REVIEW ARTICLE

Preventing childhood unintentional injuries — what works? A literature review

T Dowswell, EML Towner, G Simpson, SN Jarvis

Abstract

***Aim*—The aim of this paper is to report on a systematic review of the world literature to provide information about the most effective forms of health promotion interventions to reduce childhood (0–14 years) unintentional injuries. The findings are of relevance to policy makers at a local or national level, to practitioners and researchers.**

***Methods*—The relevant literature has been identified through the use of electronic databases, hand searching of journals, scanning reference lists, and consultation with key informants.**

***Results*—Examples of interventions that have been effective in reducing injury include: bicycle helmet legislation, area wide traffic calming measures, child safety restraint legislation, child resistant containers to prevent poisoning, and window bars to prevent falls. Interventions effective in changing behaviour include bicycle helmet education and legislation, child restraint legislation, child restraint loan schemes, child restraint educational campaigns, pedestrian education aimed at the child/parent, provision of smoke detectors, and parent education on home hazard reduction. For the community based campaigns, the key to success has been the sustained use of surveillance systems, the commitment of interagency cooperation and the time needed to develop networks and implement a range of interventions. Education, environmental modification and legislation all have a part to play and their effect in combination is important.**

***Conclusion*—The design of evaluations in injury prevention needs to be improved so that more reliable evidence can be obtained. Better information is needed on process, so that successful strategies can be replicated elsewhere. There is also a need for literature reviews on effectiveness to be updated regularly and for their findings to be widely disseminated to policy makers, researchers, and practitioners.**

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Throughout the developed world, child unintentional injury is a leading cause of death, serious morbidity, and permanent disability. In a number of countries, policy makers have set targets for reducing injury rates.[1–3] However, it is important to recognise that unintentional injury encompasses a range of injury types occurring in a number of settings, for example on the roads, at home, and in play/leisure environments. In different injury settings and for different injury types there may be a number of potential countermeasures that may achieve reductions in the frequency of events or in the severity of those injuries which occur. Hence, there is no single measure that would solve the injury 'problem', or any single target group on which to focus interventions. For this reason, those involved in health promotion need to know which interventions have been demonstrated to be effective.

Methods

In an earlier paper in *Injury Prevention* we examined the role of health education in injury prevention and contended that criticisms of health education were based on a narrow view of what it has contributed.[4] The present review draws on a systematic review of the world literature.[5] It is broader in remit, in that the earlier review drew on specific examples of educational interventions to illustrate the argument, whereas this review has included a larger number of studies and assesses the relative contribution of education, environmental modification, and legislation in changing behaviour and reducing injury. Relevant studies for inclusion in the present review were identified by systematic bibliographic searches, through existing reviews,[6–13] and from the reference lists of important books and articles. In addition, key 'informants' with particular expertise in aspects of child injury prevention identified further sources. Bibliographic searches were carried out through BIDS, MEDLINE, EXCERPTA MEDICA, the DHSS database, and the Social Science Research Index. Searches were also carried out at the Department of Transport and the Transport and Road Research Laboratory. Most of the studies were published in English in peer reviewed journals and were studies in which a preventive intervention had been evaluated. However, in some areas of the literature, and for some types of interventions (for example home and product design and environmental

changes) few evaluated studies have been published and what evidence there is regarding effectiveness is relatively weak. There is also some evidence from epidemiological studies that suggests strategies for prevention. These background studies are discussed within this paper because they suggest potential strategies for future evaluative work.

Given the heterogeneity of injury types, study designs, outcome measures, and statistical methods in the studies reviewed we have not attempted a meta-analysis. We have presented findings from the review in tabular form elsewhere.[5 6]

Results

THE ROAD ENVIRONMENT (TABLE 1)

In a number of developed countries, injuries on the roads are the leading cause of injury death in childhood. There is a steep social class gradient for road injuries. For example, in England and Wales children in the lowest social class (V) are more than four times as likely to die as pedestrians than children in social class I.[14] Most child pedestrian injuries occur in built up areas and rather that being concentrated in 'blackspots' they are scattered across the road network.

CHILD PEDESTRIAN AND CYCLIST INJURIES

(A) Broad land use and transport policies

The evidence from evaluated studies demonstrating links between road policy interventions and injury rates has been limited. Nevertheless, land use and transport policies have a potentially important part to play in reducing children's accidents on the roads. Children use roads and streets not only to move from place to place but also as an outdoor play area. Policies that change the road environment or affect the volume or speed of traffic have potential to affect child casualty rates. For example, removal of subsidies on public transport in London led to increased traffic volumes and increased road casualties.[15] The design of street environments also has an impact on child casualty rates. Areas with narrow streets, with no garden play areas and on-street parking, have higher casualty rates than those where children and traffic are separated.[16 17] There is also evidence that broader policies concerning land use can influence injury rates. Preston demonstrated that an increase in school size in England during the 1970s was associated with increased journey times to and from school and a corresponding increase in child casualties.[18] Such studies show the potential impact of land use and transport policies on child injury rates and there is a need for further research to measure the impact of similar policy changes. In the meantime, child road safety needs to be high on the agenda of policy makers and planners.

Table 1 Injuries in the road environment

- There is a need for more studies of the effects of land use policy changes on children's road injury rates
- Environmental modifications of the road environment have resulted in casualty reductions. More work is needed in this area
- Road safety education for parents and children may improve knowledge and behaviour, there is less evidence that such training achieves injury reductions
- Cycle helmets are associated with injury reduction and a number of interventions have achieved increased helmet wearing
- Adequate restraint of children in cars reduces injury risk. Legislation and education should ensure that all car occupants are restrained

(B) Local changes in the road environment

There is good evidence from a number of countries that changes in the road layout and, in particular, the separation of children from traffic by area wide engineering has the potential to reduce injury rates for child pedestrians, cyclists, and other vulnerable road users. Evaluations of area wide engineering schemes have been carried out in Britain, Denmark, Germany, and the Netherlands.[19-26] The interventions in different urban safety schemes have varied, ranging from simple measures to close off residential streets to traffic to complex schemes to reduce traffic speed and volume or to restructure the road environment to give priority to pedestrians (the Woonerf model). Janssen compared three levels of intervention and described casualty reductions of up to 25% from a scheme that restricted traffic volumes and speeds.[26] In the UK one demonstration project that achieved positive results was the Urban Safety Project.[21 22] This involved changes in the traffic environment in five towns. Areas with similar casualty rates were selected for interventions and these were matched with control sites. The engineering measures adopted were designed to take account of the needs of vulnerable road users and included the provision of central refuges on wide roads and sheltered parking bays to aid pedestrians. The measures in one town resulted in reductions in casualties among child cyclists and pedestrians.[23] The reduction in casualties also led to reduced accident costs and the evidence suggests that such schemes may be cost effective.

(C) Education aimed at drivers

There is relatively little evidence that driver education has achieved reductions in child casualty rates. At the same time there is evidence that drivers do not always take account of the needs of children as legitimate road users. A study by Thomson *et al* of driver behaviour showed that drivers do not adjust their speeds or alter their road position in the presence of child pedestrians.[27] Radar measurements of vehicle speeds outside school entrances by the same research team revealed that more than a third of drivers were exceeding posted speed limits, and for these drivers if a child did enter the carriageway there would be 'nothing' they could do to avoid killing or seriously injuring the child.[28] There are strong links between vehicle speeds and the severity of injuries sustained by pedestrians after collisions.[29] Campaigns aimed at reducing speed have considerable potential to save lives and

reduce the severity of injuries sustained by pedestrians. Meanwhile, more research is needed on the effectiveness of driver education campaigns.

A novel educational campaign aimed at both drivers and pedestrians in Canada has shown some positive results.[30] A multifaceted approach that included road engineering measures and school based education, encouraged drivers to yield to pedestrians signalling their intention to cross the road. The campaign encouraged 'courtesy' by both drivers and pedestrians. The interventions resulted in large increases in the number of drivers yielding right of way to pedestrians. This is one of the few campaigns that acknowledges the role of *both* drivers and pedestrians in road safety. An assumption underpinning many campaigns is that the main responsibility for an accident lies with the child.

(D) Road safety education aimed at children and their parents

Whether it is possible to train children to avoid injury on the roads is open to question. Some researchers maintain that children do not have the perceptual and motor skills necessary to negotiate difficult road crossing situations.[31] Others take a more pragmatic view and maintain that, given that children are exposed to the road environment it is necessary to equip them with at least some knowledge and skills to improve their chances of using roads safely.[32] A number of studies have demonstrated that children can increase their knowledge about the road environment. Nevertheless, few studies have achieved behaviour changes in child pedestrians and fewer still have been able to link child education campaigns with changes in casualty rates.

A campaign in the USA described by Yeaton and Bailey involving road crossing training for 5 to 9 year olds resulted in improved road crossing skills in the study group and these improvements were maintained at one year follow up.[33] However, this was a small scale study and there was no control group. Other programmes using simulated road environments have also shown improved crossing skills in groups receiving instruction.[34-38] Programmes involving observations of children crossing in real road environments have also resulted in improved crossing behaviour.[39] While it is clear that crossing roads demands a large number of skills, many of these programmes focused on single or groups of target skills, such as identifying safe places to cross or safe gaps in the traffic. It is not easy to decide whether improvement in specific skills will protect a child from injury on the roads.

Longer term campaigns aiming to improve children's road safety knowledge and behaviour at a more general level have achieved mixed results. An early evaluation of 'The Tufty Club' — a campaign aimed at preschool children and their parents — resulted in knowledge gains in one evaluation[40] but not in another.[41] Other evaluations of children's 'traffic clubs' have also produced mixed, although somewhat encouraging results. Schioldborg reported lower casualty rates for traffic club members in Norway.[42] However, the lower casualty rate in the intervention group could be explained by selective club membership. Since the 1970s similar clubs have been introduced in a number of European countries. A disturbing finding from an evaluation of a traffic club in Sweden was that club members reported more accidents than controls.[43] This finding may be explained by a reporting bias in the intervention group. Evaluations of the UK traffic club also revealed mixed findings. West *et al* report improvements in some aspects of child/parent knowledge and behaviour, but for many target skills there were small or no differences between controls and intervention groups.[44] A recent evaluation of a UK traffic club claimed casualty reductions among club members. Differences of 20% were found between intervention and control groups for accidents involving children emerging from behind parked cars. Eighty one thousand children were enrolled in the club (half of the target population of 3 year olds) and all social groups were represented.[45,46]

Findings from other large scale campaigns have also produced some encouraging results, with a number of evaluations claiming casualty reductions among children exposed to road safety mass media campaigns.[47-49] Programmes involving school based training for pedestrians have achieved some positive results including improvements in knowledge and behaviour.[50-52] School based cycle training schemes have also been shown to improve children's skills,[53,54] although there is no evidence that cycle training programmes have been associated with casualty reductions. The lack of coordination in road safety education programmes has made it difficult to evaluate the impact of school based training, mass media campaigns, and other activities on child pedestrian and cyclist injury rates. While educational campaigns aimed at children have shown positive results, it is important that effort should not be solely concentrated on this one aspect of road safety. Measures that offer passive protection to children in the road environment must run alongside campaigns aimed at making children 'street-wise'.

(E) Cycle helmets and cycle helmet campaigns

Over the past decade a large number of studies have provided evidence about the effectiveness of cycle helmets and the effectiveness of campaigns promoting their use. Useful reviews are provided by Royles[55] and Graitcer *et al*.[56] Like child road safety training, a tacit assumption underpinning the promotion of cycle helmets is that responsibility for avoiding injury lies with the cyclist rather than the driver.[57] However, there is good evidence that the majority of cyclists killed on the roads sustain head injuries[58] and that cycle helmets offer some protection from head injury, although helmets would be unlikely to protect a cyclist from death in a high velocity impact.[59] The evidence

of the relative protective effect of helmets has been the subject of debate.[60-63] Some of the protection associated with helmet wearing may be afforded by the safer riding habits of wearers, and a large number of campaigns promoting helmet wearing have taken place.[64-72] In addition, in some areas in the USA and Australia, cycle helmet legislation has been introduced and this has also been subject to evaluation.[73-81]

One of the earliest campaigns promoting cycle helmet wearing took place in Seattle in the 1980s.[60] It involved a range of agencies and educational methods and provided subsidies towards the cost of helmets. Observed helmet wearing rates increased after the campaign from 5% to 14%. While similarly positive results have been achieved in campaigns throughout Europe, North America, Australia and New Zealand, there is some evidence that increased wearing rates are achieved most easily in higher income areas[71] and in younger children rather than teenagers.[79] A description of the components and outcomes of cycle helmet campaigns is provided elsewhere.[4] Until recently there was little evidence that observed increases in helmet wearing were associated with casualty reductions. New evidence from Victoria, Australia, however, suggests that high helmet wearing rates have achieved reductions in deaths and injuries by as much as 70% after the introduction of legislation.[75-81] Although it is still too early to evaluate the total effect of legislation on injury rates, these results suggest that mandatory helmet wearing along with educational efforts to promote helmet use do reduce unintentional injury in young cyclists.

IN CAR RESTRAINT

There is no doubt that children appropriately restrained in cars are at reduced risk of serious injury and death in the event of a road traffic accident.[82 83] A large number of evaluations have focused on the effect of legislation on the use of child restraints and most have reported injury reductions as a result of changes in the law. Invariably, legislation preceded by educational campaigns is effective in increasing observed child restraint use. Nevertheless, there are still gaps in the legislation in that it frequently relates to younger children rather than all ages, and there remain large numbers of children travelling in cars either unrestrained of incorrectly restrained.[84 85] In the UK, an evaluation of front seat belt legislation revealed that children aged 11–14 travelling in the front suffered fewer fatal and serious injuries.[84] The effect on casualty rates of the introduction of legislation for rear seat belt use has not yet emerged and there remain gaps in the law.

For infants and young children educational campaigns and loan schemes have some success in promoting correct restraint. Nevertheless, findings in one UK study revealed that many young babies continue to travel on their mother's laps in the rear seat of cars, and many infants were secured in non-approved devices such as carry cots.[86] Campaigns encouraging older children to 'buckle-up' have met with mixed results.[87-91]

A number of educational campaigns have achieved changes in behaviour — that is, increased numbers of children observed travelling correctly restrained in cars. Reductions in death and injury, however, have followed the introduction of legislation and there is a strong case for extending legislation to cover all car occupants. Nevertheless legislation will not achieve its full potential while children remain inadequately restrained. Children and parents need access to approved devices at reasonable cost and restraints must be properly fitted and easy to use on every car journey. Hence supportive educational and loan schemes should also be extended.

INJURIES IN THE HOME ENVIRONMENT (TABLE 2)

For young children (between 1 and 5) most unintentional injuries occur in the environment where this group spend most of their time — at home. Children under 5 are at particular risk of deaths from fire, falls, suffocation, and strangulation, and while deaths from poisoning are rare, a large number of children suffer non-fatal injury as a result of poisoning. Like road traffic accidents there is a social class gradient for unintentional injuries in the home (particularly for burns), with children from more deprived homes being at greatest risk.[92]

(A) Safe home design

There is little direct evidence that modifications in home design have achieved injury reductions. Nevertheless, some aspects of domestic architecture are clearly hazardous and have been covered by building regulations: these include the provision of handrails on stairs and restrictions on the use of interior glazing in new built homes. To evaluate the effect of features of home design on injury there is a need for constant monitoring of home accident reports.

(B) Product design

A number of products have been associated with specific injury types and, therefore, withdrawal of certain products from the market have resulted in decreases in injuries. Sorensen describes injuries associated with particular types of domestic products — coffee makers, vacuum cleaners, and front loading washing machines — and the specific injuries resulting from their poor design.[93] Lobbying manufac-

Table 2 Injuries in the home environment

- The provision, installation, and maintenance of home safety devices (such as smoke detectors) offer potential for injury reduction. Legislation increases the number of homes protected by safety devices
- A number of home safety education campaigns aimed at children and parents have resulted in improved knowledge and some behaviour changes. There is little evidence that this approach alone has achieved injury reductions

turers and policy makers, and the subsequent withdrawal of these products led to injury reductions. Avery and Jackson summarise children's products regulated in the UK and emphasise the need for monitoring new products so that hazardous ones can be withdrawn.[94]

(C) Safety devices

Despite the fact that many safety devices are promoted as part of home safety campaigns, there is little evidence that most of these are effective in reducing injuries. While some devices such as fire guards, stairgates, and cupboard locks are associated with lower risks, there is a need for further research on the efficacy of safety devices, such as cooker guards which may introduce new hazards.[98] Smoke detectors have been evaluated in a number of studies discussed below.

(D) Parent and child home safety education

A large number of studies have evaluated the impact of home safety education. Some focus on a range of target injuries,[96-108] whereas others have targeted single injury types such as burns and scalds, poisoning, or falls from windows.[109-141] The results of such educational campaigns have been mixed. An early study by Colver in the UK involving home visits and targeted advice from health visitors alongside a mass media campaign led to the majority of intervention families making a change to remove or reduce the effects of a hazard in their homes.[99] Similarly, a study by Dershewitz evaluating the effect of counselling and the provision of free devices resulted in some changes being made but the absolute number of hazards in the homes of both intervention and control families remained high.[98] These studies illustrate the difficulties of measuring 'hazard reduction'. The way that particular hazards relate to injury risk is unclear, and interpreting the results of such campaigns is, therefore, not simple. An early campaign focusing on a single injury — falls from windows — achieved positive results. It is one of the few home injury campaigns achieving injury reductions among its outcomes.[110] As part of that campaign free window guards were provided to 4200 families and a 35% decrease in mortality from falls was reported for the study area. Other single focus campaigns achieving successful outcomes include the promotion of smoke detectors. Campaigns which involved providing, installing, and maintaining these devices were more likely to achieve positive outcomes than those where individuals had to buy, install, and maintain them themselves.

Smoke detector legislation has been associated with injury reductions[120] and such legislation, along with appropriate support and education, is likely to achieve the best results. A large number of studies have also focused on campaigns aimed at reducing scald injuries from domestic hot water. Again, the conclusion seems to be that campaigns that provided, installed, and maintained devices were more likely to achieve outcomes such as observed reductions in tap water temperatures. Nevertheless, there is evidence that some devices promoted as part of safety campaigns are not practicable in everyday use. Waller *et al*[137] and Fallat and Rengers[138] report on campaigns where devices were ineffective or not compatible with heating systems in many households. Mass media campaigns aimed at burn prevention have been shown to achieve some gains in knowledge but have not been associated with reductions in injury.[115] Claims that burn injury reduction was achieved as a result of a large scale campaign in Denmark are unconvincing.[120] While the authors did show a reduction in burn admissions, the lack of control group meant that it was not possible to conclude that the reductions were attributable to the programme.

For poison prevention the extension of regulations concerning the safe packaging of medicines and hazardous substances have been successful in reducing deaths and hospital admissions among young children. However, regulations are patchy and many poisons remain unregulated. Sibert *et al* have also revealed that voluntary codes of practice for safe product packaging are of limited value.[132] Many substances continue to be dispensed in unsafe packaging. A campaign in South Africa encouraging the safe storage of paraffin achieved a reduction in paraffin ingestions.[136] This study showed that providing families with a free, fairly effective safety device, achieved positive results. Nevertheless, 'safe' packaging is not a panacea. Many poisoning incidents involve regulated products. Walton has noted that 'child resistant' is not childproof, and safer packaging does not reduce the need for safe storage of poisons and adequate supervision of young children at risk from poisoning.[140] There is no evidence that poison labelling deters young children and a study evaluating 'Mr Yuk' stickers found that children were attracted to labelled containers rather than repelled by them.[141]

THE LEISURE ENVIRONMENT (TABLE 3)

There have been few evaluations of programmes aiming to reduce unintentional injury in the leisure environment despite the fact that large numbers of children are injured each year playing and participating in sport. Drowning is a major cause of unintentional injury death in England and Wales and among children over 5 (and particularly boys) these submersion injuries are likely to occur in leisure environments, especially in open waterways.[142] Teaching children to swim seems to offer some protection.[143] Whether this protective effect

Table 3 Injuries in the leisure environment

- There have been few evaluated studies of interventions in the sport and play environment
- Teaching older children to swim reduces the risk of drowning
- Protective devices are available for many sports. Many have not been formally evaluated although they show potential to reduce injury

extends to younger children is more controversial as it has been suggested that teaching these children to swim may lead to greater exposure and poorer supervision by parents. There have been no large scale trials comparing injury in children exposed to swimming training programmes. The provision of guards on beaches and popular swimming areas have been associated with reductions in drowning deaths.[144 145] Although there has been no trial comparing guarded and unguarded pools, the very small number of drowning deaths in public pools in England and Wales suggests that trained lifeguards do offer some protection against drowning. Of course, this may be because supervised children take fewer risks and the potential for drowning incidents is reduced. However, Kemp and Sibert suggests that the relatively high ratio between drowning and near drowning events suggests that prompt resuscitation by pool guards also saves lives.[142]

Barriers for domestic ponds and pools have been shown to reduce injury deaths in Australia and the USA.[146-155] Above, rather than in-ground pool design, also reduces the risk of young children wandering into pools. Legislation in favour of pool barriers has been estimated to reduce domestic pool deaths by half.[155] Despite the fact that pool barriers are of known efficacy, a study by Wintemute and Wright revealed that the majority of domestic pool owners were not in favour of legislation but favoured first aid training instead.[149] Such findings underline the need for any legislative changes to be backed by educational campaigns to raise awareness of the relative efficacy of different approaches and to create a climate of opinion in favour of legislation.

A large number of children are injured each year playing. There are a number of possible countermeasures for play and sports injuries including policy changes, environmental improvement, the provision of safety devices, and child and parent education.

The section on road injury emphasised that the street environment doubles as a play area for children, and policy changes that reduce the volume and speed of traffic in residential streets have the potential to reduce child injuries. There have been few evaluated studies examining the impact on child casualty rates of interventions such as closing off streets to provide 'play streets'.

Similarly, there has been no reported evaluation of the impact of environmental changes in playgrounds, and although playground equipment and surfaces have been associated with injury, there are no before and after trials with different types of equipment. While public opinion seems to favour shock absorbing surfaces in playgrounds, there is no study of the relative effect of different surfacing materials on injury rates. King and Ball suggest that the concentration on surfaces rather than equipment or simple overcrowding is based on a misconception about the scale and severity of head injuries after playground falls.[156] An evaluated intervention in the USA however, did achieve reductions in hazardous equipment in playgrounds.[157]

There is little evidence that child and adult education result in reductions in play and leisure injuries, although there is evidence that lack of supervision and poor motor control in children are associated with injury.[158]

There is a need for greater investigation of the value of a number of protective devices used in sporting activities. While helmets are of known value for horse riders[159] there is a need for further surveillance in other sports.[160]

COMMUNITY BASED CAMPAIGNS

A number of studies have targeted all injury types and all age groups as part of community based injury prevention campaigns.[161-172] These are discussed in more detail by Popay and Young[9] and Towner *et al.*[5] Many programmes are still underway and longer term follow up is needed. Nevertheless, some studies have produced changes in knowledge and behaviour in the target populations. Several studies have also claimed injury reductions, although the lack of adequate controls make these claims difficult to interpret.[171 172] A factor underpinning successful community based programmes has been good local injury surveillance data to stimulate local interest and to evaluate the impact of campaigns. Interagency collaboration is essential to develop different elements of a local campaign and time is needed to develop the networks and range of local programmes.

Conclusions

What works in child injury prevention? While legislation, environmental changes, and education each have a part to play to reduce injury in children and young adolescents the most successful interventions seem to be those where the three approaches are combined. For example, legislation or education promoting the use of infant car restraints achieve increases in the use of correct restraints. However, the evidence suggests that education alone achieves more modest gains and that legislation without education means that the law is not observed or that car restraints are used inappropriately.

In the road environment changes in land use and transport policy show potential to reduce child injuries. However, the evidence from evaluated interventions remains scarce. Environmental changes at the local level have been associated with injury reductions. Education aimed at the child and parent have been shown to increase knowledge and to improve some aspects of behaviour. It is less clear whether these changes translate into injury reductions. There is little evidence that training young cyclists protects them from injury, although encouraging them to wear cycle helmets seems worthwhile as helmet wearing has been linked with injury reductions. Car restraints protect children inside cars and there is a need for legislation to be extended to cover all car occupants. At the same time, parent and child education is necessary to ensure that children are adequately restrained on all journeys.

In the home environment, those campaigns focusing on a single injury type seem to produce the most successful outcomes. Where a simple, effective device is available and provided free to families the potential for injury reduction is great (for example smoke detectors, safe containers for hazardous products, or window bars). More general campaigns have more limited success, with modest increases in knowledge, some behaviour changes, but little evidence of injury reduction.

In the leisure environment there is a need for more evidence regarding the value of lifeguards on beaches, although what evidence there is seems positive. Teaching older children to swim is also associated with reduced risk of drowning. For playground and sports injuries there is a need for more systematic research into the value of protective devices and to establish the degree of hazard associated with particular sports and pieces of equipment.

The early findings from community based trials suggest positive findings. The key to success is the sustained use of surveillance systems, the commitment to interagency cooperation, and time to develop networks and implement measures.

A more general conclusion regarding evaluations of programmes aimed at child injury reduction is that the quality of the research evidence is mixed and unevenly spread over different injury types. There have been relatively few randomised trials in this field (less than 20% of the studies we reviewed) and many studies have no adequate control groups. More robust experimental design tends to be limited to single measure interventions (for example cycle helmets), and to 'closed' environments such as schools and hospitals. Few studies provided sufficient detail to allow succesful interventions to be replicated. Lack of such process information also makes it difficult to understand why an intervention works in some localities but not others. Further, many studies are too small to draw any firm conclusions. Death and serious injury are relatively rare events and in most smaller scale studies 'outcome' measures other than injury (such as increases in knowledge and changes in behaviour) are used. Unless there is a clear relationship between these proxy measures and an injury outcome, it is difficult to judge whether the gains reported in campaigns are worth having.

A final conclusion is that many programmes do not address the issue of social deprivation. It is known that there is a steep social class gradient in mortality for unintentional injury. Some studies did attempt to target more deprived neighbourhoods but in most cases it is not clear whether findings would be generalisable across different social class groups.

The field of child and adolescent injury prevention is maturing rapidly and this is reflected in the rate of increase in publications. There is a continued need for literature reviews on effectiveness in injury prevention to be updated regularly and for their findings to be widely disseminated to policy makers, researchers, and practitioners.

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Editorial Board Member: brief biography

LIZ TOWNER

Liz Towner graduated with a BSc in geography from the University of Durham, UK in 1972 and obtained an MA in geography from York University, Canada in 1974. After teaching in a range of secondary schools she started working in dental health education research in the Department of Dental Health, University of Birmingham in 1980. This involved developing and evaluating dental health education programmes in school and workplace settings, which formed the basis for a PhD in 1986.

Since 1990 she has worked in childhood injury prevention research in the Department of Child Health, University of Newcastle upon Tyne. She was appointed as Senior Lecturer in Health Promotion and Executive Director of the Childhood Injury Prevention and Promotion of Safety (CHIPPS) Programme. The programme is funded by the Department of Health and Northern and Yorkshire Regional Health Authority. The focus of the research programme is on children, unintentional injury at a local and regional level, and the effects of social deprivation.

Liz Towner's research interests are measuring the prevalence of exposure to injury risk and the application of risk data in local injury prevention, effectiveness reviews in injury prevention, and evaluation of injury prevention programmes.