second reviewer of at least 10%, more if resources allow), and then by examination of full papers. Where the research methods used are not clear from the

---

<sup>4</sup> Primary qualitative research designs which use recognised methods of data collection and analysis (including, but not limited to, observational methods, interviews and focus groups for the former and grounded theory, thematic analysis, hermeneutic phenomenological analysis, discourse analysis etc. for the latter).

abstract, assessment will be based upon a reading of the full paper. Any relevant systematic reviews will be used first as a further source of references for primary studies, but where there is a recent and high quality systematic review that substantively answers an aspect of the review question(s), we shall include the review, updating and extending it if it is considered feasible to do so. All such decisions regarding the utilisation of systematic reviews will be made in consultation with the NICE CPHE team.

If there are a large number of includable studies, such that a high quality review of them all would not be feasible within the time and resources available, then studies may be excluded from the full review on the basis of the study quality and/or applicability to the UK context. The reasons for such exclusions will be discussed and agreed with the CPHE team at the interim progress meeting (9<sup>th</sup> October).

#### 11.4. Quality assessment and data extraction

All included studies for the **reviews of effectiveness and cost-effectiveness studies, and of qualitative research** will be quality assessed using the relevant quality assessment checklists in the Second Edition of *Methods for development of NICE public health guidance 2009* Quality assessment will be undertaken by one reviewer and checked by a second reviewer.

Any proposed departures from the methods manual will be discussed and agreed with the NICE CPHE Team. Data extraction and quality assessment will be conducted by a single reviewer, and checked by a second reviewer.

#### 11.5. Data synthesis and presentation, including evidence statements

Data synthesis and presentation, including evidence statements will be conducted according to the procedures outlined in the 1st Edition of *Methods for development of NICE public health guidance 2006*.

Key choices in how to synthesise the included evidence, or in how to develop evidence statements, will be discussed with the relevant analysts at CPHE.

## **11.6. Report 3: Economic analysis of a selected type of intervention**

### **(IF FEASIBLE AND USEFUL)**

#### **11.6.1. Aim**

For a selected type(s) of the defined educational intervention(s), to assess the relationship between the amounts and combinations of resources and costs, and the levels of resulting benefits and/or effectiveness (related to avoiding unintentional injuries to, and death in, children).(ie. To look at the costs and benefits of all impacts of an intervention in relation to unintentional injuries including death in children).

Also, where possible, to make assessments about whether the interventions evaluated would be judged as cost-effective from an NHS/PSS perspective (given the levels of willingness to pay for a QALY typically used by NICE to make judgements about the value for money of health technologies).

#### **11.6.2. Perspective**

The analysis will adopt a public sector perspective in relation to costs and benefits (*Methods for development of NICE public health guidance, 2006*). Wherever possible, injury-related health outcomes will be expressed in terms of QALYs or life-years gained/lost. If good data are available, and where appropriate, impacts in terms of other outcomes, such as lost school days may also be part of a broader cost-consequence approach to analysis.



## Search protocol and strategies

### Interventions to prevent unintentional injury to children during outdoor play and leisure

**This protocol relates to the search strategies for all reviews covered under the named intervention above**

Searches will be performed to find relevant primary research using a comparative design, qualitative studies, and cost-effectiveness studies. The reference lists of systematic reviews of found studies will also be utilised. Searches will be conducted in medical and social science databases along with a search for grey literature. All searches will be limited to those in English published since 1990, where possible.

#### **PART 1: Bibliographic Databases**

Selection of databases was informed by the “core and topic specific” recommendations in the *Methods for the development of NICE public health guidance 2009*. The following databases will be searched.

##### **From the “core databases”:**

- MEDLINE
- EMBASE
- PsycINFO
- Social Science Citation Index
  
- AMED
- NHS CRD databases: Database of Abstracts of Reviews of Effectiveness (DARE); NHS EED; HTA
  
- EconLit

##### **From the “topic-specific databases”:**

- EPPI Centre databases
  - (a) Bibliomap
  - (b) DoPHER
  - (c) TRoPHI
- SPORTDiscus

## Supplementary file 2 – Search strategy

- ERIC
- Campbell Collaboration Database

### Search Strategy

Search Strategies for the bibliographic databases will be based on text words and thesaurus headings applicable to the individual database. Search results will be downloaded into RefMan and de-duplicated before screening.

The Medline search strategy example below will be “translated” according to the appropriate thesaurus terms for each individual database. Where a database does not have a thesaurus or does not have a search facility to incorporate thesaurus searching, text words only will be used. All searches where possible will be limited to English language and with a publication or database entry date from 1990-current. Search strategies for EMBASE and Medline will include a “child filter”, strategies for all other databases will not include a child filter.

### Example Database Search Strategy using: Ovid MEDLINE(R) 1950-current (online version)

1. exp Leisure Activities/
2. leisure\$.tw.
3. sport\$.tw.
4. game\$.tw.
5. recreation\$.tw.
6. holiday\$.tw.
7. countryside\$.tw.
8. ((open or outdoor) adj space\$1).tw.
9. adventure\$.tw.
10. amusement\$.tw.
11. (water\$ adj2 sport\$).tw.
12. (swim\$ or div\$).tw.
13. park\$2.tw.
14. outing\$.tw.
15. (beach\$ or coast\$ or cliff\$ or seaside or (sea adj side)).tw.
16. farm\$.tw.
17. zoo\$.tw.
18. (quarry or quarries or pylon\$ or sub-station\$ or (sub\$ adj station\$)).tw.
19. (firework\$ or fair\$ or fete\$ or outdoor\$).tw.
20. ((physical or external) adj (environment or activit\$)).tw.
21. or/1-20
22. (playground\$ or (play adj area) or (play adj ground\$)).tw.
23. (skatepark\$ or (skate adj park\$)).tw.
24. (bike\$ or bicycle).tw.
25. ((play\$ or recreation) adj2 (field\$ or area\$ or pitch\$)).tw.

## Supplementary file 2 – Search strategy

26. (play\$ adj3 (building or rail\$ or construct\$)).tw.
27. (play\$ adj3 water).tw.
28. ((informal or unstructured or free) adj2 (play or play?time)).tw.
29. (game\$ adj area\$).tw.
30. (swing\$ or trampoline\$).tw.
31. (roundabout\$ or seesaw\$ or sandpit\$ or slide\$ or (climbing adj frame\$)).tw.
32. ((activity or climbing) adj (wall\$ or center\$ or centre\$ or frame\$ or net\$)).tw.
33. (skateboard\$ or roller skat\$ or roller blade\$ or in-line skat\$).ti,ab.
34. (scooter\$ or heely or heelies or (street adj glider\$1) or go?cart or (go adj cart) or goped\$).tw.
35. ((adventure or fitness or trim or leisure) adj2 trail\$).ti,ab.
36. ((cycle or bmx) adj (trail\$ or track\$)).ti,ab.
37. ((paddl\$ or swim\$ or dive or diving or dived) adj3 (lido\$ or pool\$)).tw.
38. ((paddl\$ or swim\$ or dive or diving or dived) adj3 (river\$ or pond\$ or lagoon\$ or sea or canal\$ or ocean\$ or (open adj water\$1))).tw.
39. ((dive or diving or dived) adj3 (lido\$ or pool\$)).tw.
40. (water ski\$ or wakeboard\$ or raft\$ or windsurf\$ or yacht\$ or sail or sailing or lilo\$ or canoe\$ or dingh\$ or kayak\$ or raft\$ or surf\$).ti,ab.
41. (kite adj3 fly\$3).tw.
42. (fishing or angl\$3 or climbing).tw.
43. (inflatabl\$2 or dingh\$3 or (bouncy adj castle\$1)).tw.
44. or/22-43
45. 21 or 44
46. inform\*.tw.
47. teach\*.tw.
48. learn\*.tw.
49. (lesson\$ or tuition or coach or supervis\$).tw.
50. aware\*.tw.
51. (advice or advise).tw.
52. educat\*.tw.
53. train\*.tw.
54. campaign\$.tw.
55. (program\$1 or programme\$1 or intervention\$).tw.
56. promot\*.tw.
57. skills.tw.
58. Patient Education as Topic/
59. exp Health Promotion/
60. knowledge.tw.
61. health education/

## Supplementary file 2 – Search strategy

62. School Health Services/
63. or/46-62
64. exp Mass Media/
65. mass media.tw.
66. ((public\$ or mass or digital or mobile) adj3 (campaign\$ or advert\$ or commercial or market\$)).tw.
67. social marketing.tw.
68. mass campaign\$.tw.
69. media.tw.
70. (dvd or dvds or video\$ or motion picture\$ or film or films or broadcast\$ or radio or televised or televised or movie\$).tw.
71. ((advert\$ or campaign\$ or program\$ or commercial\$) adj3 (tv or television or cable or satellite or cinema or cinemas or theatre or theatres or theater or theaters or movies or media or newspaper\$ or journal\$ or magazine\$)).tw.
72. (viral video or internet buzz or buzz device or advergam\$3 or adver?gam\$3).tw.
73. (newspaper\$ or press).mp. or magazine\$.tw.
74. (internet or website).tw.
75. (e-mail\$ or email\$ or electronic mail\$ or mailing list\$).tw.
76. (pod cast\$ or podcast\$ or blog or blogs or blogging or blogosphere).tw.
77. (open space technolog\$ or social networking or bebo or facebook or myspace or netlog or profileheaven or xanga or yahoo\$ or twitter\$ or tweet\$ or youtube or pageflakes or netvibes or habbo).tw.
78. (text messag\$ or texting or sms or short messag\$ service\$ or instant messag\$ or videomessag\$ or video messag\$ or multimedia messag\$).tw.
79. (digital adj3 (media or device\$ or platform\$ or technolog\$)).tw.
80. (wireless adj3 (media or device\$ or platform\$ or technolog\$)).tw.
81. ((digital or interactive or mobile or online or viral or buzz) adj3 (market\$ or campaign\$ or advert\$ or commercial\$)).tw.
82. (online or web or www).tw.
83. Computer-Assisted Instruction/
84. cell\$ phone\$.tw.
85. Cellular Phone/
86. (mobile adj phone\$).tw.
87. (pamphlet\$ or book\$ or literature).tw.
88. leaflet\$.tw.
89. Pamphlets/
90. Publications/
91. advert\$.tw.
92. campaign\$.tw.

## Supplementary file 2 – Search strategy

93. or/64-92
94. 63 or 93
95. Health Behavior/
96. adolescent behavior/ or child behavior/
97. risk factors/
98. Risk Assessment/
99. Risk-Taking/
100. ((safe\* or protect\*) adj2 (gear or equipment or cloth\$ or device\$)).tw.
101. eye protective devices/
102. protective clothing/
103. head protective devices/
104. equipment safety/
105. protective devices/
106. (helmet\$ or knee pad\$ or wrist guard\$ or elbow pad\$ or shin guard\$ or shin pad\$ or safety harness\$ or gum shield\$ or life jacket\$ or buoyancy aid\$ or arm band\$).tw.
107. (risk adj2 (taking or behav\$ or factor\$ or reduc\$)).tw.
108. (risk adj2 (prevent\$ or limit\$ or protect\$ or control)).tw.
109. risk reduction behavior/
110. accident proneness/
111. ((health or safety) adj2 (behaviour\$ or behavior\$)).tw.
112. harm reduction/
113. or/95-112
114. exp Child/
115. Infant/
116. Adolescent/
117. (child\$ or infan\$ or toddler\$ or pre-school\$ or preschool\$ or pre school\$ or young or youth\$ or adolesc\$ or teen\$ or paediatr\$ or pediater\$ or minor\$ or boy\$ or girl\$ or baby or babies).tw.
118. (kid\$ or minor\$ or under 15 or (under adj fifteen) or juvenile or pupil or student).tw.
119. or/114-118
120. (94 AND 113)
121. (120 and 45) AND 119
122. (animals not humans).sh.
123. 121 not 122
124. limit 123 to (english language and yr="1990 -Current")

## Part 2: Organisation web-sites and in-house databases:

Websites of the following relevant organisations will also be searched for published and unpublished research:

- Child Accident Prevention Trust (<http://www.capt.org.uk>)
- Children in Wales  
(<http://www.childreninwales.org.uk/areasofwork/childsafety>)
- Injury Observatory for Britain & Ireland  
(<http://www.injuryobservatory.net>)
- Public Health Observatory website for the South West (lead on Injuries)  
(<http://www.swpho.nhs.uk/>)
- The Royal Society for the Prevention of Accidents  
(<http://www.rospa.org>)
- Fields in Trust (FIT) (<http://www.api-play.org/NPFA-FIT>)
- Play England (<http://www.playengland.org.uk/Page.asp>)
- International Society for Child and Adolescent Injury Prevention  
(<http://www.iscaip.net/>)
- Department for Children, Schools and Families  
(<http://www.dcsf.gov.uk/>)
- All Wales Injury Surveillance Systems  
(<http://www.capic.org.uk/aande.html>)
- CERUK (current educational research in UK (<http://www.ceruk.ac.uk>)
- Healthy schools ([www.healthyschools.gov.uk/](http://www.healthyschools.gov.uk/))



## **Supplementary file 2 – Search strategy**

- Teachernet ([www.teachernet.gov.uk/](http://www.teachernet.gov.uk/))
- Maritime and coastguard agency ([www.mcga.gov.uk/](http://www.mcga.gov.uk/) )

### **PART 3: Additional Searches**

If, (as a result of PART 1 and 2 of the above strategy), it is determined that key programmes exist that could be further investigated, then additional database and/or search engine focused searches may be performed. This decision will be made in collaboration with CPHE following discussion with the relevant lead analyst and associate director, with regard to the feasibility and usefulness of further searches given the time and resources available.

### **PART 4: Citation and Reference Searching**

Where a reference is found pertaining to an includable piece of research with incomplete data or only an interim report has been identified a citation search will be conducted. The reference lists of recent (2004-2009) systematic reviews and/or key reports will be searched for potentially missed studies. Should time and resources allow further systematic review reference lists will be searched.

## Supplementary file 3 – Quality appraisal

### Interventions to prevent unintentional injury to children during outdoor play and leisure: Quality appraisal

	Asher et al. (1995)	Azaredo et al. (2003)	Bennett et al. (1999)	D'Argenio et al. (1996)	Frederick & Barlow (2006)	Frederick et al. (2000)	Forjuoh et al. (2004)	Gielen et al. (1996)	Greene et al. (2002)	Heck et al. (2001)	Kendrick et al. (1999)	Mayer et al. (1998)	McCallum et al. (2005)	Moran & Stanley (2006)	Morrongiello & Mark (2008)	Morrongiello & Matheis (2007)	Richards et al. (1991)	Solis (1991)	Tenn & Dewis (1993)	Terzidis et al. (2007)	Treser et al. (1997)	Wehner & Sutton (2005)	Wesner (2003)
Source population well described?	++	+	+	++	NR	-	-	+	NR	-	+	+	+	-	+	+	+	NR	+	++	-	-	-
Eligible population representative of the population of interest?	+	+	++	NA	NR	-	NR	+	NR	NR	+	NR	NR	-	+	+	+	NR	NR	-	NR	+	NR
Selected area represents eligible population?	+	+	-	NA	-	-	NR	++	NR	NR	++	+	-	-	+	++	+	NR	NR	-	-	+	+
Allocation to I/C arms	+	NR	NA	NA	NA	-	NA	NA	NR	NA	+	++	-	NA	-	-	-	NA	NR	-	NA	NA	+
I/C well described and appropriate?	++	+	++	+	++	++	+	++	+	+	++	++	+	+	+	++	+	+	++	++	+	+	++
Allocation concealed?	NR	NA	NA	NA	NA	-	NA	NA	NR	NA	++	NR	NA	NA	+	NR	NA	NA	NR	-	NA	NA	NR
Participants/ investigators blind to exposure and comparison?	+	NA	NA	NA	NA	NR	NA	NA	NR	NA	+	+	NA	NA	+	NR	NA	NA	NR	-	NA	NA	NR
Exposure to I/C adequate?	++	+	-	NR	NR	-	NR	NR	NR	NA	+	++	NR	NR	NA	++	+	+	NR	NR	NA	+	NR
Contamination acceptably low?	++	NR	NA	NA	+	+	NA	NA	NR	NA	++	++	NA	NA	+	+	-	NA	NR	NR	NA	NA	++
Other interventions similar in both groups?	++	NR	NA	NA	NA	-	NA	NA	NR	NA	NR	+	NA	NA	++	++	NA	NA	+	NR	NA	NA	++
All participants accounted for at study conclusion?	+	NR	-	NA	NR	++	NA	-	NR	NR	++	+	NR	++	NR	++	NA	NR	+	+	NA	NR	NR
Did the setting reflect usual UK practice?	NR	+	+	+	++	++	+	+	+	+	++	+	-	-	+	+	NA	NA	+	+	+	NA	+
Did I/C comparison reflect usual practice?	NR	+	+	+	+	++	NR	-	+	+	++	+	-	-	+	+	NA	NA	+	+	+	NA	+
Outcome measures reliable?	+	+	+	+	-	-	-	+	-	-	+	+	-	-	+	-	-	NR	+	+	-	-	+
Outcome measurement complete?	+	+	++	+	NR	+	NR	+	NR	NR	++	+	NR	+	NR	NR	+	+	+	NR	+	+	+

### Supplementary file 3 – Quality appraisal

	Asher et al. (1995)	Azeredo et al. (2003)	Bennett et al. (1999)	D'Argenio et al. (1996)	Frederick & Barlow (2006)	Frederick et al. (2000)	Forjuoh et al. (2004)	Gielen et al. (1996)	Greene et al. (2002)	Heck et al. (2001)	Kendrick et al. (1999)	Mayer et al. (1998)	McCallum et al. (2005)	Moran & Stanley (2006)	Morrongiello & Mark (2008)	Morrongiello & Matheis (2007)	Richards et al. (1991)	Solis (1991)	Tenn & Dewis (1993)	Terzidis et al. (2007)	Treser et al. (1997)	Wehner & Sutton (2005)	Wesner (2003)
Outcomes relevant?	+	+	+	++	+	+	+	++	+	+	+	+	+	+	++	+	+	-	++	+	++	+	+
Similar timing of outcome measurements in I/C groups?	++	-	+	NA	NA	++	NA	NA	++	-	+	++	NA	NA	++	++	-	-	++	+	NA	NA	++
Follow-up time meaningful?	++	-	+	++	+	++	+	-	-	-	+	+	+	-	+	+	-	-	+	+	+	+	-
I/C groups similar at baseline? If not, were these adjusted?	++	NR	NA	NA	NA	NR	NA	NA	+	NA	+	++	NA	NA	-	+	NA	NA	NR	+	NA	NA	+
Intention to treat analysis?	-	NR	NA	NA	NA	NR	NA	NA	NR	NA	++	NR	NA	NA	NR	NR	NA	NA	NR	NR	NA	NA	NR
Study sufficiently powered?	-	NR	+	NR	NR	+	NR	+	NR	NR	+	NR	NR	NR	NR	NR	NR	NR	-	+	NR	+	NR
Estimates of effect size given or calculable?	++	-	++	-	+	+	-	+	+	-	++	+	-	+	-	-	-	-	+	++	+	-	+
Analytical methods appropriate?	++	-	+	-	-	-	++	+	-	+	++	+	++	+	+	++	+	+	-	+	+	-	+
Precision/uncertainty of intervention effects given or calculable? Were they meaningful?	++	+	+	NR	NR	NR	NR	+		-	++	-	+	+	NR	NR	NR	-	-	+	+	NR	+
Study results internally valid (i.e. unbiased)?	+	-	+	-	-	+	-	+	-	-	++	++	-	-	+	+	-	-	-	+	-	-	+
Results generalisable to the source population (i.e. externally valid)?	+	-	+	-	-	+	-	+	-	-	++	+	-	-	+	+	-	-	-	+	-	-	+

**Notes:**

++ Indicates that for that particular aspect of study design, the study has been designed/conducted in such a way as to minimise the risk of bias

+ Indicates that either the answer to the checklist question is not clear from the way that the study is reported, or that the study may not have addressed all potential sources of bias for that particular aspect of study design

- Indicates aspects of study design in which significant sources of bias may persist

NR Not reported

NA Not applicable

Table5 Changes in safety behaviours following programmes

Author(s)/ Study type [quality appraisal]/ (Country)	Water	Playground	Other
<b>Oral presentation</b>			
Asher et al. <sup>25</sup> RCT [+] (USA)	2-4 yrs Safe poolside behaviour - 12 week swimming training vs. no intervention: MD +0.33*	-	-
Azeredo & Stephens-Stidham <sup>24</sup> CBA [-] (USA)	-	-	5-7 yrs - <i>intervention vs. no intervention</i> “creative problem solving (conflict resolution)”: $\chi^2=29.0$ , $p<0.01$  8-11 yrs - <i>intervention vs. no intervention</i> “creative problem solving (conflict resolution)” $\chi^2=19.6$ , $p<0.01$  Diving safety: $\chi^2=7.1$ , $p<0.01$
Heck et al. <sup>26</sup> BA [-] (USA)	-	<i>Climbing frames</i> Mean incidence of unsafe behaviour 6-7 yrs Baseline: 2.6 (range 0-6) Follow-up: 9.8 (range 5-20) 7-8 yrs Baseline: 7.6 (range 1-20) Follow-up: 4.2 (range 0-10)  <i>Slides</i> Mean incidence of unsafe behaviour 6-7 yrs Baseline: 42.5 (range 18-102) Follow-up: 35 (range 16-55) 7-8 yrs Baseline: 47.2 (range 20-102) Follow-up: 11.2 (range 3-16)	-
<b>Oral presentation + activities</b>			
McCallum et al. <sup>23</sup> BA [-] (USA)	-	-	8-13 yrs - <i>after vs. before</i> : Proximity to livestock: $p<0.001$ Travelling in all-terrain vehicles: $p<0.001$ Use of safety equipment in farm environments: $p<0.001$
<b>Video</b>			
Mayer et al. <sup>27</sup> RCT [++] (USA)	-	-	Parents' garden safety - <i>intervention vs. no intervention</i> : Pooled OR 1.43 (95% CI 0.99 to 2.08)*

**Key:**  
\* calculated by review authors  
**Abbreviation:**  
yrs - years

Table 6 Changes in safety attitudes following programmes

Author(s)/ Study type [quality appraisal]/ (Country)	Outdoors	Water	Playground
<b>Oral presentation</b>			
Azeredo & Stephens-Stidham <sup>24</sup> CBA [-] (USA)	Ages 5-9 yrs - <i>intervention vs. no intervention</i> $\chi^2$ 15.3 (p <.01)	-	-
Frederick et al. <sup>28</sup> CBA [+] (UK)	Ages 10-11 yrs - <i>intervention vs. no intervention</i> Not playing with magnifying glass: OR 2.32 (95% CI 1.20, 4.50)*	Ages 10-11 yrs - <i>intervention vs. no intervention</i> Pooled OR 1.56 (95% CI 1.29, 1.88)*	-
Moran & Stanley <sup>29</sup> BA [-] (New Zealand)	-	Parents of toddlers - <i>after vs. before</i> Pooled OR 1.58 (95% CI 1.08, 2.32)*	-
Morrongiello & Mark <sup>31</sup> cRCT [+] (Canada)	-	-	Ages 7-12 yrs Indicated change of attitude in one behaviour or more - <i>intervention vs. no intervention</i> $\chi^2$ 100.37 (p<0.001)  Hierarchical regression of predictors of decreases in risk-taking: Aggregate of cognition ratings (danger, vulnerability, severity) for all risk behaviours $\beta$ .65 (p<0.01)  Aggregate of cognition ratings (danger, vulnerability, severity) for targeted risk behaviours $\beta$ .88 (p<0.01)
Tenn & Dewis <sup>33</sup> CBA [-] (Canada)	13-17 yrs - <i>intervention vs. no intervention</i> No significant difference between intervention and control groups on any of the seven attitudinal measures	-	-
<b>Oral presentation + promotional materials</b>			
Terzidis et al. <sup>30</sup> CBA [+] (Greece)	-	Kindergarten children - <i>intervention vs. no intervention</i> MD +23.64% (95% CI +4.48%, +42.79%)  Elementary school children - <i>intervention vs. no intervention</i> MD +5.64% (95% CI -11.47%, +22.77%)  High school children - <i>intervention vs. no intervention</i> MD +6.32% (95% CI -1.87%, +14.52%)  (Ages NR)	-

Author(s)/ Study type [quality appraisal]/ (Country)	Outdoors	Water	Playground
<b>Video</b> Morrongiello & Matheis <sup>32</sup> cRCT [+] (Canada)	-	-	<p>Ages 6-10 yrs – <i>intervention (poster exercise and video) vs. control (poster exercise only)</i></p> <p>Proportion rejecting targeted risk behaviours 60% (p&lt;.01)</p> <p>Proportion rejecting risk behaviours not targeted by the intervention 29% (p&lt;.01)</p> <p>Risk-taking score (moderate risks) MD -1.04 (SD 1.89, t 10.17, p&lt;0.01)</p> <p>Risk-taking score (high risks) MD -1.49 (SD 2.50, t 7.01, p&lt;0.01)</p> <p>Hierarchical regression of predictors of decreases in risk-taking: Fear and vulnerability regarding moderate risk behaviours R<sup>2</sup> change 0.25 (p&lt;0.001)</p> <p>Fear and vulnerability regarding high risk behaviours R<sup>2</sup> change 0.26 (p&lt;0.001)</p>
<b>Health fair</b> Solis <sup>34</sup> BA [-] (USA)	Ages 10-13 yrs - <i>after vs. before</i> Helmet-wearing, on 5-point scale: MD +0.17*	<p>Ages 4-6 yrs - <i>after vs. before</i>  Swimming with friends, on 5-point scale:  MD +0.44*</p> <p>Ages 10-13 yrs - <i>after vs. before</i>  Diving alone, on 5-point scale:  MD +0.28*</p>	-

**Key:**  
\* calculated by review authors

**Abbreviations:**  
NR - not reported  
yrs – years



Table 7 Changes in safety knowledge following programmes

Author(s)/ Study type [quality appraisal]/ (Country)	Water	Brain & spinal cord anatomy and injuries	Other
<b>Oral presentation</b>			
Azeredo & Stephens-Stidham <sup>24</sup> CBA [-] (USA)	Ages 5-9 yrs - <i>intervention vs. no intervention</i> $\chi^2$ 17.6 (p <.01)	-	Ages 5-9 yrs - <i>intervention vs. no intervention</i> General outdoors: $\chi^2$ 22.6 (p <.01)
	Ages 10-14 yrs - <i>intervention vs. no intervention</i> $\chi^2$ 9.9 (p <.01)		Warning signs: $\chi^2$ 13.4 (p <.01)
Frederick et al. <sup>28</sup> CBA [+] (UK)	Ages 10-11 yrs - <i>intervention vs. no intervention</i> Pooled OR 0.90 (95% CI 0.52, 1.56)*	-	-
Frederick & Barlow <sup>36</sup> BA [-] (UK)	Ages 6-7 yrs - <i>after vs. before</i> OR 3.24 (95% CI 0.63, 16.84)*	-	Ages 6-7 yrs - <i>after vs. before</i> Fireworks: OR 1.53 (95% CI 0.25, 9.53)*
Greene et al. <sup>35</sup> CBA [-] (USA)	Age 6 yrs - <i>intervention vs. no intervention</i> MD +18.7*	Age 6 yrs - <i>intervention vs. no intervention</i> MD +18.3*	Age 6 yrs - <i>intervention vs. no intervention</i> Playground & sports: MD +1.5*
	Age 7 yrs - <i>intervention vs. no intervention</i> MD +22.2*	Age 7 yrs - <i>intervention vs. no intervention</i> MD +13.6*	
	Age 8 yrs - <i>intervention vs. no intervention</i> MD +12.8*	Age 8 yrs - <i>intervention vs. no intervention</i> MD +19.3*	
Tenn & Dewis <sup>33</sup> CBA [-] (Canada)	-	-	Ages 13-17 yrs - <i>intervention vs. no intervention</i> General outdoors: MD -3.0*
<b>Oral presentation + promotional materials</b>			
Terzidis et al. <sup>30</sup> CBA [+] (Greece)	Ages 4-6 yrs - <i>intervention vs. no intervention</i> MD +17.40% (95% CI +6.41%, +28.39%)	-	-
	Ages 6-12 yrs - <i>intervention vs. no intervention</i> MD +14.58% (95% CI -3.05%, +32.21%)		
	Ages 12-15 yrs - <i>intervention vs. no intervention</i> MD -0.15% (95% CI -5.30%, +4.99%)		
<b>Oral presentation + activities</b>			
Kendrick et al. <sup>39</sup> cRCT [++] (UK)	-	-	Ages 7-10 yrs - <i>intervention vs. no intervention</i> Falls: OR 0.48 (95% CI 0.21, 1.10)
Richards et al. <sup>38</sup> CBA [-] (USA)	-	Correct answers in intervention group: Preschool Pre 58% Post 80%	-
		Ages 6-7 yrs Pre 68% Post 92%	
		Ages 8-9 yrs Pre 66% Post 90%	
		Ages 10-11 yrs Pre 62% Post 82%	

Author(s)/ Study type [quality appraisal]/ (Country)	Water	Brain & spinal cord anatomy and injuries	Other
<b>Oral presentation + safety village</b>			
Gielen et al. <sup>37</sup> BA [+] (USA)	Ages 7-8 yrs - <i>after vs. before</i> Lower SES group Pooled OR 2.01 (95% CI 1.01, 4.01)*  Higher SES group Pooled OR 1.65 (95% CI 0.73, 3.76)*	-	Ages 7-8 yrs - <i>after vs. before</i> Warning signs: Lower SES group Pooled OR 3.37 (95% CI 2.46, 4.62)*  Higher SES group Pooled OR 1.88 (95% CI 1.35, 2.62)*
<b>Oral presentation + video</b>			
Wehner & Sutton <sup>17</sup> BA [-] (USA)	Increase in knowledge - <i>after vs. before</i> Ages 6-7 yrs 22%  Ages 7-8 yrs 16%  Ages 8-9 yrs 12%	-	-
Wesner <sup>19</sup> CBA [+] (Canada)	-	Ages 11-13 yrs - <i>intervention vs. no intervention</i> Pooled OR 2.02 (95% CI 1.27, 3.23)*	-
<b>Mass media</b>			
Bennett et al. <sup>20</sup> BA [+] (USA)	Parents - <i>after vs. before</i> Awareness of drowning prevention campaign messages: Pooled OR 2.76 (95% CI 1.68, 4.52)*	-	-

**Key:**  
 \* - calculated by review authors

**Abbreviation:**  
 yrs - years