



# How can injuries in children and older people be prevented?

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## ABSTRACT

This is a Health Evidence Network (HEN) synthesis report on injuries in children and older people. The evidence of proven and promising strategies for the prevention of unintentional injuries in children and the older people is considerable. Legislative, environmental modification and educational approaches all have a part to play in preventing or reducing childhood injuries, and their interactive effects are encouraging. A number of interventions to reduce the incidence of falls in older people are clearly effective. Those targeting multiple risk factors are effective, although it is not possible to say which of their elements most so.

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## **Summary**

### **The issue**

Injury is a serious public health problem in Europe, with the greatest burden on the young, the older people, and those living in the most deprived circumstances. However, it is largely unappreciated as a significant public health problem. Injuries are not inevitable - they can be prevented or controlled. The causes of injury are multi-faceted and inter-related, thus calling for wide-ranging policy solutions.

### **Findings**

Legislative, environmental modification and educational approaches all have a part to play in preventing or reducing childhood injuries, and their interactive effects are encouraging.

Training and education programmes can be effective. Pedestrian skills training, which involve practical roadside experience, has proved effective. School-based traffic clubs have not been shown to be effective, but education targeted directly at parents and children have produced good evidence of behavioural change and some casualty reduction. None of the pedestrian safety programmes measured health outcomes and further evidence is needed on their effect on injury rates. Bicycle training schemes can have a positive effect in improving children's cycling behaviour. There is little research about the effects on campaigns to prevent home accidents through parent education, but it shows that they do lead to some reduction in medically attended injuries in young children or to behavioural and environmental changes.

There is some evidence of a reduction in injuries as a result of a smoke alarm distribution programmes, and overwhelming evidence in favour of bicycle helmet programmes, particularly those employing multiple-intervention strategies. Child restraint (seat-belts etc.) educational campaigns lead to their increased use, but there is no evidence for injury outcomes. There is also evidence that window bars are effective in decreasing deaths and falls.

Some evidence suggests that supportive home visits effect behavioural or environmental changes that lead to a reduction in home hazards, and the introduction of child-resistant closures has been most effective in reducing the number of children's deaths from poisoning. Area-wide safety programmes are effective in reducing accidents, particularly among child pedestrians and cyclists, while reduced-speed zones are effective in reducing both traffic speed and accidents.

Legislation - for instance, bicycle helmet laws - has proved the most powerful tool in the prevention of injury, and there is strong evidence that child safety seat laws increase restraint use and reduce injury rates.

Community-based approaches allow multiple interventions to be implemented over a period of time so that messages can be repeated in different forms and contexts and a culture of safety developed within a community.

A number of interventions to reduce the incidence of falls in older people are clearly effective. Those targeting multiple risk factors are effective, although it is not possible to say which of their elements most so. There is limited evidence that complex interventions aimed at specific combinations of risk factors are more effective than those applied as a "standard package". Promoting physical activity, balance training and exercise such as Tai Chi also lower the risk of falls and fall-related injuries in selected groups of older people. Finally, there is evidence that withdrawal of certain medications reduces falls. When used on their own, cognitive or behavioural interventions have not been shown effective in reducing falls, but many effective complex interventions include behavioural components.

Several interventions have been shown to reduce injuries to older drivers, from encouraging automatic transmission use to identifying and correcting drivers' functional problems. Other interventions are useful for reducing injuries to older pedestrians.

## **Policy considerations**

The evidence of proven and promising strategies for the prevention of unintentional injuries in children and the older people is considerable. These include:

### *In children*

- education and skills development
- promoting the use of safety devices
- supportive home visits
- modification of the environment
- product modification
- legislation, regulation and enforcement
- community-based studies.

### *In older people*

- promoting physical activity and balance training
- medication withdrawal
- modifying the environment within the home
- vision assessment and modification
- cognitive/behavioural interventions
- community-based studies

In most countries, they need to be implemented in a concerted and consistent manner at national and local levels, with an emphasis on those at most risk.

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**Introduction**

Injury is a leading cause of the global burden of disease. Injury can be defined as “any unintentional or intentional damage to the body resulting from acute exposure to thermal, mechanical, electrical, or chemical energy or from the absence of such essentials as heat or oxygen” (1).

This paper concentrates on unintentional injury and examines it in two age groups, children up to 14 years old and people over 65. Both primary measures designed to prevent the incident and secondary measures designed to reduce the impact of the injuries are included.

**Sources for this review**

This synthesis is based on the findings of published systematic reviews, some of which include only randomized controlled trials (RCTs) and others which include RCTs, other controlled trials and before-and-after studies. It also draws on other reviews and guidelines.

The databases searched were the Cochrane Library, HDA evidence base, DARE, CRD and Medline. The chief sources consulted for children were: NHS Centre for Reviews & Dissemination, 1996 (2); Roberts et al., 1996 (3); Grossman et al., 1999 (4); Rivara et al., 1999 (5); Di Guiseppi & Roberts, 2000 (6); Klassen et al., 2000 (7); Dinh-Zarr et al., 2001 (8); Victorian Government Dept of Human Services, 2001 (9); Towner et al., 2001 (10); Zaza et al., 2001 (11); Towner et al., 2002 (12); Towner & Dowswell 2002 (13); Bunn et al., 2003 (14); MacKay, 2003 (15) and Millward, 2003 (16).

The chief sources consulted for older adults were: NHS Centre for Reviews & Dissemination, 1996 (17); Gardner et al., 2000 (18); Cryer, 2001 (19); Cryer & Patel, 2001 (20); Gillespie et al., 2003 (21) and Parker et al., 2003 (22).

## **Findings – children**

### **Risk factors for injuries**

Injury is the main cause of death and a major cause of ill health and disability in children. It is also a major cost to health services across Europe. The burden of disease is substantial, especially in central and eastern Europe and the former Soviet Union (23). There are considerable variations in mortality rates among and within countries and over time. The child injury death rates in Romania, Estonia and Latvia, for example, are six times those of Sweden (24). In western Europe there have been striking declines in injury mortality rates over the last 30 years, whereas in central and eastern Europe the decline has been smaller and less consistent. The former Soviet Union saw little decrease until the mid 1990s (23).

Children are particularly vulnerable to injury because they live in a world over which they have little control (25), inhabiting an environment largely built around the needs of adults. This “political” vulnerability is compounded by children’s physical, psychological and behavioural characteristics (25). The types of injuries that children have are closely linked to their age and stage of development. Gender is also important: boys are far more likely to die by injury than girls, though the underlying mechanisms of this are not fully understood.

Injuries disproportionately affect the most vulnerable children in society. Although most countries lack data, the risk of child injury deaths rise steeply with poverty (24). The likelihood of a child being killed or injured is associated with a variety of factors, including single parenthood, low education among mothers, very young mothers, poor housing, large family size and parental drug or alcohol abuse (24). Poverty and its associated social problems increase the risk of injury (24).

No internationally comparable data exist on rates of non-fatal injuries in Europe. Studies from the Netherlands and the United Kingdom show that mortality and morbidity from injuries are severely under-reported and under-counted. A study of injuries from the Netherlands estimated that for every death from injury, there were 160 hospital admissions and 2000 accident and emergency visits (24).

Children are exposed to a wide variety of unintentional injuries: traffic accidents (pedestrian, car passenger and bicyclist), fires, drowning, falls, poisoning and others. Traffic accidents are a major cause of severe injuries in most countries while the relative importance of other causes varies.

### **Measures to address injuries to children**

To illustrate ways in which primary and secondary preventive measures have been used to address childhood injury, both separately and in combination, findings from the following areas will be discussed:

- education and skills development
- promotion of safety devices
- supportive home visits
- environmental modification
- product modification
- legislation, regulation and enforcement
- community-based studies.

#### *Education and skills development*

The value of educational programmes as a form of injury prevention has been the subject of much debate owing to the need for individuals to make changes in their own behaviour. The examples given below illustrate where education and skills development have contributed to the field of injury prevention. The effectiveness of this approach is greatly enhanced when used in combination with other strategies, such as legislation or environmental modification.

Towner et al. (10) identified five studies of Children's Traffic Clubs, which provide educational, age-appropriate material for children and parents relating to road safety knowledge, skills training and adult supervision. While school-based traffic clubs have not been shown to be effective, those targeted directly at the parent and child have produced good evidence of behaviour change and some evidence of casualty reduction.

A systematic review of evaluated interventions aimed at developing child pedestrian skills (10) identified six experimental and four operational road safety programmes for children 4–10 years old. Most of the experimental studies involved training for school-children using a variety of methods including simulated road layouts, table-top models in the classroom and training on roads. Outcome measures centred on observed behaviour or children's indication of intended crossing behaviours. Pedestrian skills training programmes have been shown to improve children's skills where these have been specifically targeted. An essential component of these is practical, roadside experience. Since none of the programmes measured health outcomes, further evidence is needed on their effect on injury rates.

In a systematic review, Towner et al. (10) identified three studies, two of which were randomized controlled trials examining the effectiveness of bicycle skills training. All were targeted at children 8–10 years old. Each of the studies used observed cycling behaviour as an outcome measure and also assessed changes in the children's level of knowledge. The results from these programmes differed widely, producing general evidence that bicycle training schemes can have a positive effect in improving children's cycling behaviour.

There is little research about the effects of campaigns to prevent home accidents. The existing research shows, however, that the campaigns lead to reductions in medically attended injuries in young children or to behavioural and environmental changes (10).

#### *Promoting the use of safety devices*

A systematic review (10) identified four studies involving the free distribution of smoke alarms, three of which targeted high-risk neighbourhoods. One study measuring health outcomes reported an 80% reduction in the annual injury rate over a four-year period. DiGuseppi & Roberts, in a review of interventions based in the clinical setting (6), identified seven randomized control trials designed to increase smoke alarm ownership. All of the schemes had an educational component and three of them offered discounts on the purchase of smoke alarms. They conclude that in programmes where families had received counselling from a clinician on home safety in conjunction with a discount voucher, smoke alarm ownership was more likely than for those who received counselling alone.

Another review (12) looked at 19 intervention studies of bicycle helmet promotion among children and adolescents, 9 in a school-based setting. Discount schemes to assist with helmet purchase were identified as an important element in encouraging helmet wearing. The evidence suggests that promotional campaigns can be effective in increasing helmet use, with the most positive effects being shown in younger children and girls. Klassen et al. (7) identified 11 community-based injury prevention programmes and reported their positive effect on helmet use. Within these programmes, the employment of multiple intervention strategies was considered an important element. The influence of peer pressure and of adult role models was noted.

A systematic review (10) identified 16 studies examining the effects of educational campaigns aimed at increasing the use of safety seats and seat belts for children. A variety of approaches were used, with all studies including an element of professional counselling to encourage use of restraints (seat-

belts etc.), supported by a range of media. Some programmes included rewards or coercion such as fines to encourage compliance. There is evidence that the campaigns led to an increase in observed restraint use, although this may not be sustained in the long term. This conclusion is supported by Grossman and Garcia (4), who report that the magnitude of positive effects from such programmes diminishes substantially one or more months after the intervention. More intensive programmes appear to produce more positive results. There is some indication that programmes may be less effective for older children. Two further reviews (6,8) conclude that education alone has a modest effect in increasing use of child restraints. This can be considerably strengthened among younger children where appropriate restraints are provided alongside guidance for their use. No evidence has been shown for injury outcomes.

There was evidence on window bars' positive effect on health outcomes, with a decrease in deaths and reported falls. In 1995, Spiegel and Lindaman (26) evaluated a community-based programme aimed at reducing the incidence of falls from high rise windows in the United States. The programme targeted all children living within the high-risk area and was conducted as a before-and-after study, without a control group. The range of interventions included individual counselling, mass media campaigns and free distribution and installation of window guards. While this intervention proved extremely effective in the original setting, its transferability would largely depend on the prevalence of high-rise housing.

Two studies have been identified aimed specifically at increasing the use of protective equipment during sports (10). The first provided and encouraged the use of mouth guards among high school rugby players in New Zealand, 61% of whom reported using them regularly with a consequent reduction in the tooth fractures. The second promoted the use of life vests among children in the United States resulting in increases from 20 to 29% in reported ownership and from 69 to 75% in use of the vests. No health outcomes were included in the latter study; however, it is well known from other studies that the use of life vest is worthwhile.

#### *Supportive home visits*

An early review of the effect of supportive home visits to families of young children, incorporating a safety audit and preventive advice, found that relatively few programmes had been adequately evaluated but the results were generally positive (3). Six studies evaluating the effect of home visits and assessments by professionals, together with targeted advice on home safety, were identified in a systematic review (10). Some of the studies also provided free safety equipment and two ran alongside national media campaigns. The results are inconclusive, but suggest that such programmes can achieve positive benefits. There is some evidence of behavioural or environmental changes reducing home hazards. In the two studies measuring injury outcomes through attendance at accident and emergency departments, no reduction was found (10).

#### *Environmental modification*

Modifying the environment to make it more "user-friendly" has become a well-regarded approach to injury prevention, benefiting not only children but all people. With approaches ranging from separate pathways for cyclists to improvements in street-lighting, environmental modification provides a real opportunity for public concerns to be addressed by local and national policy. In this way, the responsibility for injury prevention and safety is shared by the whole community.

There is good evidence that area-wide safety programmes are effective in reducing accidents and are of particular benefit to vulnerable road users such as child pedestrians and cyclists. The area-wide approach to traffic management aims to produce safer distribution and lower speed of traffic, especially on residential roads. Six studies evaluated the impact of area-wide measures on injuries in the road environment (10); two of these provided details relating to child pedestrians or cyclists. Most programmes involved a range of measures such as roundabouts, road closures and the location of central refuges. Three studies were controlled trials and three were before-and-after studies. All used traffic accident statistics as an outcome measure, in some cases over considerable periods of time. Bunn et al. (14) identified 16 controlled before-and-after studies which assessed whether traffic

calming schemes reduced crash-related deaths and injuries in all age groups, and concluded that area-wide traffic calming in towns has the potential to reduce road traffic injuries.

There is also good evidence that 30 kmph (20 mph) speed limit zones are effective in reducing both traffic speed and accidents. There is an established link between vehicle speed and the severity of pedestrian injuries. The introduction of 30 kmph speed limit zones in the United Kingdom led to local reductions of child pedestrian and cyclist accidents of as much as 70% and 48%, respectively (10). No migration of accidents to other areas was reported.

The installation of rubber or bark surfacing in playground areas is associated with a reduced rate of childhood injury, and a reduction in the height of monkey bars would also reduce injury (10). Mackay (15) identified nine studies, two of which examined engineering strategies related to landing surface and seven examined educational approaches. Only three used rigorously controlled designs and none of the studies appeared to have broadly influenced practice.

#### *Product modification*

There is considerable evidence that the introduction of child-resistant closures has been the most effective intervention in reducing the number of childhood deaths from poisoning. Fatal episodes in the United Kingdom and the United States fell by 85% following their introduction (10,27,28). A systematic review conducted for the State Government of Victoria, Australia (9) reported reductions of 45 to 60% in mortality and 60 to 90% in accident and emergency attendance based on five evaluated interventions. Limitations relate to the number of substances which use child-resistant closures. Regulations for a range of products such as refrigerators and freezers, plastic bags and cribs showed some limited evidence of injury reduction (10).

#### *Legislation, regulation and enforcement*

Legislation has proven to be the most powerful tool in the prevention of injury. For example, in a review of the effectiveness of bicycle helmets, Towner et al. (12) identified 13 studies on helmet legislation, of which 12 related to federal structures and one (New Zealand) to national legislation. Many cited a period of health promotion prior to the introduction of legislation in order to increase helmet wearing rates (in New Zealand voluntary rates of 84% in the 5–12 year age group were achieved before legislation was introduced). While 10 of the 13 studies reported on observations of helmet-wearing levels, 4 reported on health outcomes. Legislation was found to be effective in increasing rates of helmet wearing and was associated with reductions in head injuries. Four of the studies reported on whether legislation affected the levels of cycling (exposure). In one Australian study, estimated cycling exposure for teenagers decreased by 44%, a considerable reduction in activity, suggesting that compulsory wearing of helmets may discourage some bicycle use. This point is of particular importance given current concerns over low levels of physical activity among young people.

Legislation on the use of restraints (seat-belts etc.) by children travelling in vehicles was initially introduced to protect those most at risk of injury; babies and young children. In a review of the scientific evidence for five interventions designed to increase child safety seat use, Zaza et al. (11) report on 72 studies, concluding that there is strong evidence for the effectiveness of child safety seat laws in increasing levels of restraint use and reducing injury rates. Rivara (5) and Dinh-Zarr (8) report similarly, and conclude that the effect is stronger in the case of primary laws (those provide for stopping and fining drivers for non-compliance) than for secondary laws (whereby a vehicle must be stopped for a reason other than non-compliance).

#### *Community-based studies*

Unintentional injury, with its broad range of injury types and possible counter-measures, lends itself to community-based approaches. A systematic review (13) has identified ten community-based injury prevention programmes that targeted children and were evaluated using some measure of outcome.

There is increasing evidence regarding the effectiveness of community-based injury programmes. Legislative, environmental modification and educational approaches all influence childhood injury prevention and their combined effect is important. The use of multiple interventions, repeated in different forms and contexts, begins to develop a culture of safety within a community.

An important injury type where there are few interventions have been evaluated is drowning. There are many promising areas of intervention: water safety instruction, adult supervision of children, installation of isolation fences around outdoor swimming pools and legislation for pool fencing. The WHO Guidelines for safe recreational water environments provide useful summaries of the problem and range of solutions (29, 30).

## **Findings – older people**

### **Risk factors for injuries**

Most evidence on injury in older people is on the prevention of falls and traffic accidents (19). The risk of injuries in older populations includes factors both personal (for example, muscle strength and flexibility, balance, physical function, mental function, sensory impairment and medications), and environmental (such as uneven pavements, slippery surfaces, poor lighting, carpeting, steps etc.).

Falls are a major problem among older people. About 30% of people over 65 years living independently fall each year, and this figure is even higher for people in residential or acute care settings. There is an increased risk of falling with age. About 20% of falls require medical care and fewer than 10% result in fractures (21). A review of 16 studies examining risk factors for falls found that the most important were: muscle weakness, history of falls, gait deficit, balance deficit, use of assistive devices, visual deficit, arthritis, impaired activities of daily living, depression, cognitive impairment, and age over 80 (31). Several studies have shown that the risk of falling increases dramatically with number of risk factors (32).

Motor vehicle and pedestrian-related injuries affect many older people. Older drivers drive less than younger ones, but succumb to fatal accidents more often (33). Visual performance, medical problems, slowed neurological response, decreased muscle strength and range of motion, and reduced trunk and neck mobility become significant factors with age. Many medicines may impair driving ability, and a history of falling is another important risk factor (19).

### **Measures to address falls injuries**

To illustrate the primary and secondary preventive measures, the findings concerning following approaches will be discussed:

- physical activity and balance training promotion
- medication review
- dietary supplements
- vision assessment and modification
- feet and footwear review
- home modification
- promoting safety equipment and associated devices
- cognitive or behavioural interventions
- community-based studies.

*Physical activity and balance training*

Promoting physical activity, balance training and exercise is effective in lowering the risk of falls and fall-related injuries in selected groups of older people (18), as concluded in a review of RCTs of exercise as a means to prevent falls.

The WHO Health Evidence Network synthesis on fall prevention strategies studied those living in the community (at home) and those in institutions and hospitals (34), and concluded that fall prevention programmes can be effective in reducing both the number and rate of falls. For those living in the community, targeted strategies aimed at behavioural change and risk modification appear to be most promising. Multidisciplinary, multifactorial intervention programmes that include risk factor assessment, screening, and appropriate intervention have been shown to be effective. Elements of the multifactorial interventions showing some benefit are home-based, professionally prescribed exercise programmes promoting dynamic balance, muscle strengthening and walking and home visits and modifications for those with a history of falling.

Individually tailored home exercise programmes promoting muscle-strengthening and balance-retaining activities have been found to reduce falls in community-dwelling women over 80 years old (19). Professional support or interaction with a health care professional appears to be important in promoting exercise and adherence (17). Effective programmes have been administered by qualified physiotherapists, trained district nurses or trained nurses in general practice. Derivatives of the balancing exercise Tai Chi can also reduce falls in older people (21), as observed in a fifteen-week intervention (35). In contrast to this, most group-targeted exercise programmes for community-dwelling older people have not been shown to reduce falls (19,21). There is also no evidence that exercise programmes for nursing home residents — who are not at increased risk of falling — reduce falls (19). One intervention involving brisk walking in women who had had an upper limb fracture in the previous two years was found to be unbeneficial (36). Although exercise in general has many proven benefits, the optimal type, duration and intensity of exercise for falls prevention remain unclear (37).

#### *Medication review*

For all settings (community, long-term care, hospital and rehabilitation), there is a consistent association of psychotropic medication use with falls and there is evidence that withdrawal of certain medicines reduce them (37). Gillespie et al. (21) reported such a finding from a trial with 93 participants (21), where gradual withdrawal of psychotropic medication significantly reduced risk of falling but participants were reluctant to comply permanently (38). The authors suggest that a much larger trial with significant power to investigate the effects of withdrawal of various psychotropic drugs would be justified.

#### *Dietary supplements*

There is little evidence of the effectiveness of falls prevention from dietary supplements. Gillespie et al. reported on four RCTs of nutritional supplementation. Three of them evaluated the efficacy of Vitamin D supplementation on fracture prevention, both alone and with calcium (38–40), reporting falls as a secondary outcome measure, and found no strong evidence of effectiveness (21). Gray-Donald (41) studied the use of oral multiloading, high-energy, nutrient-dense dietary supplements over a twelve-week period by a group of frail elderly people with a low body mass index or recent weight loss, finding no evidence of effectiveness (21).

#### *Vision assessment and modification*

There is a significant relationship between falls and fractures and visual activity (37). Patients with visual impairments have higher rates of fall-related hip fractures, for example. Visual factors associated with two or more falls include poor visual acuity, reduced contrast sensitivity, decreased visual field, posterior subcapsular cataract and the use of nonmyotic glaucoma medication (37).

#### *Feet and footwear review*

The footwear of older people may be important in affecting their balance and stability (37). A trial in laboratory conditions found that stability was better in shoes with a thinner and harder midsole, compared with thicker training-type shoes (42).

#### *Home modification*

Extrinsic risk factors for falls and fall-related injuries include the presence of a range of hazards within the home, including loose carpets, clutter on the stairs and slippery surfaces. Interventions can include the introduction of assistive devices such as grab rails or practices such as removing objects left on the stairs. Gillespie et al. report three trials with a substantial home hazard component (21). Several studies have reported data supporting the interventions' effectiveness (43,44), but the exact mechanisms of the effect remains uncertain (21), and the level of the population's resistance to environmental modification is unknown.

#### *Promoting safety equipment and assistive devices*

There are a few studies which evaluated the effect of assistive devices such as canes and walkers in preventing falls (37, 45). Frail older people are particularly at risk of falling when getting out of bed. In acute care settings there is no conclusive evidence concerning the use of bed alarms (46) or coloured identification bracelets (47) to prevent falls in high-risk elderly patients.

The use of hip protectors has been advocated as a way of dissipating the impact of a fall and thereby reducing the chance of a hip fracture. A systematic review of 13 RCTs of hip protectors for preventing hip fractures was conducted by Parker et al. (22), five of which were cluster randomized by care unit, nursing home or nursing home ward, reporting a reduced incidence of hip fractures. A further five studies were individually randomized trials conducted in nursing or residential care settings and showed no significant reduction in hip fractures. Two individually randomized trials of community dwellers reported no reduction in hip fractures. No important adverse effects of hip protectors were reported in this systematic review. Easterbrook et al., however, report that there is some evidence that the incidence of arm fractures is higher among those wearing hip protectors (48). A disadvantage of hip protectors is that they only work when worn, and because they may be uncomfortable, reduced compliance can limit their efficacy (20).

#### *Cognitive or behavioural interventions*

Gillespie et al. (21) examined six studies which included cognitive and behavioural interventions. Four of these were part of complex interventions and two concentrated on cognitive or behavioural interventions alone: risk assessments and counselling, and a falls prevention education programme. When these interventions were used on their own they were not shown to be effective in reducing falls, but many effective complex interventions include cognitive or behavioural components.

#### *Community-based studies*

There is considerable evidence for the effectiveness of complex falls prevention programmes that target combinations of risk factors and are tailored for selected risk groups. Programmes based on falls risk-factor assessment and tailored interventions in selected groups of at-risk older people reduce falls. The assessments can be made by a variety of health professionals or volunteers in a variety of settings (19).

In one study from the Netherlands, however, van Haastregt (49) found the home visit approach was ineffective and noted that the evidence of effectiveness mostly comes from the United States (49). Details of the status of participants and the interventions' context, content and method of presentation are of utmost importance in learning which types of intervention are most effective (21).

#### *Prevention of motor vehicle related injuries*

In this section the evidence comes from a general review from Cryer (19) and Millward et al. (16). Interventions that are beneficial for older drivers include encouraging the use of automatic transmissions, designing signals and road markings for the more limited capabilities of older drivers, replacing junctions with roundabouts and provision of right turn lanes, identifying and correcting

health and physical functioning problems, encouraging eye tests every two years and giving advice on tiredness, alcohol and medicines.

Interventions to reduce risk to motor vehicle related injuries in older pedestrians can include a range of interventions such as traffic calming, low speed limits, pedestrian crossing design, reduced kerb heights and audible signals and stippled stones at crossings. More research is required in this area.

## **Gaps in the evidence**

Research is required to examine the effectiveness and cost-effectiveness of interventions across the range of injuries incurred by children and older people (16).

Some areas of childhood injury prevention have very few evaluated intervention studies. These include studies targeting the young adolescent age group and those targeting professionals or policy-makers. There are very few evaluated interventions in the areas of the prevention of sports and leisure injuries, in drowning prevention and agricultural injuries. The issue of social deprivation has increasingly been addressed in evaluated trials but there are few examples of studies comparing relative impacts on deprived and affluent communities.

More trials are needed to evaluate the effectiveness of falls prevention programmes in institutions such as nursing homes and hospitals. There is a need to investigate what subgroups of older people should be targeted, and who would benefit most from falls prevention strategies. There is also a need to identify the necessary components of multiple-intervention falls prevention programmes, which risk factors are modifiable by what methods and whether their modification reduces the rate of falls. More research is required in the area of preventing motor vehicle related injuries in older people.

## **Current debate on injury prevention**

There has been some debate in the field of injury prevention about the balance between reducing injury risk and other health effects. For example, increased cycling and walking may lead to higher levels of injury and need to be weighed against the benefits of reducing the risk of cardiovascular disease, diabetes, hypertension and other effects related to the lack of exercise.

Other areas of debate concern the implementation of research in a more widespread manner and how this can best be achieved. Involvement of stake-holders such as practitioners and policy-makers in the translation of evidence into practice may promote optimal dissemination. Incorporating the findings from qualitative and quantitative non-intervention studies into the evidence base of intervention studies may also clarify which elements of intervention work are effective for which target groups. Programmes that have been developed and evaluated in the United States and Australia, for example, may not be directly transferable to countries in the European Region, which requires its own field trials.

## **Other points to be considered**

Community-based approaches have been central to the concept of Safe Communities, which began at the First World Conference on Accident and Injury Prevention in Stockholm in 1989, and has been coordinated by the WHO Collaborating Centre at the Karolinska Institutet in Stockholm (50). Sixty-nine communities around the world have been designated as Safe Communities, where community members define the important problems and an infrastructure is developed based on partnerships and collaborations between agencies.

The European Child Safety Alliance has set out an agenda for action in the European Union (51) that includes: member state report cards to determine child injury and prevention performance, dedicated funding for child injury research, European-level policies that are evaluated, enforced and advocated as national laws, annual child safety promotions to educate the public, national and European strategic plans with injury reduction targets for child injury prevention.

This synthesis attempts to emphasize that when community and individual measures are used in combination — for example when environmental modification and legislation are combined with education and communication strategies — some of the greatest health gains can be achieved. The WHO publication *Transport Environment and Health*, for example, sets out a broader vision of road safety emphasizing the creation of safe environments and infrastructure for vulnerable road users (52). Injury prevention activities need also to consider the broader picture of maximizing health gains for the European population through increasing levels of routine physical activity. Transport and land use policies that create conditions for safer walking and cycling need to pay particular attention to the needs of vulnerable road users (53). In relation to older people, WHO offers a policy-makers' framework for action for active aging, focusing on community-based approaches to promote accessible, pleasant and affordable opportunities to be active (54).

## **Conclusions**

The gap in injury rates among within countries suggests that there is considerable potential for improvement. Thousands of deaths could be prevented if all European countries had the same injury death rates as countries with the lowest rates of injuries. What is needed is the political will to implement, enforce and sustain preventive measures. This requires promoting a culture of safety, where unintentional injuries are not accepted as inevitable but active comprehensive policies are put into place.

The evidence of proven and promising strategies for the prevention of unintentional injuries in children and older people is considerable. In most countries they need to be implemented in a concerted and consistent manner at national and local levels, with an emphasis on those most at risk. Programmes and research need funding, resources and a skilled, committed work-force to drive the process forward.

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