PUIC Review 5: FINAL REPORT

Strategies, policies and regulatory or legal frameworks and/or mass media campaigns to prevent unintentional injury to children during play and leisure in the external environment

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West Midlands Health Technology Assessment Collaboration

The West Midlands Health Technology Assessment Collaboration (WMHTAC) is an organisation involving several universities and academic groups who collaboratively undertake research synthesis to produce health technology assessments. Most of our members are based in the Public Health, Epidemiology & Biostatistics Unit, University of Birmingham, however other members are drawn from a wide field of expertise including economists and mathematical modellers from the Health Economics Unit, University of Birmingham.

WMHTAC produce systematic reviews, health technology assessments and economic evaluations for the NHS R&D HTA programme (NCCHTA), the National Institute for Health and Clinical Excellence (NICE), and for the health service in the West Midlands. WMHTAC also undertakes methodological research on research synthesis, and provides training in systematic reviews and health technology assessments.

Name of other institution(s) involved

WMHTAC work in close collaboration with the Peninsula Technology Appraisal Group (PenTAG) with respect to providing support to the NICE Centre for Publc Health Excellence (CPHE).

GLOSSARY OF KEY TERMS

Keys terms/ glossary	Definition
Banger	Firework consisting of a small explosive charge and fuse in a heavy paper casing (also referred to as firecracker or cracker
Children and young people	Those aged under 15
Compliance	"Compliance" in this protocol relates to those at whom legislation, regulation or standards are aimed. For example, in the case of fire alarms, this may be practitioners, such as fire office departments, who may be required to comply with regulation for their installation; or it may relate to parents or other carers, at whom standards about checking and maintaining the alarms are aimed.
External environment	Physical environments not part of the home or school boundary or road and street network that are used by children and young people.
Leisure	Time spent in, or free for relaxation or enjoyment
Leisure activities	Including activities in public external settings such as parks, countryside, seaside and beaches, waterparks and natural water (e.g. ponds, lakes, rivers and canals); visitor attractions such as theme parks, amusement parks, farms and zoos; skate parks, nature trails. Activities may include family outings, bike rides, swimming, bonfire and firework parties, etc
Play	" ...freely chosen, personally directed, intrinsically motivated behaviour that actively engages the child..." (Play England). This would include games and sports played informally and without adult supervision such football, cricket, rounders.
Mass Media	For the purposes of this strategic programmes guidance, advertising communications and publicity targeted at and designed to reach the whole population within a country or large region within a country. (NB. The intervention guidance, in contrast, will focus on education designed targeted at and designed to reach sub population at community and/or smaller group level.)
Mass media strategies	A strategic action to disseminate information
Strategies and regulatory or legal frameworks	Legislation (primary and secondary), regulation, standards and their enforcement
Standard	An agreed, repeatable way of doing something. It is a published document that contains a technical specification or other precise criteria designed to be used consistently as a rule, guideline, or definition. They are voluntary, but may be referred to or made compulsory by other laws or regulations. (Source: BSI)
Unsafe incidents	Near misses or non-compliance identified or defined by risk assessments that do *not* result in actual unintentional injury.

LIST OF ABBREVIATIONS

Abbreviation	Meaning
A&E	Accident and Emergency
AIS	Abbreviated Injury Score
CBA	Controlled before and after studies
CSA	Canadian Standards Association standards
CI	Confidence interval (around an estimate, for a given level of statistical significance)
CIHI	Canadian Institute for Health Information
CPHE	Centre for Public Health Excellence
EU	European Union
ICD	International Classification of Diseases
NA	Not applicable
NICE	National Institute for Health and Clinical Excellence
NR	Not reported
PenTAG	Peninsula Technology Assessment Group
TBI	Traumatic Brain Injury
TDSB	Toronto District School Board
UK	United Kingdom
USA	United States of America
WMHTAC	West Midlands Health Technology Assessment Collaboration

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1 Summary

1.1 Introduction

This project is one of five pieces of work informing NICE guidance on how to prevent unintentional injuries among children and young people aged under 15. The others are:

- Preventing unintentional road injuries among under 15s: road design. This guidance is expected to cover the design and modification of highways, roads and streets
- Preventing unintentional injuries among under 15s: home environment. This guidance is expected to cover the supply and/or installation of safety equipment and the provision and conduct of home risk assessments
- Preventing unintentional injuries among under 15s in the external environment. This guidance is expected to cover sports and leisure.
- Preventing unintentional road injuries among under 15s: education and protective equipment. This guidance is expected to cover safety equipment such as helmets and visibility clothing.

1.2 Aim

To locate, review and synthesise studies of the performance of strategies, policies and regulatory or legal frameworks and mass media campaigns for guiding, enforcing or promoting activities to manage risk and safety during play and leisure and to prevent unintentional injury to children and young people in the external environment.

The review questions were:

1. Can strategies, policies and regulatory or legal frameworks (either with or without specific activities or factors which may enforce them or encourage compliance with them), improve the planning, implementation and effectiveness of programmes/initiatives to manage risk and safety, and prevent unintentional injuries to children and young people in the external environment during play and leisure?

2. Are mass media campaigns effective as a tool to deliver information about how to manage risk and safety, to change behaviour and to prevent unintentional injuries to children and young people in the external environment during play and leisure?
3. Which other activities or circumstances are associated with greater or lower effectiveness of mass media approaches to managing risk and safety during play and leisure?
4. In what ways can strategies, policies and regulatory or legal frameworks (either with or without specific activities or factors which may enforce them or encourage compliance with them), improve the planning, implementation and effectiveness of programmes/initiatives to manage risk and safety, and prevent unintentional injuries to children and young people in the external environment during play and leisure?
5. In what ways can mass media improve the operation/effectiveness of legislation, regulation and/or standards?

1.3 Methods

CPHE methods of systematic review were used for this review. This involved the development of a pre-defined protocol containing strategies for literature searching, screening of identified studies according to inclusion and exclusion criteria, data extraction and study quality assessment. Data from the included studies were analysed but due to the heterogeneity of the data, synthesis of the results was carried out using a narrative approach, culminating in specific evidence statements.

1.4 Findings

Searches of electronic databases and other sources yielded about 17,000 references. Screening of these titles and abstracts against the inclusion/exclusion criteria resulted in the retrieval of 89 full text articles. An additional 19 full texts were retrieved due to: i) refinement of the breath of the focus to include school playgrounds, which was in response to the amount and quality of studies identified (see scope) and agreed with NICE. ii) additional suggestions/clarification from NICE and from the bibliographies of already retrieved articles.

Eventually, 46 comparative studies, mostly relating to the evaluation of bicycle helmet legislation/enforcement (26 studies) and playground standards (16 studies), were found to meet the inclusion criteria. In response to the amount and quality of studies identified and in agreement with NICE (see scope), in cases where studies from both the higher and lower spectrums of the evidence hierarchy report a particular sub-topic area of interest, those higher on the evidence hierarchy were subject to full data extraction and reporting and those from lower down the evidence hierarchy (32 studies) are listed in Appendix 6 of the report with their abstracts. A total of 14 (mostly controlled before and after) studies, covering four domains of injury prevention in the external environment among children (bicycle helmet/head injuries, playground standards, fireworks safety and drowning prevention), were thus selected for data extraction/quality assessment and subsequent evidence synthesis.

The resulting five evidence statements are on the following pages.

Evidence statement 1: Impact of legislation (with minimal or no enforcement) on bicycle helmet use and head injury

There is moderate evidence from five controlled before-and-after studies to show that legislation mandating the use of bicycle helmets for children (without enforcement) can increase compliance with helmet use and also decrease head injuries related to riding bicycles, which is the ultimate goal of such legislation (Ji et al 2006 [+]; Lee et al. 2005 [+]; Macpherson et al. 2002 [+]; Cote et al. [+]; Hagel et al. [+]).

In terms of compliance with the legislation, three CBA studies – 2 from the USA, I from Canada (Cote et al. 1992 [USA]; Hagel et al. 2006 [Canada]; Ji et al. 2006 [USA]) found that the rate in increase in helmet use for children over the study periods ranged from between 43% (Cote et al. 1992) and 84% (Ji et al. 2006) per year. In the studies by Ji et al. (2006) and Hagel et al. (2006), helmet use by adults served as comparators, while two counties without legislation served as comparators in the Cote et al. (1992) study. In the Ji et al. (2006) study, helmet use as reported by injured cyclists post-injury increased significantly amongst children post legislation (OR 1.84, 95% CI 1.48 – 2.28), with a concurrent smaller trend amongst adult controls for increased helmet wearing (OR 1.17, 95% CI 1.00 – 1.38). Results of Cote et al. showed that in crude helmet use in Howard County (intervention) was 4% at baseline and rose to 47% at follow-up, while in Montgomery County (control – educational campaign), helmet use at baseline was 8% and rose to 19% at follow-up; and in Baltimore County (no intervention), helmet use was 19% at baseline and 4% at follow-up. Results of the Hagel et al. (2006) study showed that the prevalence of helmet use amongst children increased significantly (Prevalence Ratio 2.96, 95% CI 2.22-3.94) and remained unchanged in the adult population.

Three CBA studies that assessed the impact of helmet legislation on bicycle-related head injuries - 2 from the USA, 1 Canada (Ji et al. 2006 [USA]; Macpherson et al. 2002 [Canada]; Lee et al. 2005 [USA]) all reported a significant protective effect of helmet laws on head injuries.

Applicability: The studies are deemed to only be partially applicable to the UK. This is because none of the studies was carried out in the UK and there are environmental and legislative differences between the UK and Canada/USA such as differences in cycling rates, design of bicycle paths, etc.

Evidence statement 2: Impact of police enforcement of existing legislation on bicycle helmet use

There is moderate evidence from one controlled before and after study to show that enforcement of existing legislation can increase compliance with helmet use (Gilchrist et al. 2002 [+]).

The study was conducted in rural Georgia, USA, and revealed that without enforcement, the state and local laws did not prompt helmet use in the community, as none of the 97 observed riders (adults and children) wore a helmet before the programme started. However, active police enforcement, coupled with helmet give-away and education was effective, as during the next five months, helmet use among 358 observed children averaged 45%, a significant increase ($p = 0.001$) in all race and gender groups. In contrast, adult use (which served as control) did not change significantly.

The effect of programme was not only sustained (two years after its initiation, 54% of child bicycle riders (21/39) were observed to be wearing a helmet) but may also have improved general safety behaviour/norm (during the 2-year follow-up, children were seen to be wearing bicycle helmets while participating in other activities that did not mandate them to wear them: 2 children rollerblading, all 3 children jumping on a trampoline, as well as 3 children walking along a street without bicycles.

However, it is difficult to tell if the addition of the helmet give-away and educational programmes had any confounding effects on the enforcement component; or if indeed enforcement alone motivated helmet use.

Although both the UK and the US, where this study was conducted, are at par, in terms of economic development, the evidence was judged not to be applicable to the UK scenario as bicycle helmet legislation or their enforcement do not apply in this country.

Applicability: The evidence is deemed as currently not applicable to the UK setting (as bicycle helmet legislation does not apply in the UK); however it might become applicable if bicycle helmet legislation were brought in.

Evidence statement 3: Impact of mass media campaigns on bicycle helmet use and head injury

There is moderate-to-weak evidence from two controlled before-and-after studies to show that mass media campaigns, employed as part of a broader non-legislative strategy (that involved educational programmes and purchase subsidies) were effective in increasing compliance with bicycle helmet use (Bergman et al. 1990 [+]; Lee et al. 2000 [-]. There was also moderate evidence from uncontrolled before-and-after data from one of the studies (Lee et al. 2000) that such programmes helped to reduce the rates of bicycle-related head injuries in the intervention area.

In the US study by Bergman et al. (1990), the sales of one brand of a youth helmet in the Seattle area (intervention area) rose from 1500 to 22,000 over a 3-year period (no figures stated for the control area) while observed helmet usage rate among school-age children increased from 5% to 16% compared with a rise of only 1% to 3% in a control community, Portland, Oregon, over the same period (Bergman et al. 1990)

In the UK study (Lee et al. 2000) self-reported helmet use among 11-15 years olds living in the campaign area increased from 11% at the start of the campaign to 31% after five years ($p<0.001$), with no significant change in the control group. Hospital casualty figures in the campaign area (Reading) for cycle related head injuries in the under 16 years age group, fell from 112.5/100 000 to 60.8/100 000 (from 21.6% of all cycle injuries to 11.7%; $p<0.005$). No injury data were provided for Basingstoke, the control (Lee et al. 2000)

Applicability: The evidence is judged to be directly applicable to the UK – one of the studies (Lee et al. 2000) was carried out in the UK and although the Bergman study was carried out in the US, it was embarked upon and completed before the introduction of a bicycle helmet legislation, so in a sense the settings reflected what is currently obtainable in the UK, a country without mandatory helmet wearing legislation. Furthermore, both countries are similar in terms of living standards and economic development.

Evidence statement 4: Effect of compliance with playgrounds standards on injury rates among children during play/leisure

There is mixed evidence from two controlled before and after studies that removal and replacement of unsafe equipment is an effective strategy for preventing playground injuries (Howard et al. 2005; Sibert et al. 1999) .

The Canadian study (Howard et al. 2005) demonstrated statistically non significant reduction in equipment-related injury rate in the intervention schools after replacement of equipment using the new Canadian Standards Association standards (RR=0.82 to 0.66 to 1.03). This translated into 177 equipment-related injuries avoided during the study period. The comparable equipment-related injury rate in the non-intervention schools increased by about 15% after the study period, although not statistically significant (RR=1.15; 95% CI 0.96 to 1.37). The overall injury rate reduced in the intervention schools (RR= 0.70; 95% CI 0.62 to 0.78) and increased in the non-intervention schools (RR=1.40; 95% CI 1.07 to 2.53) after the study period. However, in the UK study, injury rate per observed child was significantly reduced in the five playgrounds where changes (use of greater depth of bark and replacement of over head horizontal ladders with rope climbing frame) had been made compared to the control playgrounds without changes (Sibert et al. 1999).

Applicability: The non-UK study (Howard et al. 2005), (Canada) is only partially applicable to the current UK context due to similarities in level of economic development, nature of the playgrounds, as well as targeted populations. The Sibert et al.1999 (UK) findings are directly applicable.

Evidence statement 5: Impact of fireworks legislation on fireworks related injuries among children during outdoor play and leisure

There is weak evidence from two before and after studies (from UK and Italy) and one retrospective time series (from UK) on the effect of fireworks legislation and enforcement activities on firework related injuries.(D'Argenio et al. 1996; Edwin et al. 2008; Fogarty & Gordon 1999)

One study in Italy reported that a comprehensive, multifaceted programme, comprising the combination of enforcement of fireworks law, media campaign and education reduced the rate of fireworks related injury from 10.0/100 000 before the intervention programme to 6.1/100 000 after it was implemented (D'Argenio et al. 1996), and a time-series based study found that amendments to restrictive fireworks legislation led to a reduction of firework related injury in children (Edwin et al. 2008).

The other study from Northern Ireland, however (Fogarty & Gordon 1999), did not find a significant increase in fireworks related injuries requiring hospital admission following liberalisation of the law on fireworks sale (incidence of admissions before: 0.38/100000; after: 0.43/100000). However, the annual number of injuries in this study was already very small relative to annual variations.

Applicability: The Italian study (D'Argenio 1996, Italy) is partially applicable to current UK context while the Fogarty & Gordon 1999 and Edwin et al 2008 (UK) findings are directly applicable. However, the Northern Ireland study (Fogarty & Gordon 1999, UK) may not be directly applicable to the rest of UK because of the civil unrest reported in that part of the kingdom.

Evidence statement 6: Impact of drowning prevention campaign on life vests use and ownership among children
There is weak evidence from one before and after study (Bennett et al. 1999; Fogarty & Gordon 1999)[-]) in the USA that comprehensive, community based campaign programme (coalition support and involvement, community partnerships, sponsor relationships, news reporting and public service advertising, educational materials and interactive displays) with a focus on increasing the use of life vests, increase the use of life vest. One study from USA found a significant, although modest, increase in self reported life vest use (OR=1.6; 95% CI 1.1 to 2.5) and ownership (pre-campaign=69%; post-campaign=75%) among children aged 1 to 14 years at beaches, pools, or docks after three year drowning prevention campaign. Programmes targeting life vest use may want to consider multiple strategies that could include targeted audiences and messages by water site, increasing parent confidence in fitting a life vest, and life vest availability through discount and loan programmes. During the three years before the campaign, 12 children aged 1-14 years drowned in King County, compared with eight deaths in the campaign. Applicability: The study is deemed to be partially applicable to the UK as it was carried out in the USA a country of similar economic development and probable exposure of children to leisure activities by lakes, sea, rivers and other waterways.

2 Background

In every single industrialized country, injury has now become the leading killer of children (UNICEF 2001). The leading cause of death in children in the UK is unintentional injury, and for every child who dies, many more live with the consequences of injury (Towner & Towner 2001). Children are particularly vulnerable to injury because of their physical, psychological and behavioural characteristics. Furthermore, although children from all levels of society are vulnerable, it is known that the burden is not spread evenly, as injuries disproportionately affect the more deprived children - the social class gradient is steeper for injuries than any other cause of death.

Interventions to prevent unintentional injuries have traditionally been considered in terms of the “three E’s”: education, enforcement and engineering (MacKay et al. 2006). Thus, opportunities to prevent injuries occur through a range of educational, legislative and environmental approaches. Legislation is regarded not only as a “test of commitment to the cause of child safety” but also the most powerful tool in the prevention of injury (UNICEF 2001; WHO 2004). According to the World Health Organization, there is evidence that legislation has increased the uptake of preventive measures and reduced childhood injuries (WHO 2008b). Legislative efforts may either prevent injury-producing events from occurring in the first instance or may be designed to prevent an injury once an injury-producing event does occur (Sleet et al. 2003).

Mass media campaigns are said to be most effective when combined with enforcement, policy or incentive programs (CDC 2002). Mass media campaigns are likely to have the best effect when used to address childhood injury, due to parents’ desire to protect children (CDC 2002). Also, environmental modification and engineering can be effective in reducing the potential for occurrence of injuries. In playgrounds, for instance, impact absorbing surfaces and equipment height can reduce the severity of injuries (Towner & Towner 2001). However, injury prevention is increasingly being seen to require a combination of these approaches (WHO 2008a). Thus, legislative, environmental modification and educational approaches all have a part to play and their effect in combination is important.

With regards to injury prevention in the external environment - physical environments that are used by children during play and leisure - the need for knowledge of what works is growing every day among those working to reduce the burden of unintentional injuries amongst children. Good use of evidence is central to achieving this and knowing 'what works' should be at the heart of developing good policy and programmes. The four areas for which there is evidence (with regards to strategies, policies and regulatory or legal frameworks and/or mass media campaigns) to prevent unintentional injury to children and young people during play and leisure in the external environment, include bicycle helmet use, playground standards, fireworks safety and water safety.

2.1 Bicycle Helmet

Cycling is a very popular play/leisure activity for children and bicycle-related injuries are also common and frequently lead to hospitalization. Bicycle helmets are designed to prevent an injury when a crash event occurs and there is evidence from case control studies (MacDermott et al. 1993; Maimaris et al. 1994; Spaite et al. 1991; Thomas et al. 1994b; Thompson et al. 1989) as well as recent systematic reviews (Karkhane et al. 2006; Macpherson & Spinks 2008) that cycle helmets help prevent injuries.

Previous studies have indicated that helmet use is inversely correlated with hospital admissions and deaths from bicycle-related head injuries (CDC 1993; Mock et al. 1995; Thomas et al. 1994a) and that as many as 88% of serious brain injuries could be prevented by bicycle helmet use (Thompson et al. 1989). Despite these findings, results of a US study indicated that only 50% of child bicyclists ages 5 to 14 owned a helmet, and only 25% of them always wore it in the past month when riding, as reported by their parents and other adults (Sacks et al. 1996).

From the late 1980s, states and countries have adopted bicycle helmet legislation, mostly preceded by or in combination with comprehensive, multifaceted, school-, community- and/or mass media-based education programs (Schieber et al. 2000). Initially this occurred for certain limited age groups: for example the states of California and New York in the USA where legislation for child bicycle passengers under 5 years old was enacted in 1987 and 1989. The state of Victoria in Australia was the first state to introduce legislation for all ages of bicycle riders in July 1990 (Cameron et al. 1992; Curnow 2008). There is currently no legislation in the UK mandating bicycle helmet use,

but in 2000, the Department for Transport set a target to reduce the number of children killed or seriously injured by 50% by 2010, particularly tackling the significantly higher incidence in disadvantaged communities (MacKay et al. 2006).

2.2 Playground Standards

Play is a child's foremost activity and outdoor playgrounds are widely recognized as providing important opportunities for cognitive and motor development and the enhancement of communication and motor skills of children (Mitchell et al. 2007; Mowat et al. 1998). However, there is also evidence that playgrounds act as important locations of childhood injury, resulting in substantial trauma and medical costs. This has prompted many industrialized countries, including the UK, to introduce standards aimed at improving the safety of play equipment and thus, promote safe play for children. The British standard on play-spaces and equipment was originally published by the British Standards Institute in 1986 (BSI 1986), but this was withdrawn in 1998 and replaced by the current European Standards which apply in the UK (BS EN 1176, parts 1-6). These provide both general safe design and testing guidance as well as specific design and testing approaches for swings, slides, cableways, carousels (i.e. roundabouts) and rocking equipment.

2.3 Fireworks Legislation

Fireworks are devices designed for the purpose of producing a visible or audible effect by combustion, deflagration, or detonation (Berger et al. 1985)**.** Colourful fireworks exploding in the sky are great to watch and certainly add an extra sparkle to special events, or Bonfire Night. However, they are also explosive devices capable of inflicting great harm and are dangerous for anyone, not least children, who can take great delight in engaging with activities relating to fireworks.

But as fireworks are essentially explosive materials, there are inevitably key safety issues. The first law in the UK regarding explosives (including fireworks) was introduced in 1875 and there have been a number of firework laws since the 1990s, the most recent being the Fireworks Regulations 2004 (Edwin et al. 2008). Laws relating to fireworks safety are an example of a legislative effort that is intended to prevent injury-producing events from occurring in the first instance.

2.4 Drowning prevention campaign

Water to most children means fun, play and adventure – in a pool, pond, lake or simply in the road following a rain storm. Water, though, can be a dangerous medium. Young children are at a high risk of drowning due to their curious nature, their attraction to water without understanding the risks, and their ability to get into the water quickly and quietly without adults being aware (Beatty 2007). Most drownings in young children occur when they are playing near water.

In most countries around the world, including the UK, drowning ranks among the top three causes of death from unintentional injury, with the rates highest among children under five years of age (HIPRC 2009; WHO 2008b). Unfortunately, while many studies have been carried out on the incidence and epidemiology of drowning, with the exception of studies on pool fencing, only few studies have evaluated other intervention programs for their effectiveness (HIPRC 2009).

3 Aims and Methods

3.1 Objectives and Rationale

To locate, review and synthesise studies about the performance of *strategies, policies and regulatory or legal frameworks, and **mass media campaigns (that may or may not support strategies, policies and regulatory or legal frameworks) that aim to manage risk in children during play and leisure in the external environment.

*'Strategies, policies and regulatory or legal frameworks', will include Legislation (primary and secondary), regulation, standards and their enforcement while **mass media campaigns will include advertising and communications and publicity targeted at and designed to reach the whole population within a country or large region within a country (the intervention guidance, in contrast, will focus on education designed targeted at and designed to reach sub population at community and/or smaller group level.)

3.2 Review Questions

1. Can strategies, policies and regulatory or legal frameworks (either with or without specific activities or factors which may enforce them or encourage compliance with them), improve the planning, implementation and effectiveness of programmes/initiatives to manage risk and safety, and prevent unintentional injuries to children and young people in the external environment during play and leisure?
2. Are mass media campaigns effective as a tool to deliver information about how to manage risk and safety, to change behaviour and to prevent unintentional injuries to children and young people in the external environment during play and leisure?
3. Which other activities or circumstances are associated with greater or lower effectiveness of mass media approaches to managing risk and safety during play and leisure?
4. In what ways can strategies, policies and regulatory or legal frameworks (either with or without specific activities or factors which may enforce them or encourage compliance with them), improve the planning, implementation and effectiveness of

programmes/initiatives to manage risk and safety, and prevent unintentional injuries to children and young people in the external environment during play and leisure?

5. In what ways can mass media improve the operation/effectiveness of legislation, regulation and/or standards?

3.3 Key Outcomes

Measures of compliance with legislation, regulation, standards that are relevant to the aim of the policy/regulatory change.

Rates of unintentional injuries, severity of unintentional injuries, or number of care episodes (e.g. hospitalisations) resulting from unintentional injuries in the external environment.

Rates of relevant safety behaviours or compliance rates (e.g. number/ proportion of facilities complying with standards (e.g. playgrounds complying with EN 1176 and 1177 or Local Play Indicator 3), measures of use of safety equipment for example life-vests during activities on the water).

Knowledge of and attitudes to risk factors and safety behaviours (e.g change in risk attitude scale score, hazard recognition)

Factors impacting on compliance

3.4 Identification of Evidence

3.4.1 Search methods and search strategies

Searches were conducted in a range of medical, social science and policy databases as well as the grey literature via organisation web-sites and internet searches using the Google search engine and subject portals. The reference lists of systematic reviews were utilised to locate studies and suggestions from experts and the team at CPHE were also considered for inclusion.

All searches were limited to English language papers published between 1990 and the present.

3.4.1.1 Bibliographic Databases

3.4.1.1.1 Databases

The following databases were searched, based on the "core and topic specific" sources in the NICE methods manual. (NICE 2009)

- **From the "core databases":**

  MEDLINE (Ovid) 1950 to July Week 3 2009

  MEDLINE In Process (Ovid) & Other Non-Indexed Citations July 29, 2009

  EMBASE (Ovid) 1980 to 2009 Week 30

  Cochrane Library - Cochrane Database of Systematic Reviews Cochrane Library (Wiley) 2009 Issue 3

  CRD databases (DARE ; NHS EED; HTA)

  HMIC (Health Management Information Consortium) (Ovid) May 2009

  Social Science Citation Index (ISI Web of Science) 1990 – 2009

- **From "topic-specific databases":**

  SafetyLit 1990 - 2009

  EPPI Centre databases (Bibliomap, DoPHER and TRoPHI)

  The Campbell Collaboration 2002-2009

  SPORTDiscus (EBSCOhost) 1990 – 2009

3.4.1.1.2 Search Strategy

Search strategies for the bibliographic databases were based on text words and index terms applicable to the individual database. All search strategies are listed in Appendix 2.

The results of the searches were de-duplicated against each other before the screening process.

The searches of the core databases were restricted to children only. However as this strategy risked missing some relevant studies relating to events and activities for all age

groups, and in line with parallel pieces of work, searches of the other databases were not restricted by age or population group.

As the searches were required to find relevant primary research using a comparative design, qualitative studies and cost-effectiveness studies, no specific study design filter was applied to the search strategies. Instead studies of appropriate designs were selected during the screening by reviewers.

3.4.1.2 Organisation web-sites:

Websites of the following relevant organisations were 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)
- International Society for Child and Adolescent Injury Prevention (http://www.iscaip.net/)
- Integris (EU Injuries programme for coordinating injury data) www.rp7integris.eu/en/pages/home-1.aspx
- Eurosafe http://www.eurosafe.eu.com/csi/eurosafe2006.nsf/wwwVwContent/l2europeanchildsafetyalliance.htm
- EU Injury Database https://webgate.ec.europa.eu/idb/index.cfm?fuseaction=publicaccess
- Department for Children, Schools and Families http://www.dcsf.gov.uk/
- Scottish Executive http://www.scotland.gov.uk/Home
- Welsh Assembly Government http://wales.gov.uk/splash;jsessionid=klvyKlpK8Tp9xvNJCYPWMs6C0GgLZdDQy1lTG8fVDyMzFjJzBdVW!514291769?orig=/

- All Wales Injury Surveillance Systems http://www.capic.org.uk/aande.html

3.4.1.3 Additional Searches

Some smaller focused searches of MEDLINE were also carried out for specific named activities (snow sports, fitness trails and aerial walkways) and activities in community settings (indoors and outdoors) (see Appendix 2 for strategies).

3.4.1.4 Reference Searching

The reference lists of recent (2004-2009) systematic reviews and key reports were searched for potentially missed studies.

3.4.1.5 External contacts and supplementary references

Additional references suggested by members of the CPHE team at NICE were followed up.

3.4.2 Inclusion of Relevant Evidence

3.4.2.1 Inclusion Criteria

3.4.2.1.1 Interventions

Studies which are included are those that focused on the performance of:

- Strategies, policies and regulatory or legal frameworks, (with or without activities to enforce or encourage compliance) to improve the planning, implementation and effectiveness of programmes/initiatives to manage risk and safety, and prevent unintentional injuries.
- Mass media campaigns to manage risk and safety and prevent injury- they are not limited to legislation, regulation and/or standards.

3.4.2.1.2 Study design

Any quantitative study design (randomised and non-randomised controlled trials, before and after studies, case control studies, ecological studies, cross-sectional studies,

prospective and retrospective cohort studies) where there are comparisons within or between groups of people or places or activities.

3.4.2.1.3 Study focus

Focus on strategies, policies and regulatory or legal frameworks, and/ mass media campaigns (that may or may not support strategies, policies and regulatory or legal frameworks) that aim to manage risk and reduce injury in play and leisure.

3.4.2.1.4 Population

Children under 15 years of age, parents/carers, practitioners and organisations.

3.4.2.1.5 Language and Year

Published in the English language, from 1990 or after

3.4.2.1.6 Screening

Records retrieved from the main search of bibliographic databases were imported into a Reference manager database (18,045), which detected and excluded some of the duplicated records during importing (1112). Among 16,933 records imported, a further 583 duplicated citations were identified and removed. All titles and abstracts of the remaining records were screened by one reviewer (KA or IY) to identify potentially relevant studies. 107 potentially relevant studies were identified with a further three duplicates removed before ordering for 104 full papers or reports. Papers were also identified from the reference lists of previous systematic reviews, and other papers were identified and suggested for inclusion by the CPHE team at NICE.

Of the 104 full papers, 46 were found to be relevant after they were assessed using the inclusion/exclusion criteria described below. In response to i) the amount and quality of studies identified (see scope); ii) time and resource constraints, and iii) in agreement with NICE, in cases where a number of studies from both the higher and lower end of the quality of evidence hierarchy report on a particular programme area of interest, those higher on the evidence hierarchy were subject to full data extraction and reporting, and those from lower down the evidence hierarchy are listed in an appendix of the report with their abstracts (See Appendix 6).

3.5 Methods of Analysis/Synthesis

3.5.1 Data Extraction

For each of the included studies, one reviewer extracted data about study characteristics, methodology and results into an evidence table, modelled on those found in the NICE CPHE methods guidance (NICE 2009) and adapted where appropriate to the identified study designs.

3.5.2 Quality Assessment

Included studies were quality assessed using the quality appraisal checklist for quantitative intervention studies in the CPHE Methods Handbook (2009).

Overall assessment of internal validity and external validity were graded using a code, '++', '+' or '-', based on the extent to which the potential sources of bias have been minimised according to the Methods for the development of NICE public health guidance:

- ++ All or most of the criteria have been fulfilled. Where they have not been fulfilled the study conclusions are thought very unlikely to alter.
- + Some of the criteria have been fulfilled. Those criteria that have not been fulfilled or not adequately described are thought unlikely to alter the study conclusions.
- - Few or no criteria have been fulfilled. The study conclusions are thought likely or very likely to alter.

Quality assessment and data extraction were undertaken by a single reviewer and 10% verification was done by a second reviewer. Disagreements were discussed in order to reach a consensus.

3.5.3 Data Analysis and Synthesis

Data from included studies was analysed and synthesized, and evidence statements generated together with information on the quality and applicability of the relevant studies. Narrative synthesis was used because quantitative data pooling was not possible.

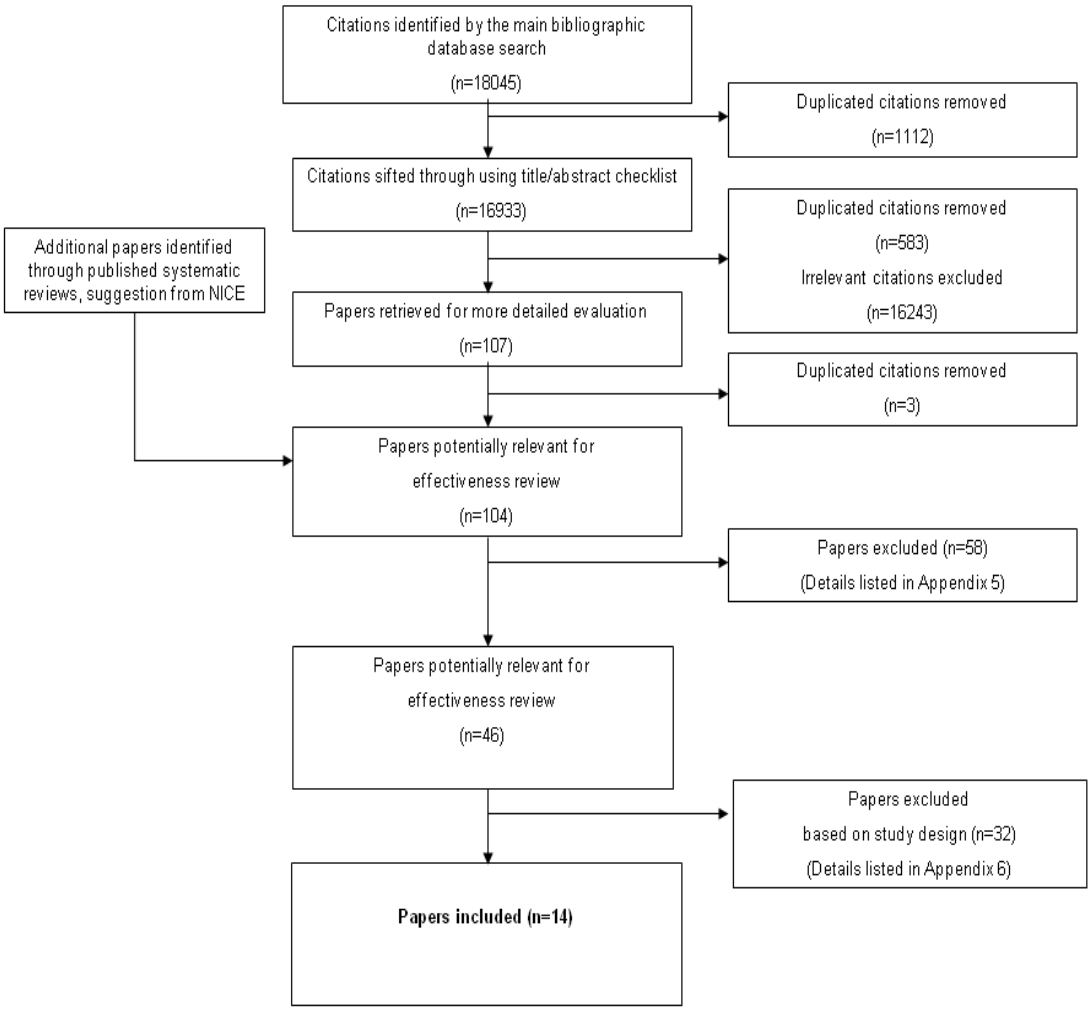
For the other relevant studies which were not included in the main review, but excluded due to non robustness of the study design, the abstract of each of the papers/reports were presented in the appendix.

4 Results

4.1 Summary of Included Studies

The process of study identification/selection is shown in Figure 1.

Figure 1: Review Flowchart



A total of 14 studies were included: eight related to the use of bicycle helmets (Bergman et al. 1990; Cote et al. 1992; Gilchrist et al. 2000; Hagel et al. 2006; Ji et al. 2006; Lee et al. 2000; Lee et al. 2005; Macpherson et al. 2002), two related to playground standards (Howard et al. 2005; Sibert et al. 1999), three related to fireworks safety (D'Argenio et al.

1996; Edwin et al. 2008; Fogarty & Gordon 1999) and one related to life vest use (Bennett et al. 1999; D'Argenio et al. 1996; Edwin et al. 2008).

The 14 studies are reported in detail below, with separate sections describing studies relating to each intervention type: bicycle helmets, playground standards, fireworks legislation and life vests. The section relating to bicycle helmets is further divided into three: impact of legislation (without enforcement); impact of enforcement in combination with other helmet promotional activities and the impact of mass media in combination with other interventions.

Each of the main sub-sections begins by providing background information on the intervention (e.g. legislation or mass media campaign and associated activities) that was evaluated; study characteristics and results are then described. Finally, these are considered in light of interpretations provided by the authors as well as key study limitations/ weaknesses.

Full details of all the studies and their methods can be found in the evidence tables in Appendix 3 and the study quality assessment can also be found in Appendix 4. Ten of the included studies were considered to be of moderate quality [+] and four of poor quality [-] following quality assessment.

4.2 Bicycle Helmets

Eight controlled before-and-after studies were identified that evaluated interventions relating to the use of bicycle helmet by children. Five of these assessed the impact of legislation (without enforcement), one study assessed the impact of enforcement of legislation (in combination with other promotional activities) and two studies assessed the impact of mass media campaigns (and other associated activities) to increase the uptake of bicycle helmets among children. Of the studies evaluating legislative efforts only, three were from the USA (Cote et al. 1992; Ji et al. 2006; Lee et al. 2005) and two were from Canada (Hagel et al. 2006; Macpherson et al. 2002); the study evaluating enforcement of helmet legislation was from the USA (Gilchrist et al. 2000); and of the two mass media campaign studies, one was from the USA (Bergman et al. 1990), and the other from the UK (Lee et al. 2000).

4.2.1 Bicycle Helmet Legislation (with minimal or no enforcement)

Five controlled before-and-after studies were identified which assessed the impact of legislation (without enforcement) among children. Key study characteristics are given in Table 1. Both the Ji et al (2006) and Lee et al. (2005) studies were set in California, which in 1993 became the sixth US state to pass a state-wide bicycle helmet law for school-age children. The legislation became effective on 1 January 1994 and required bicyclists aged 17 years and under to wear helmets.

The study by Macpherson et al. (2002) was set in Canada. At the time of the study, legislation mandating helmet use for children had been adopted in four provinces, as follows: Ontario - October 1995; New Brunswick - December 1995; British Columbia - September 1996; and Nova Scotia - July 1997.

The Cote et al. (1992) study was carried out in three counties of the US state of Maryland (Howard, Montgomery and Baltimore). In response to bicycling deaths of two children in 1989, Howard County, Maryland, on October 1, 1990, became the first jurisdiction in the USA to mandate use of bicycle helmets for persons younger than 16 years old. The police sent warning letters to parents of unhelmeted children and issued a citation after the third offence. The law also provided for fines which could be waived if a helmet was purchased. At the time of the study, the law was in effect only in Howard County.

The setting of the study by Hagel et al. (2006) was the city of Edmonton, located in the Canadian province of Alberta, where helmet legislation was implemented in 2002 for cyclists under 18 years of age.

4.2.1.1 Bicycle helmet legislation (with minimal or no enforcement): Study characteristics

Study characteristics for the five studies are shown in **Table 1** on the following page.

Table 1: **Bicycle helmets legislation (without enforcement): Study characteristics**

Reference	Aim	Method	Population	Location
Ji 2006	To evaluate the local effect of the California Helmet law on helmet use and bicycle-related head injuries in San Diego County.	Controlled before and after study. *Injured youths aged 17 years comprised the intervention group and injured adults (≥18 years) served as controls.*	All bicycle-related injury records from 1992 to 1996, obtained from a Trauma Registry in San Diego County, California.	San Diego County, California, USA.
Lee 2005	To detect any significant reductions in the proportions of head injuries among youth cyclists subject to the state-wide helmet law	Controlled before and after study. *Cases were young bicyclists (≤17 years of age) required to use helmets; controls were adults not required to do so.*	All non-fatal bicycle-related cases during 1991-2000, identified from hospital discharge records	The state of California, USA.
Macpherson 2002	To measure the impact of mandatory helmet legislation on the incidence of bicycle-related head injury among Canadian children	Controlled before and after study *Children residing in the four provinces with helmet legislation comprised the intervention group, while children from the rest of Canada served as controls.*	All children (5-19 years) hospitalized as a result of bicycle-related injuries during the period 1994-1998, identified from Canada-wide hospital discharge records.	Canada (country-wide study)
Cote 1992	To evaluate the effect of legislation and education on bicycle helmet use among Maryland children	Controlled before and after study *Howard County, with legislation in place, served as the intervention and two other counties without legislation were controls*	All bicyclists observed in the three counties on the days of data collection	Howard, Montgomery and Baltimore counties, Maryland, USA
Hagel 2006	To determine changes in helmet use in cyclists following the introduction of a bicycle helmet law for children in Alberta Province, Canada.	Controlled before and after study *Adults (≥18 years) were not subject to the legislation requirements and were therefore used as a comparative control group.*	All individuals seen to be bicycling during the baseline and follow-up observations	Edmonton City, Alberta , Canada

Ji et al. 2006

To assess the effects of the Californian state-wide helmet law in San Diego County, Ji et al. (2006) accessed bicycle-associated trauma data from the San Diego County Trauma

Registry from 1992 until 1996. Variables extracted from the registry and used in analysis included demographics (gender, age and race/ethnicity), anatomic site of injury (head or other) and injury severity (AIS score[a]), time of injury (calendar year), protective device (helmet or no helmet) [b] and outcomes (survived or expired, and discharged location). A variable for serious head injury was created; it was said to be present if the anatomic site of injury was head and the AIS score was ≥3.

As the helmet law was enacted in 1994, it was possible to recode the year of injury into two periods: pre-law (1992, 1993) and post-law (1994-1996) and because the law only applied to persons younger than 18 years of age, the variable age was recoded as a categorical variable, child (<18 years) and adult (≥18 years). Outcomes measures were reported helmet use and serious head injury.

Lee et al. 2005

The study by Lee et al. (2005) was also set in California but unlike Ji et al. (2006), the authors assessed the effects of the helmet law throughout the entire state. The authors obtained 10 years of patient discharge records from all public hospitals in California, from 1991 to 2000, and identified all bicycle-related non-fatal cases during the 10-year period. For each case, seven variables were available for analysis: year, age, injury type, cause, county of residence, race/ethnicity, and sex; no data were available on actual helmet at the time of injury. Therefore, it was only possible to examine the association of the legislation with injury outcomes.

Two age groups, two time periods, and three injury types were defined for analysis. The study cases were young bicycle users (17 years of age and under), who were required to use helmets; the controls were adults who were not required to do so. The two periods were 1991 through 1993 (pre-legislation) which provided baseline data and 1994 through 2000 (post-legislation) that provided the post-intervention data. The three injury types included two for the head – traumatic brain injuries (Head-TBI) and other injuries to the head, face, and neck (Head-Other), and one for all other injuries below the neck (Other). It was thus possible to make direct comparisons between the two age groups across the two time periods. And because, a direct measure of risk exposure (e.g. bicycle distance travelled) was not available, the proportion of each of the three injury

[a] Abbreviated injury score
[b] as reported by the injured cyclist

types to the total number of injuries per time period was used as the study outcome measure.

Macpherson et al. 2002

The Macpherson 2002 report was a Canada-wide study that compared rates of head injury in provinces with and without mandatory helmet legislation. Data on Canadian children who were hospitalized because of bicycle-related injuries during the period 1994-1998 inclusive were obtained from the Canadian Institute for Health Information (CIHI) and children with bicycle injuries were categorized as 'head injury' or 'other injury' on the basis of ICD-9 codes: all injuries to the head, face, and brain were defined as head injuries, injuries to other parts of the body were classified as other injuries.

The authors conducted their analysis using two approaches. First, tends in bicycle-related injury over time in the legislation provinces and no-legislation provinces were examined. The four provinces that adopted mandatory helmet legislation during the study period (irrespective of timing) were combined to form the legislation provinces. As a comparison group, the remaining 8 provinces/territories were combined to form the no-legislation provinces.

Annual rates of bicycle-related head injuries and other injuries for the four years of the study (1994-1998) were calculated for the two groups (legislation and no-legislation provinces). The chi-squared test for trend was used to test for differences over time in head injury rates and other injury rates between the two groups. In addition, for each year of the study, the ratio of head injuries to other injuries for each group (legislation and no-legislation provinces) was calculated. Hospitalization rates from the provinces were combined irrespective of when the helmet legislation was passed: the authors maintained that this approach was adopted for methodological reasons and would confer a conservative estimate of the protective effect of helmet legislation.

Cote et al. 1992

Unlike the three previous studies that utilized hospital records or registries as their source of data, the study by Cote et al. (1992) directly observed cyclists for compliance with helmet use. In response to bicycling deaths of two children in 1989, Howard County, Maryland, became the first jurisdiction in the USA to mandate use of bicycle helmets for children. School children were lectured by the police about the law before its enactment.

Pre-law and post-law helmet use was observed by volunteer observers in Howard County and two control counties: Montgomery (which sponsored a community education program) and Baltimore County (no helmet activities). Baseline observations of bicyclists in the intervention (Howard) and control (Montgomery and Baltimore) counties were held on Saturday, July 28, 1990 and a follow-up on Saturday, May 4, 1991.

Hagel et al. 2006

Hagel et al. (2006) also used direct observation for their data collection: the study measured the prevalence of bicycle helmets two years after the introduction of legislation mandating their use in cyclists under 18 years of age, in the province of Alberta, Canada. The legislation was introduced in 2002. The study authors compared bicycle helmet use observations conducted from July to August 2004 (two year post-legislation), to similar observations performed in 2000 (prior to legislation). Observations were made for all cyclists irrespective of their age, with the age of the cyclist estimated into broad age groups (<6 years, 6-12 years, 13-17 years, 18-54 years and 55+ years). The adult group (aged ≥18 years) was not subject to the legislation requirements and was therefore used as a comparative control group. In 2000, the observations were conducted in the two main cities of Edmonton and Calgary, and additional communities located within 50 km of these two city centres; in 2004, the observations were made in Edmonton only.

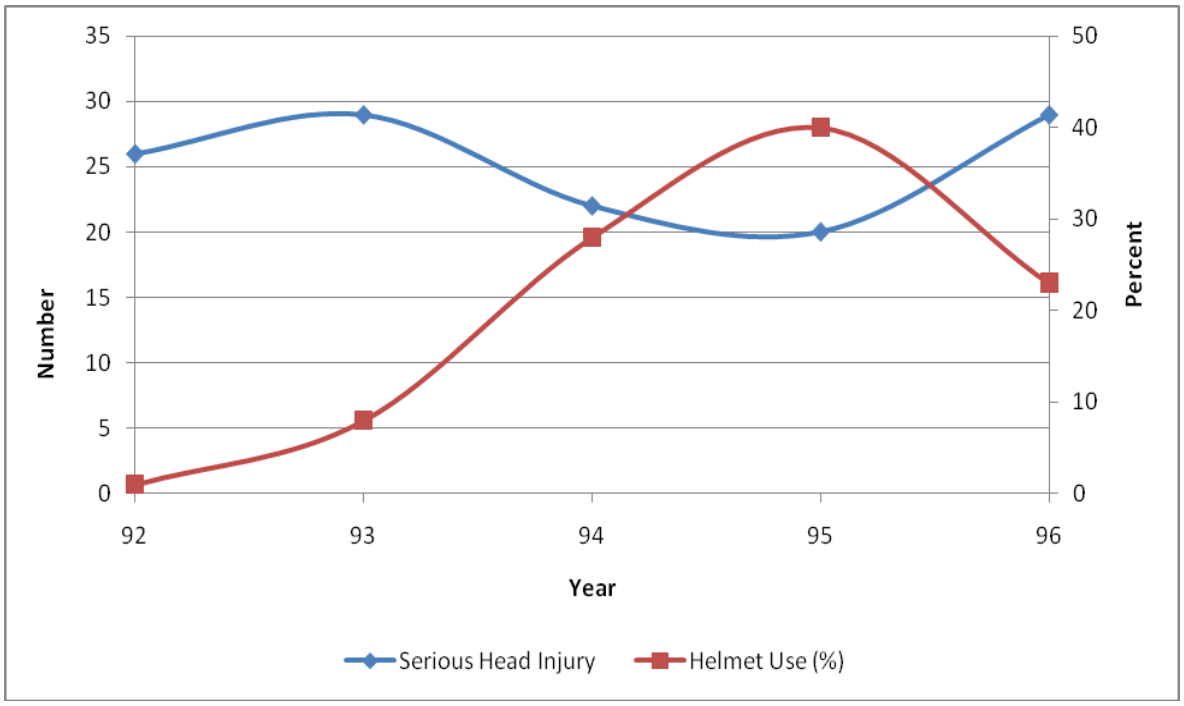
4.2.1.2 Bicycle helmet legislation (with minimal or no enforcement): Results

Ji et al. 2006

There were 1116 bicycle trauma patients recorded in the San Diego County Trauma Registry between 1992 and 1996: 510 children and 606 adults. Helmet use as reported by injured cyclists post injury increased significantly amongst children post-legislation (OR 1.84, 95% CI 1.48 – 2.28). There was a concurrent smaller trend amongst adult controls for increased helmet wearing (OR 1.17, 95% CI 1.00 – 1.38).

Of the admitted cases, 310 involved serious head injuries. A plot of serious head injuries against the percentage of helmet use for each year showed that in the first segment of the curve, 1992-1993, both variables were rising for both children (Figure 2) and adults (not shown). After 1993, the inverse nature of the two curves can be easily appreciated.

Figure 2: Number of serious head injuries and percent helmet use among children bicycle trauma patients, San Diego, 1992 – 1996



Source: Ji et al 2006

Although downward trends were apparent in the post legislation period (see Figure 2), logistic regression analysis of time trends of serious head injury found no statistically significant decrease in the proportion of head injuries post legislation compared with the pre-legislation period for either child (p = 0.19) or adults (p = 0.4).

The results of multivariate logistic regression for testing helmet use and serious head injuries controlling for age, ethnicity and time showed that age was significantly associated with helmet use (OR = 0.6, 95% CI 0.52–0.86), meaning children with severe head injuries were 0.6 times as likely to wear a helmet compared to adults. For ethnicity, Black patients were 0.21 times as likely to wear a helmet and Hispanic patients 0.17 times as likely to wear a helmet compared to White patients. Asian/other did not differ significantly from Whites in terms of the likelihood of helmet use. Time period showed significant associations for all years post-law, compared to the reference category pre-law period (1992, 1993). Patients injured in 1994 were 2.61 times as likely to wear a helmet compared to the pre-law period. Those injured in 1995 were 4.42 times as likely, and patients in 1996 were 2.86 times as likely to wear a helmet compared to the pre-law

period. Patients with a serious head injury were 0.43 times as likely to have worn a helmet compared to those without serious head injury, a significant association.

Lee et al. 2005

There were 44,069 cases of non-fatal bicycle-related injury events that required hospitalizations in the state of California between 1991 and 2000. Aggregate data analysis revealed changes in the distribution of proportion of injury types over the 10-year period for youth aged 17 years and younger ($p < 0.001$) but not for the adult comparison group ($p = 0.505$). There was also a significant reduction of 18.2% (99% CI 11.5 – 24.3%) in traumatic brain injuries (Head-TBI injuries) among youth over this time (OR 0.818, 99% CI 0.757 – 0.885) but not among adults during the same period (OR 1.01, 99% CI 0.926 – 1.10) see Table 2 (on following page).

Among others, pooled disaggregate data analysis using MNL models showed that the youngest riders, aged 0-9 years, had the greatest decrease in the proportion of Head-TBI.

Table 2: Odds ratios of bicycle-related non-fatal injuries in California - proportions of the total by injury types and age for the pre-legislation period compared with corresponding proportions for the post-legislation period.

Age	Type of Injuries	Pre-legislation (1991-1993) [A]	Post-legislation (1994-2000) [B]	Odds Ratios [B/A]
Youth	Head-TBI	0.327[a] (0.313 – 0.341)[b]	0.268 (0.258 – 0.277)	0.818 (0.757 – 0.8855)
	Head-Other	0.0710 (0.0634 – 0.0785)	0.0765 (0.0708 – 0.0823)	1.08 (0.901 – 1.23)
	Other	0.602 (0.588 – 0.612)	0.656(0.646 – 0.666)	1.09 (1.05 – 1.13)
Adult	Head-TBI	0.203 (0.192 – 0.214)	0.205 (0.198 – 0.212)	1.01 (0.926 – 1.10)
	Head-Other	0.0793 (0.0721 – 0.0866)	0.0833 (0.0786 – 0.0880)	1.05 (0.908 – 1.22)
	Other	0.718 (0.705 – 0.730)	0.712 (0.704 – 0.719)	0.992 (0.965 – 1.02)

[a] Proportion of the total number of Youth cases in this period for this injury type
[b] 99.0% CI

Source: Lee et al. 2005

Multinomial Logit (MNL) models examined three-way interactions that combined age and year with the cause, residence area type, sex, and race/ethnicity variables. For the race/ethnicity variable, the legislation was associated with decreases in the proportion of *Head-TBI* for all categories of *Youth* riders except for Black and other. In addition, it appeared that the association with the legislation was particularly strong for Asians and Hispanics. Possible reasons for the differences in changes for the different races/

ethnicities are different social/cultural attitudes towards obeying the law and different socio-economic conditions. Research shows that demographic and economic factors are significant determinants for at least one type of bicycle collisions, those with motor vehicles (Epperson, 1995), and it may be possible that bicycle safety helmets are, on average, more of a financial burden for Black and other racial groups. Resources for encouraging helmet use may also be, for whatever reasons, more accessible and effective in the Asian and Hispanic communities. For the sex variable, there was a significant decrease in the proportion of *Head-TBI* for males but the proportion was unchanged for females.

Macpherson et al. 2005

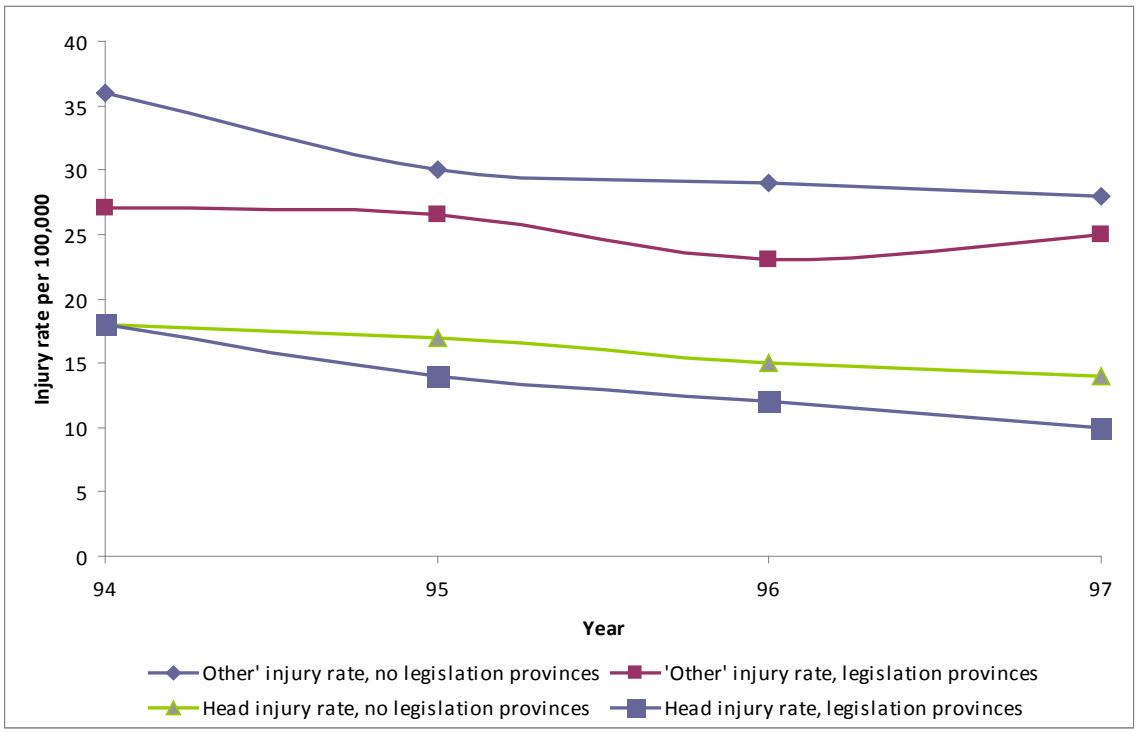
Over the four-year study period (1994-1998), there were 9769 paediatric admissions due to bicycle related injury throughout Canada. As discharge information was missing for 119 children, only 9650 were included in the analysis. Before legislation was implemented, the rates of head injuries in provinces were similar (18.27 and 18.35 per 100,000 in provinces with and without legislation, respectively) (Table 3, on following page). Following the enactment of legislation, there was a 45% reduction in the rate of bicycle-related head injuries in the intervention provinces (from 18.27 per 100,000 in 1994-1995 to 9.96 per 100,000 in 1997-1998), while a concurrent reduction of 27% also took place in the no-legislation provinces (from 18.35 per 100,000 in 1994-1995 to 13.33 per 100,000 in 1997-1998) (Figure 3). A chi-square test for trend between groups found that the decline was significantly greater ($p = .001$) in legislation provinces than in the control provinces. The logistic regression analysis showed that legislation was the only significant variable: a significant protective effect of legislation on head injury among injured cyclists was noted (OR 0.77, 95% CI 0.69 – 0.85).

Table 3: Bicycle-related head injury rates (Children 5-19 years) by province, 1994 - 1998

Province	Date of adoption of legislation	Head Injury Rates by Year (Rate per 100,000)			
		1994 - 1995	1995 - 1996	1996 - 1997	1997 - 1998
Legislation provinces					
• Ontario	October 1995	16.25	11.85	10.51	8.36
• New Brunswick	December 1995	22.18	22.18	13.70	18.27
• British Columbia	September 1996	24.03	20.00	15.30	13.69
• Nova Scotia	July 1997	15.57	12.35	3.76	6.98
SUBTOTAL		**18.27**	**14.22**	**11.37**	**9.96**
No-legislation provinces					
• Newfoundland		27.24	30.45	23.24	22.44
• Prince Edward Island		13.27	13.27	3.32	9.95
• Quebec		19.77	17.29	15.59	15.73
• Manitoba		7.45	9.10	8.28	8.69
• Saskatchewan		23.39	16.16	17.86	9.78
• Alberta		15.54	14.07	12.43	9.65
• Yukon, NWT		31.45	18.87	12.58	0.00
SUBTOTAL		**18.35**	**16.29**	**14.60**	**13.33**
Canada		18.31	15.15	12.83	11.48

Source: Macpherson et al. 2006

Figure 3: Comparison of changes in head injury and other injury rates in legislation and no legislation provinces



Source: Macpherson et al. 2002

Cote et al. 1992

At baseline (July 28 1990), persons aged 16 years or older were more likely to wear helmets than persons younger than 16 years in Howard County (72% vs 4%), Montgomery County (52% vs 8%) and Baltimore County (48% vs 19%). Crude helmet use in Howard County was 4% at baseline and rose to 47% at follow-up (May 4 1991). An increase was noted for all variables studied. In Montgomery County, helmet use at baseline was 8% and rose to 19% at follow-up; in Baltimore County, helmet use was 19% at baseline and 4% at follow-up (Table 4).

Table 4: Prevalence of helmet use for bicyclists younger than 16 years in three counties in Maryland, 1990-1991

County	Intervention type	Baseline		Follow/up	
		No. helmeted/ No. observed	(%)	No. helmeted/ No. observed	(%)
Howard County	Legislation	3/64	4	24/51	47
Montgomery County	Education	11/140	8	19/102	19
Baltimore County	None	7/37	19	2/49	4

Source: Cote et al. 1992

With regard to sub-group effects, analysis by gender, race, site type, census tract type (socio-economic status), and group (cycling in a group or alone) suggested a consistent pattern of increased helmet use in Howard county following enactment of the law. Restricting analysis to persons younger than 16 years of age, gender was not predictive of helmet use, but in each county, whites were more likely to wear helmets than persons of other races, both at baseline and follow-up.

Hagel et al. 2006

Pre-legislation, there a total of 699 cyclists were observed (in the cities of Edmonton and Clagary, along with surrounding communities within 50km). 28% (46/164) of child cyclists and 49% (234/474) of adult cyclists were helmeted during these observations (Table 5). There were 271 observations made in the post-legislation period (in Edmonton only). During this time, 83% (34/41) of child and 48% (110/230) of adult cyclists were helmeted. The prevalence of helmet use amongst children increased significantly (Prevalence Ratio 2.96, 95% CI 2.22-3.94) and remained unchanged in the adult population. After adjusting for gender, age and average annual income, the increase in

prevalence of helmet use amongst children was 3.69 (95% CI 2.65-3.14) compared with the pre-law period.

Helmet use was estimated to increase in residential areas and on commuter routes in both males and females, regardless of average annual income.

Table 5: Helmet prevalence rates by year of survey

VARIABLE	2000 HELMET PREVALENCE	2004 HELMET PREVALENCE	2004 VS 2000 PREVALENCE RATIO	2004 VS 2000 ADJUSTED* PREVALENCE RATIO
Age				
<18	46/164	34/41	2.96 (2.22 – 3.94)	3.69 (2.65 – 5.14)
18+	234/474	110/230	0.97 (0.79 – 1.19)	1.17 (0.95 – 1.43)
Location				
Commuter route	130/353	64/121	1.44 (1.21 – 1.71)	1.17 (0.95 – 1.43)
Campus	22/62	9/29	0.88 (0.47 – 1.64)	0.74 (0.49 – 1.11)
Residential	23/65	13/21	1.75 (1.35 – 2.26)	1.49 (1.14 – 1.96)
Cycling path	59/114	35/61	1.11 (0.66 – 1.85)	0.75 (0.51 – 1.10)
Park	66/105	23/39	0.94 (0.74 – 1.19)	0.78 (0.58 – 1.05)

*Poisson regression model with adjustment for clustering by site contained terms for age, date, sex, average annual income, location, and the interaction of date and location and date and age

Source: Hagel et al. 2006

4.2.1.3 Bicycle helmet legislation (with minimal or no enforcement): Considerations

Although none of the studies reported either exclusively or separately on the use of bicycle helmets during play/leisure, almost all of the studies alluded to the fact that in addition to being a form of transportation, cycling is invariably also a play/leisure activity for children. Hence, both studies which used direct observation methods to assess the impact of legislation on helmet use (Cote et al. 1992, Hagel 2006) ensured observations were also carried out in places where children would likely be cycling for play and leisure, for example, recreation centers or pools, county thoroughfares, residential areas and parks. However, we should be cautious when generalizing the findings of these studies to play/leisure in the external environment (i.e. within the context of this review).

In terms of compliance with the mandatory helmet legislation, three CBA studies (Cote et al. 1992; Hagel et al. 2006; Ji et al. 2006) found that the rate in increase in helmet use for children over the study periods ranged from between 43% (Cote et al. 1992) and 84% (Ji et al. 2006) per year. Three other CBA studies that assessed the impact of

helmet legislation on bicycle-related head injuries (Ji et al. 2006; Macpherson et al. 2002; Lee et al. 2005) all reported a significant protective effect of helmet laws on head injuries.

However, these results must be interpreted within the context of the methodological limitations of the review and included studies. Strengths of the review are the high level of methodological rigour required for the studies to be included. Comparison of the intervention group against a control is important for study validity mainly because it allows for the control of changes over time. Without a concurrent comparison group, it may be impossible to determine the relative effect of the helmet law compared to other environmental and legislative changes e.g. improved bicycle paths, changes in cycling rates. Limitations of the review are related to the small number of high quality studies that were identified for inclusion, meaning that there was either restricted or no evidence to provide sound scientific support for either side of the bicycle helmet legislation debate. For instance, none of the studies that reported on potential adverse effects of helmet legislation and only three studies reported on bicycle-related head injuries.

For the studies which evaluated changes in bicycle-related head injury, the biggest limitations were the inability to measure actual helmet use (Lee et al. 2005), or missing helmet use data (Ji et al. 2006). The lack of helmet use data makes it difficult to clearly demonstrate that lower head injury rates are the direct consequence of increased helmet use, as there could be other possible explanations for the decreases in the reported head injury rates or proportion of serious head injuries. These include reduced cycling exposure/bicycle use or changes in hospital admission procedures (for reduced head injury rates); or an increase in other bicycle related injuries (for reduced proportion of head injuries).

The inclusion of comparison control groups attempts to discount these other possible explanations, however, the adequacy of the chosen controls may also be questionable. In particular, comparing adults with children (Ji et al. 2006, Li et al. 2005, Hagel et al. 2002) may be problematic because cycling exposure and admission procedures may be not be the same for the two groups, while comparisons between counties or provinces (Macpherson et al. 2002, Cote et al. 1992) may not take into account other local changes such as improved road conditions and changes to speeding laws, for instance.

Evidence statement 1: Impact of legislation (with minimal or no enforcement) on bicycle helmet use and head injury

There is moderate evidence from five controlled before-and-after studies to show that legislation mandating the use of bicycle helmets for children (without enforcement) can increase compliance with helmet use and also decrease head injuries related to riding bicycles, which is the ultimate goal of such legislation (Ji et al 2006 [+]; Lee et al. 2005 [+]; Macpherson et al. 2002 [+]; Cote et al. [+]; Hagel et al. [+]).

In terms of compliance with the legislation, three CBA studies – 2 from the USA, I from Canada (Cote et al. 1992 [USA]; Hagel et al. 2006 [Canada]; Ji et al. 2006 [USA]) found that the rate in increase in helmet use for children over the study periods ranged from between 43% (Cote et al. 1992) and 84% (Ji et al. 2006) per year. In the studies by Ji et al. (2006) and Hagel et al. (2006), helmet use by adults served as comparators, while two counties without legislation served as comparators in the Cote et al. (1992) study. In the Ji et al. (2006) study, helmet use as reported by injured cyclists post-injury increased significantly amongst children post legislation (OR 1.84, 95% CI 1.48 – 2.28), with a concurrent smaller trend amongst adult controls for increased helmet wearing (OR 1.17, 95% CI 1.00 – 1.38). Results of Cote et al. showed that in crude helmet use in Howard County (intervention) was 4% at baseline and rose to 47% at follow-up, while in Montgomery County (control – educational campaign), helmet use at baseline was 8% and rose to 19% at follow-up; and in Baltimore County (no intervention), helmet use was 19% at baseline and 4% at follow-up. Results of the Hagel et al. (2006) study showed that the prevalence of helmet use amongst children increased significantly (Prevalence Ratio 2.96, 95% CI 2.22-3.94) and remained unchanged in the adult population.

Three CBA studies that assessed the impact of helmet legislation on bicycle-related head injuries - 2 from the USA, 1 Canada (Ji et al. 2006 [USA]; Macpherson et al. 2002 [Canada]; Lee et al. 2005 [USA]) all reported a significant protective effect of helmet laws on head injuries.

Applicability: The studies are deemed to only be partially applicable to the UK. This is because none of the studies was carried out in the UK and there are environmental and legislative differences between the UK and Canada/USA such as differences in cycling rates, design of bicycle paths, etc.

4.2.2 Police enforcement of existing legislation

One controlled before and after study was identified which assessed the impact of police enforcement of mandatory helmet legislation among children (Gilchrist et al. 2000). Key study characteristics are given in Table 3. The study was set in a small community (population = 2400) in the US state of Georgia, which mandated bicycle helmet use for children, effective July 1993. Later that summer, the city council of a rural Georgia community passed an ordinance strengthening the state law by instructing police officers to impound the bicycle of any child (<13 years) seen riding without a helmet but this was enforced only briefly and not subsequently. Police reinstituted the program in April 1997 by initially issuing warnings to unhelmeted children and in late April, also embarked on a helmet give-away/education program. After this, the police began to impound the bicycle of any unhelmeted child rider.

4.2.2.1 Police enforcement of existing legislation: Study characteristics

Study characteristics of the Gilchrist et al. (2000) study is shown in Table 6 below.

Table 6: Police enforcement of existing bicycle helmet legislation: Study characteristics

Reference	Aim	Method	Population	Location
Gilchrist 2000	To study the effectiveness of adding police enforcement (combined with a give-away and educational program) to state-wide legislative efforts	Controlled before and after study. *Riders were classified as children (estimated age <13 years), teens (13-15 years) and adults (>16 years). The adult population was used as a comparative control group.*	All bicycle rides observed before (1 observation) and after (7 observations) helmet distribution	A small rural community in the US state of Georgia.

Approximately 580 children from kindergarten to grade seven received free helmets along with fitting instructions and safety education. Helmet use observations were made before distribution, several times during the five month program, and once two years later[c]. Riders were classified as children if their age was estimated to be under 13 years, teens if 13 to 15 years and adults if older than 16; the adult population was used as a comparative control group.

[c] Although not a part of the formal study, 2 years after the initial helmet distribution, most of the authors and 1 volunteer observed bicyclists 1 Thursday after school in May 1999, using the same canvassing technique to determine whether helmet use was sustained.

4.2.2.2 Police enforcement of existing legislation: Results

Prior to the enforcement program, no cyclists wore helmets during 97 observations. 61 of the cyclists initially observed were children. During the five months of the enforcement programme, police impounded 167 bicycles and 654 observations of cyclists were made. 45% of children (range 30%-71%) wore helmets during 358 child observations (Table 7). There were, however, no significant changes in adult usage among adult controls (from 0% to 3%). Two years post-intervention, 54% of child cyclists (21/39) observed wore a helmet compared with 15% (2/13) teens and no (0/23) adults. In addition, during the two-year follow-up, children were seen participating in other activities wearing bicycle helmets not required by law – 2 children rollerblading, all 3 children jumping on a trampoline, as well as 3 children walking along a street without bicyles.

Children's helmet use increased significantly in all race–gender strata for which significance could be determined.

Table 7: Observed Helmet use by age group predistribution and postdistribution

Age Group	*Predistribution Helmeted/Total*	*%*	*Postdistribution* Helmeted/Total*	*%*	*Range (%)*	**P value**
Children (estimated 5-12 y)	0/61	0	161/358	45	30-71	.001
Teens (estimated 13-15 y)	0/16	0	23/125	18	0-50	.074
Adults (estimated 16+ y)	0/20	0	5/171	3	0-6	1.000
Total	0/97	0	189/654	29	0-71	.001

* Aggregate findings from 7 observational periods from 1 week to 5 months after helmet distribution

Source: Gilchrist et al. 2002

4.2.2.3 Police enforcement of existing legislation: Considerations

The study by Gilchrist et al. 2000, conducted in rural Georgia, demonstrates the importance of police enforcement. Prior to the enforcement programme, the existing state and local laws did not prompt helmet use, as no children were observed using a bicycle helmet despite the pre-existing legislation. The positive effects of active enforcement, in which police were instructed to impound the bicycle of non-helmeted child cyclists was still seen two years after the commencement of the programme. In addition, children were also seen wearing bicycle helmets for the purposes of other activities that the law did not require helmets (e.g. rollerblading, jumping on trampoline).

Because no other helmet safety programmes were provided during the period of the study, the authors posit that their findings suggest that the enforcement programme caused the behaviour change. However, as the enforcement programme was coupled with a helmet giveaway and educational programme, it was not possible to distinguish the effects of the enforcement programme from the concurrent helmet give-away/educational programme on observed helmet use.

Evidence statement 2: Impact of police enforcement of existing legislation on bicycle helmet use

There is moderate evidence from one controlled before and after study to show that enforcement of existing legislation can increase compliance with helmet use (Gilchrist et al. 2002 [+]).

The study was conducted in rural Georgia, USA, and revealed that without enforcement, the state and local laws did not prompt helmet use in the community, as none of the 97 observed riders (adults and children) wore a helmet before the programme started. However, active police enforcement, coupled with helmet give-away and education was effective, as during the next five months, helmet use among 358 observed children averaged 45%, a significant increase ($p = 0.001$) in all race and gender groups. In contrast, adult use (which served as control) did not change significantly.

The effect of programme was not only sustained (two years after its initiation, 54% of child bicycle riders (21/39) were observed to be wearing a helmet) but may also have improved general safety behaviour/norm (during the 2-year follow-up, children were seen to be wearing bicycle helmets while participating in other activities that did not mandate them to wear them: 2 children rollerblading, all 3 children jumping on a trampoline, as well as 3 children walking along a street without bicycles.

However, it is difficult to tell if the addition of the helmet give-away and educational programmes had any confounding effects on the enforcement component; or if indeed enforcement alone motivated helmet use.

Applicability: The evidence is deemed as currently not applicable to the UK setting (as bicycle helmet legislation does not apply in the UK); however it might become applicable if bicycle helmet legislation were brought in.

4.2.3 Mass media campaigns to promote helmet use

Two controlled before-and-after studies were identified relating to non-legislative strategies to the uptake of bicycle helmets among children. One of these assessed the impact of mass media, as an integral part of a multi-faceted campaign (Bergman et al. 1990) while the other assessed a hospital-led school-based education campaign that

involved talks and demonstrations; local media and a low cost helmet purchase scheme (Lee et al. 2000).

Bergman et al. 1990

The study by Bergman et al. (1990) was carried out in the US city of Seattle, Washington. A campaign to induce as many children as possible in the Seattle area to wear helmets while riding bicycles was initiated in the summer of 1986 and lasted for three years. The campaign was mainly in response to the very low levels of helmet use and ownership in the area at the time, as revealed by a 1985 survey of parents which demonstrated that only 3% (8/242) parents reported ownership of helmets among their children.

To help shape their campaign, the authors conducted an attitudes survey on helmet ownership and usage among 1057 randomly selected third-graders and their parents in the Seattle Public Schools. The results showed that to achieve success, three major obstacles had to be overcome: 1) ignorance among parents of not only the magnitude of bicycle-related head trauma but also the protection afforded by helmets; 2) high costs ($40-$60) of helmets which was an appreciable deterrent to mass marketing; 3) reluctance of children to wear helmets because of the infrequent use by their peers. To address each of these findings, a multi-faceted campaign involving three separate but related strategies (mass media campaign to raise parental awareness, lowering the price of bicycle helmets and inducing children to wear helmets) was undertaken and was achieved through a coalition of health, bicycle and helmet industry organization.

Efforts to raise parental awareness involved a combination of personal contact with healthcare providers, events such as trade shows for parents, and most importantly, exposure to mass media. Physician offices, hospitals, and health department clinics were heavily utilised to increase contact, but many more parents were reached by newspapers, television and radio, where publicity was given to up-to-date statistics on bicycle trauma and individual victims (Bergman et al. 1990).

The second strategy, to lower the price of bicycle helmets from $40-$6- to less than $25 was achieved by creating a demand so that major retailers, who hitherto sold and stocked only bicycles, started to stock and promote children's helmets along with bicycles. Subsequently, helmet producing companies were convinced to mass-produce

and market them through shops throughout the state for $25 on presentation of a discount coupon.

Lastly, a school-based campaign was undertaken to ensure children not only purchased helmets but also actually wore them. As the main resistance from children stemmed from them being perceived as 'being different' or being labelled as a 'nerd' and this was overcome by the recruitment into the campaign of prominent local sports figures, who promoted the theme that helmets should be a part of the uniform of anyone who rides a bike, just as they are for other sports such as baseball and American football. Numerous school assemblies and bicycle rodeos were also conducted, where rewards in the form of tickets to baseball games, were given to children wearing helmets.

Lee et al. 2000

The study by Lee et al. (2000) assessed the 'Helmet your Head' health-led education campaign based in Reading, West Berkshire, UK, that was aimed at increasing bicycle helmet wearing among teenagers. The programme lasted between 1992 and 1998 and involved the fostering of a close relationship between the local media (newspapers, radio and television), schools and the teenagers themselves. It consisted of school based talks; age specific information for the children; true case scenarios/videos of head injured children; a demonstration using an egg and small helmet to illustrate the effect of a head injury with and without a helmet to illustrate the effect of a head injury with and without a helmet; information on how to wear a helmet properly; and a low cost helmet purchase scheme.

4.2.3.1 Mass media campaigns to promote helmet use: Study characteristics

Key study characteristics of the two studies are presented in **Table 8**.

Table 8: Mass media campaigns to promote helmet use: study characteristics

Reference	Aim	Method	Population	Location
Bergman 1990	To increase helmet use among school children in the Seattle area	Controlled before and after study *Seattle served as the intervention community while Portland, Oregon was used as a control.*	All observed child bicyclists (5-12 years old) in the two communities during the course of the study	Seattle, USA
Lee 2000	To increase bicycle helmet wearing among young people, especially teenagers in Reading.	Controlled before and after study *Reading, where the intervention took place was compared with the neighbouring area of Basingstoke, which served as control.*	3000 teenagers (11-15 year olds) from intervention and control groups each, who completed a self-administered questionnaire on helmet use	Reading and Basingstoke, South East England.

Bergman et al. 1990

The authors of the Seattle study aimed to evaluate their programme by relying on changes in behaviour that may have resulted from their multi-faceted campaign, namely changes in the sales and changes in the use of bicycle helmets.

Data on the number of discount coupons distributed and the number of these redeemed (i.e. number of bicycle helmets sold) were collected from all sites (e.g. physicians offices, schools, fairs and bicycle rodeos) where discount coupons were distributed during that phase of the campaign in 1988. Data on annual sales of helmets were also collected from the bicycle helmet manufacturer that was involved in the campaign.

To evaluate the change in the use of bicycle helmets, a survey of helmet usage among elementary school children (aged 5-12 years) in the Seattle area and in Portland, Oregon, a control community, was carried out. This involved 9827 observations made before, during and 16 months after the start of the campaign, in upper-, middle- and lower-income neighbourhoods,

Lee et al. 2000

The authors compared Reading (where the campaign was run) and the neighbouring area of Basingstoke (where there was no campaign). From each city, independent samples of 500 teenagers (11-15 years) were recruited from each of two centres – state

schools and youth groups, to complete a self-administered questionnaire that consisted of five items relating to cycling behaviour and opinions held about helmets. However, the authors only item 2 'If you cycle, do you wear a helmet?', which consisted of a three point response scale (always,; sometimes; never), for analysis.

The questionnaire survey was undertaken at the beginning of the campaign and repeated at the end of each of the next two years of the three year campaign. Thus the survey employed a total of 6000 teenagers over the period of the campaign, 3000 from the intervention community (Reading) and another 3000 teenagers from the control community (Basingstoke). Injury data were also collected from the A&E department in Reading to monitor injury figures relating to pedal cycle crashes among the under 16 age group from June 1988 to May 1998, and information on head injuryies and total number of cycle injuries was recorded. However, no A&E figures were provided from the control area.

4.2.3.2 Mass media campaigns to promote helmet use: Results

Bergman et al. 1990

Of the 109, 450 discount coupons distributed in 1988, 5162 (4.7%) were redeemed, claimed to be an extraordinarily high figure by the authors, who reported those involved in product promotion (Bergman et al. 1990). As seen in table 9, 4.3% of coupons given out by physicians and 8.7% of those distributed at fairs and events were redeemed.

Table 9 – Discount coupon redemptions in 1988 by distribution site

Site	No. Distributed	No. (%) Redeemed
Physician offices	33 700	1457 (4.3)
Schools	35 000	818 (2.3)
Youth groups	12 100	385 (3.2)
other (events, fairs, etc)	28 650	2502 (8.7)
Total	**109 450**	**5162 (4.7)**

Source: Bergman et al. 1990 (Table 1)

With regards to annual figures from Pro-Tec, the sale of their Pro-Tec Freestyle II youth helmet in the Seattle King County area increased from 1500 in 1986, to 5000 in 1987, to 20 000 in 1988, and to 30 000 for the first 8 months of 1989.

Finally, the results of the helmet usage survey among elementary school children showed an increase from 5% to 16% in Seattle compared with an increase of only 1% to 3% in Portland over the same period (Table 10)

Table 10: Observed Use of Bicycle Helmets by Children Aged 5 to 12 years in two communities

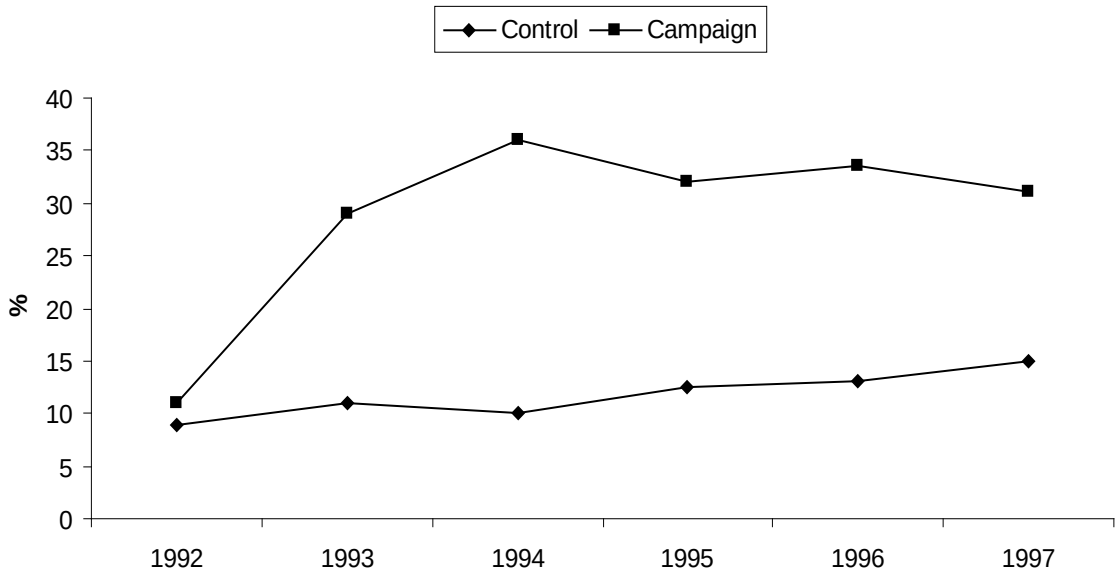
	Seattle, Washington		Portland, Oregon	
Month	**No of Observations**	**% Wearing Helmets**	**No of Observations**	**% Wearing Helmets**
May 1987	905	5	1052	1
September 1987	1213	5	1331	2
May 1988	1259	11	1188	2
September 1988	1563	16	1316	3

Source: Bergman 1990

Lee et al. 2000

In Reading, there was an increase in the number of 11-15 year olds reporting that they 'always' wore a helmet while cycling – from 11% in 1992 to 31% in 1997 ($p < 0.001$). In the control city (Basingstoke), there was a smaller, non-significant increase in use, from 9% in 1992 to 15% at the end of the study in 1997 (see Figure 4). At the beginning of the study, there was no significant difference between the intervention and control group in the numbers of 11-15 year olds reporting that they always wore a helmet when cycling. At the end of the study in 1997, there was a 16% higher self reported wearing rate in the intervention group compared with controls ($p < 0.001$).

Figure 4: Percentage of 11-15 year olds in the control and campaign (intervention) areas reporting that they always wear a helmet when cycling



Source: Lee et al. 2000

The injury rate for those under 16 years old attending the A&E department from 1988-98 for cycling related head injuries and total cycle injuries is shown in Table 11. There was little change in either the rate of the total injuries or head injuries before the start of the promotion campaign in 1992. In the next year, however, the rate of cycle injuries fell from 520.8/100 000 population of under 16 year olds in West Berkshire in 1991-92 (i.e. before the campaign started) to 376.7/100 000 in 1992-93. This was largely maintained over the five years of the campaign. The rate of head injuries also reduced significantly, from 112.5/100 000 in 1991/92 to 60.8/100 000 ($p < 0.005$). This represents a fall in head injuries, as a percentage of total bicycle related injuries from 21.6% to 11.6%.

Table 11: Children under 16 years old who attended the A&E department, 1988-98 for treatment of a bicycle related injury, rates per 100,000 population (<16 years)

	Pre-programme				Post-programme					
	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98
Head injuries	124.2	117.5	107.5	112.5	62.5	70	74.1	48.3	51.7	60.8
All bicycle injuries	542.5	553.3	525	520.8	376.7	392.5	500	408	443.3	513.3
Head injuries as % of all bicycle	22.89	22.38	20.48	21.6	16.6	17.83	14.83	11.84	11.65	11.85

injuries										

Source: Lee 2000

4.2.3.3 Mass media campaigns combined with other activities: Considerations

The two CBA studies by Bergaman et al. (1990 – USA) and Lee et al. (2000 – UK) demonstrated the role mass media can play in attempts to reduce rates of childhood injuries, in these cases, related to bicycle helmet use. In both instances, mass media campaigns were employed as part of a broader non-legislative strategy that involved educational programmes and purchase subsidies. It is said that mass media are rarely effective when used as the sole intervention in prevention programmes (Bergman et al. 1990).

The US study (Bergman et al. 1990) evaluated changes in the use of bicycle helmets by actual observation of school children, while the UK study (Lee et al. 2000) relied on self-reported helmet use. This is a weakness of the Lee study as there is always a reason to question the validity of self-reporting of activities, where responder bias may occur.

The authors of the Bergman et al. (1990) reported only on behaviour change (changes in sales and use of bicycle helmets) and did report on changes in mortality or morbidity, which are the ultimate goals of injury prevention programmes. Lee et al. 2000 did report on injury rates pre- and post-intervention, but only for the Reading (intervention city), on account of unavailability of A&E figures from the control area.

Evidence statement 3: Impact of mass media campaigns on bicycle helmet use and head injury
There is moderate-to-weak evidence from two controlled before-and-after studies to show that mass media campaigns, employed as part of a broader non-legislative strategy (that involved educational programmes and purchase subsidies) were effective in increasing compliance with bicycle helmet use (Bergman et al. 1990 [+]; Lee et al. 2000 [-]. There was also moderate evidence from uncontrolled before-and-after data from one of the studies (Lee et al. 2000) that such programmes helped to reduce the rates of bicycle-related head injuries in the intervention area. In the US study by Bergman et al. (1990), the sales of one brand of a youth helmet in the

Seattle area (intervention area) rose from 1500 to 22,000 over a 3-year period (no figures stated for the control area) while observed helmet usage rate among school-age children increased from 5% to 16% compared with a rise of only 1% to 3% in a control community, Portland, Oregon, over the same period (Bergman et al. 1990)

In the UK study (Lee et al. 2000) self-reported helmet use among 11-15 years olds living in the campaign area increased from 11% at the start of the campaign to 31% after five years ($p<0.001$), with no significant change in the control group. Hospital casualty figures in the campaign area (Reading) for cycle related head injuries in the under 16 years age group, fell from 112.5/100 000 to 60.8/100 000 (from 21.6% of all cycle injuries to 11.7%; $p<0.005$). No injury data were provided for Basingstoke, the control (Lee et al. 2000)

Applicability: The evidence is judged to be directly applicable to the UK – one of the studies (Lee et al. 2000) was carried out in the UK and although the Bergman study was carried out in the US, it was embarked upon and completed before the introduction of a bicycle helmet legislation, so in a sense the settings reflected what is currently obtainable in the UK, a country without mandatory helmet wearing legislation. Furthermore, both countries are similar in terms of living standards and economic development.

4.3 Playground Standards

Two uncontrolled before and after studies were identified that examined safety of playground equipment (Howard et al. 2005; Sibert et al. 1999). Howard et al. 2005 examined the effect of replacing unsafe playground equipment on injury rates among school children using the new Canadian Standards Association (CSA) standards. Sibert et al 1999 reported surveillance of injuries and effects of improvements in playground equipment in Cardiff.

In Canada, where the Howard et al. 2005 was set, the 1998 CSA standards and 1990 CSA guidelines provides guidance and standards for the design, installation and maintenance of playgrounds and equipment. The Toronto District School Board (TDSB) worked with qualified playground consultant to develop a methodology for assessing the

compliance of all playground equipment in its jurisdiction with the guidelines and standards.

In Wales, where the Sibert et al study was set, the council made several changes to its largest playgrounds on the basis of findings from previous surveillance program between June and July 1995. These changes include adding greater depth of bark (600mm instead of 300mm) in Roath Park and four other large playgrounds in the north of Cardiff because of the pattern of arm fractures from falls. In addition, Roath Park monkey bars were replaced by a rope climbing frame because the fracture rate from monkey bars was twice that for other climbing frames. 14 other playgrounds surfaced with bark and the four surfaced with rubber in west and south east of Cardiff where the council had not made any changes were used as the control.

4.3.1 Playground standards: Study Characteristics

Table 12 shows the key characteristics of the two studies (Howard et al. 2005; Sibert et al. 1999).

Table 12: **Playgrounds study characteristics**

Reference	Aim	Method	Population	Location
Howard et al. 2005 Canada	to determine whether applying new standards and replacing unsafe playground equipment reduced the number of school playground injuries	Controlled* before and after	Elementary schools in Toronto District School Board (grades 1 through 6)	Toronto District, Canada
Sibert et al. 1999 UK	To examine effects of improving playground equipment	Controlled before and after	Children playing in individual playgrounds in Cardiff	Cardiff, UK

* the study may qualify as an uncontrolled before and after study because of the highly non-equivalent nature of the control group.

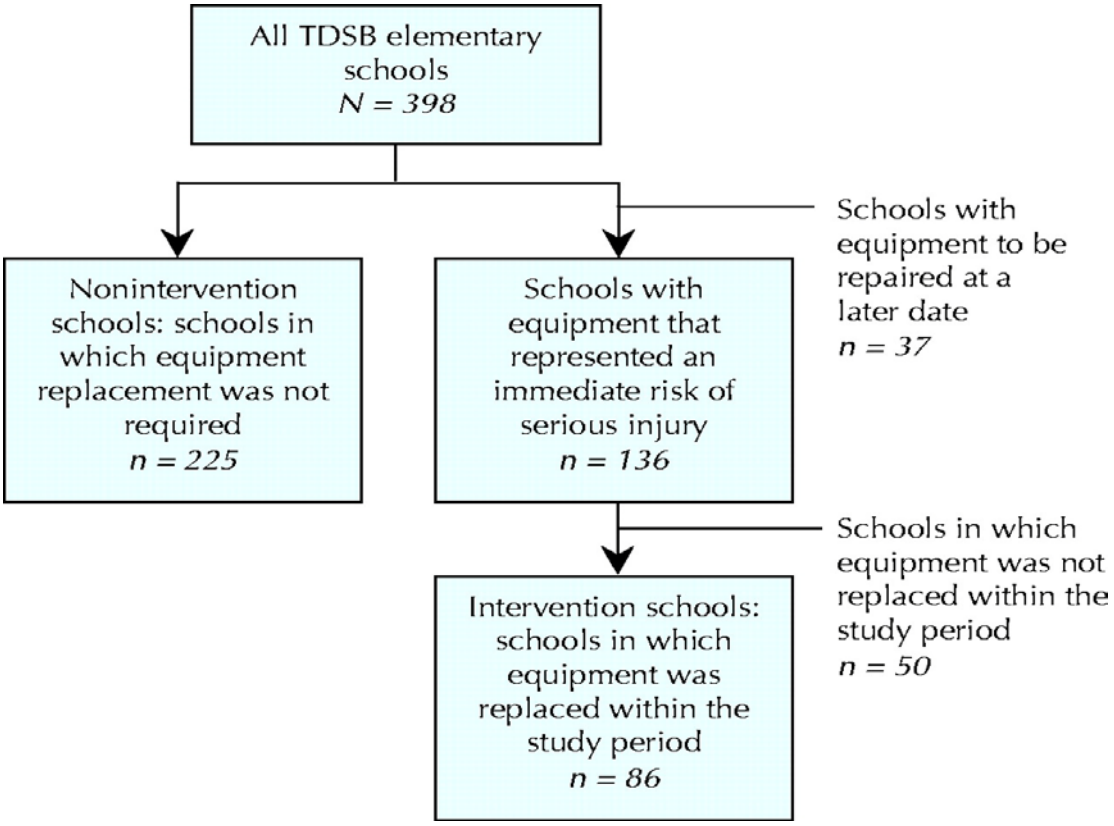
The Howard et al (2005) study evaluated the introduction of a method for assessing the compliance of all playground equipment in the TDSB. In the spring of 2000, all playground equipment in TDSB elementary schools (*n* = 398) was assessed for compliance with the 1998 CSA standards and 1990 CSA guidelines. The equipment were then either left as is, repaired or retrofitted, or removed and replaced. The following two factors were considered in making the decision: the severity of injury that could result from using the equipment and, where equipment was noncompliant, the feasibility of achieving compliance through repair or retrofit.

Figure 5 shows how intervention and non-intervention groups were selected in the Canadian study (Howard et al. 2005). 136 of the schools were assessed to have playground equipment that represented severe hazard. Out of this, 86 schools in which the equipment had been fully replaced with equipment compliant with safety standards constituted the intervention group. Another 225 schools where equipment did not require replacement were used as the non-intervention (control) group. A database of incident reports from the Ontario School Board Insurance Exchange was used to identify all injury events occurring at TDSB schools between January 1998 and December 2002 inclusive. All injuries to children 4 to 11 years of age that occurred within the school playground were included.

In the study by Howard and colleague, playground injury rates (injuries per 1000 children per month) were compared at the intervention schools and at the non-intervention schools before equipment removal and after equipment replacement. The same 10-month calendar periods were selected before and after the intervention to avoid bias related to seasonal variation in injury.

In the study by Sibert and colleague, children injured in public playgrounds in Cardiff and seen at the accident and emergency department were identified. The authors compared injuries and the injury rate per observed child in the 18 months before and after the changes were implemented, and between intervention and control groups. The five playgrounds where changes were made was used as the intervention group, while the14 playgrounds where the council had not made changes served as the control group

Figure 5: Determining the intervention and non-intervention groups of schools



Source: Howard et al. 2005

4.3.2 Playground standards: Results

Figures 6 and 7 show overall injury rate and equipment-related injury rate before and after for both intervention and non-intervention groups (Howard et al. 2005). Howard and colleagues demonstrated that equipment-related injury rate in the intervention group decreased after the equipment were replaced, however, the reduction did not reach statistical significance (RR=0.82 to 0.66 to 1.03) (see **Figure 7**). This is equivalent to an estimated 177 equipment-related injuries avoided. On the other hand, there was statistically significant reduction in injury rate in the intervention schools after the equipment was replaced (RR=0.70; 95% CI 0.62 to 0.78) (see **Figure 6**). This is equivalent to 550 injuries avoided in the post-intervention period.

The equipment-related injury rate in the non-intervention group increased by 15% during the period between July 1995 and December 1996, however it did not reach statistical

significant level (RR=1.15; 95% CI 0.96 to 1.37) (see **Figure 7**). The injury rate in the non-intervention schools increased by about 40% after the equipment was replaced (RR=1.40; 95% CI 1.07 to 2.53) (see **Figure 6**).

Sibert et al. 1999 found that injury rate per observed child was significantly reduced in the five playgrounds where changes had been made (see **Table 13**). The changes were significantly different in Roath Park with changes to both bark depth and monkey bars than in the four playgrounds with bark depth alone when compared with the control playgrounds. Similarly, the number of injuries and fractures reported were significantly reduced in the playgrounds with changes to playground facilities. Injuries and fractures in Roath Park dropped from 31 to 11 while fractures dropped from 13 to 4 ($p<0.001$) after monkey bars and bark depth were changed while in the remaining four Parks with changes to the bark depth, reported cases of injuries and fractures dropped to 21 and 6 from 53 and 23 respectively ($p<0.001$).

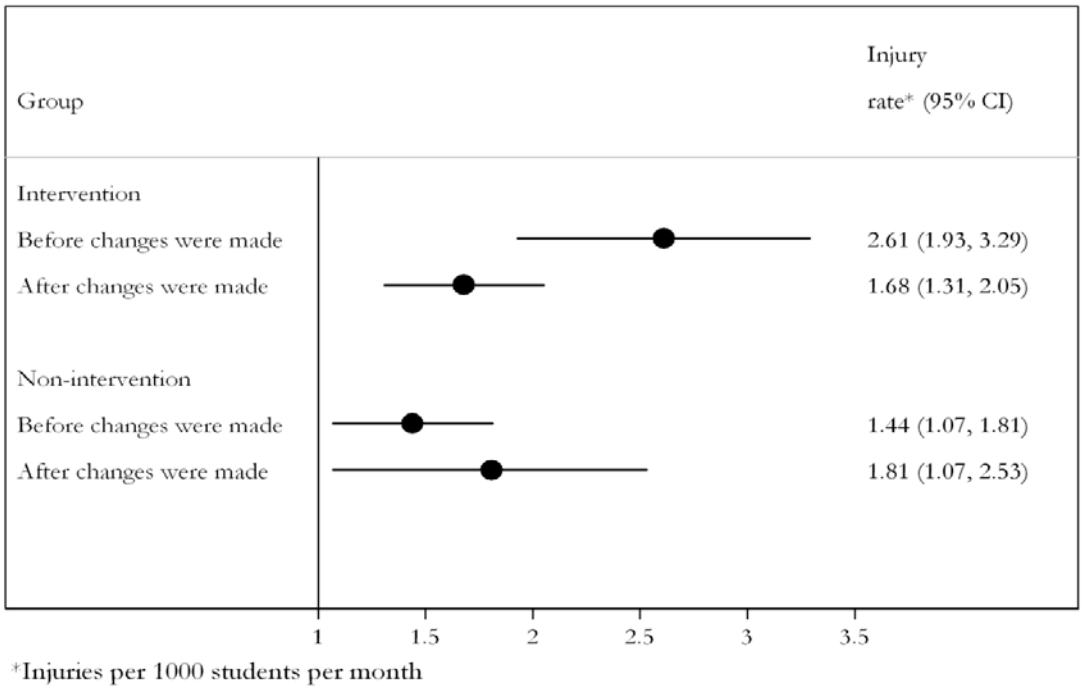
Table 13: Injury rates per observed child per 18 months in playgrounds in Cardiff

	01/1994 – 06/ 1995	***07/1995 – 12/1996***	***P value***	
	Injury rate*	Injury rate*	Before and after changes	Compared with control
Playgrounds with changes - bark depth (n=4)	0.719	0.297	<0.001	<0.03
Playground with changes (Roath Park) - Monkey bars and bark depth (n=1)	0.929	0.271	<0.001	<0.005
Playgrounds without changes (n=18)	0.433	0.346	-	-

* Injuries per observed child per 18 months

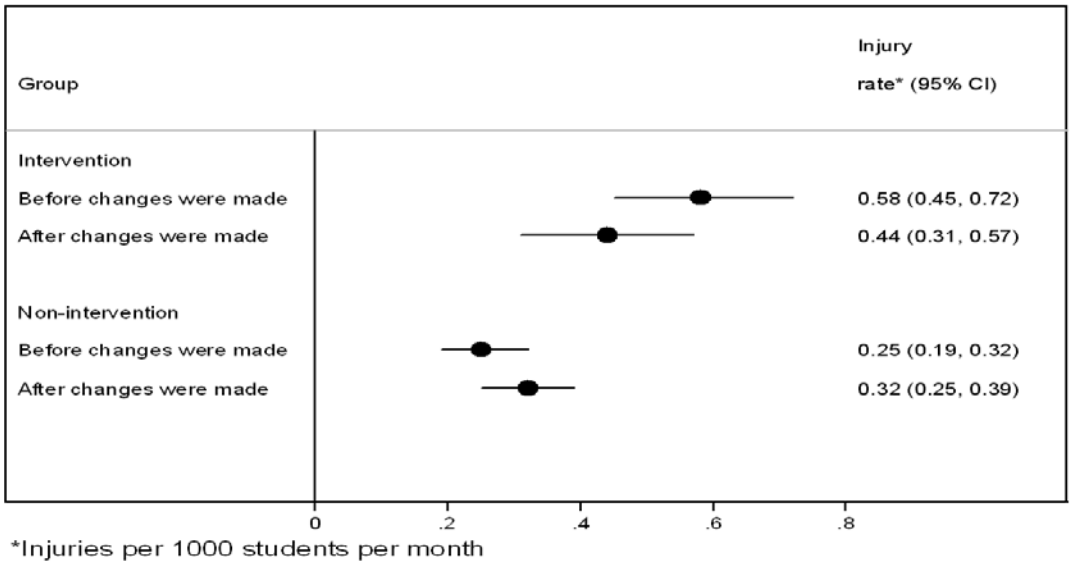
Source: Sibert et al. 1999

Figure 6: Injury rates before and after for intervention and non-intervention groups



Source: Howard et al 2005

Figure 7: Equipment-related injury rates before and after for intervention and non-intervention groups



Source: Howard et al. 2005

4.3.3 Playground standards: considerations

Howard and colleagues showed that the CSA standards were effective in identifying schools with unsafe playground equipment (Howard et al. 2005). Removing unsafe equipment and replacing it with equipment compliant with safety standards reduced the rate of playground injuries. The authors believed that the change in physical environment was the best explanation for the reduction in injury rates in the intervention schools and a possible deterioration in the nonintervention schools led to a rise in injury rates. The authors noted that the reduction in injury rate in the intervention group (non equipment related) may be possibly related to other additional dangers (fragmented asphalt, poorly drained and icy areas, steep embankments and degraded borders) that was addressed in the intervention schools. The non significant findings in equipment related injury suggest that the replacement of equipment does not have significant change on equipment related injury and the overall injury change is as a result of additional safety measures embarked upon in the intervention schools.

The authors (Howard et al. 2005) identified the following limitations. Amount of exposure to equipment or non-equipment play was not assessed in the study. The study did not measure supervision, which may have changed. Information on injuries was obtained from reports of teachers and other school employees, whose thresholds for recording and reporting injuries may have changed during the study. In addition to the limitations identified by the authors, it was identified that the control group used by the authors did not appear to be a control group in the real sense. The equipment in the control group were already compliant with CSA standards and as such, the intervention group and comparison group were similar. Howard and colleagues concluded that CSA standards were effective in identifying schools with unsafe playground equipment and that removing unsafe equipment and replacing it with equipment compliant with safety standards reduced the rate of playground injuries.

In the Cardiff study, in addition to the favourable injury outcomes reported, Sibert et al. 1999 reported that contrary to expectation, the changes made did not lessen the popularity of the playgrounds. The authors concluded that the surveillance program and changes made to the playground equipment have contributed to playground development and safety in Cardiff. In addition, the authors claimed that surveillance

program and partnership is comparatively simple to apply; it did not need expensive resources and it could be introduced widely.

Evidence statement 4: Effect of compliance with playgrounds standards on injury rates among children during play/leisure

There is mixed evidence from two controlled before and after studies that removal and replacement of unsafe equipment is an effective strategy for preventing playground injuries (Howard et al. 2005; Sibert et al. 1999) .

The Canadian study (Howard et al. 2005) demonstrated statistically non significant reduction in equipment-related injury rate in the intervention schools after replacement of equipment using the new Canadian Standards Association standards (RR=0.82 to 0.66 to 1.03). This translated into 177 equipment-related injuries avoided during the study period. The comparable equipment-related injury rate in the non-intervention schools increased by about 15% after the study period, although not statistically significant (RR=1.15; 95% CI 0.96 to 1.37). The overall injury rate reduced in the intervention schools (RR= 0.70; 95% CI 0.62 to 0.78) and increased in the non-intervention schools (RR=1.40; 95% CI 1.07 to 2.53) after the study period. However, in the UK study, injury rate per observed child was significantly reduced in the five playgrounds where changes (use of greater depth of bark and replacement of over head horizontal ladders with rope climbing frame) had been made compared to the control playgrounds without changes (Sibert et al. 1999).

Applicability: The non-UK study (Howard et al. 2005), (Canada) is only partially applicable to the current UK context due to similarities in level of economic development, nature of the playgrounds, as well as targeted populations. However, the Sibert et al.1999 (UK) findings are directly applicable.

4.4 Firework Legislation

Three studies, two before-and-after studies and one retrospective time series, were identified which assessed the impact of legislation on fire works injury. Two of the studies were from the UK, assessing the impact of legislation in Newcastle and Northen

Ireland respectively (Edwin et al. 2008; Fogarty & Gordon 1999) and one was from Italy, assessing the effects of enforcement and promotion program in the city of Naples, Italy (D'Argenio et al. 1996).

In the Naples study, existing laws prohibiting the sale of illegal fireworks were enforced by the police in the metropolitan Naples region during the 1993-1994 holiday season. This was in response to the surveillance in the region that identified that densely populated parts of the city and males between 10 and 14 year-old recorded the highest rates of fireworks injury. In addition, other measures were introduced within the region to reduce the number of fireworks associated injuries: streets were cleaned of unexploded fireworks and powder early in the morning of January 1, while children and the public were informed about the dangers and correct use of Fireworks. The media was also involved, giving considerable coverage and informing public about the risks of firework-related injury.

The study by Fogarty and colleagues (Fogarty et al. 1999) was set in Northern Ireland and it compared fireworks related injury before and after the legislation was relaxed in 1996. Before September 1996, Northern Ireland had banned all fireworks except sparklers because of the continued civil disturbance reported in that part of the United Kingdom. New more liberal legislations similar to other parts of the Kingdom were introduced in September 1996, which allowed all fireworks except those used by professional display organisers to be legally available to the public.

The study by Edwin et al. 2008, reviewed all the legislation affecting fireworks from between 1875 and 2004, together with time-series data on firework-related injuries from 1995 to 2005. The emphasis was therefore placed on assessing the impact of legislation after 1994 when the fireworks law became more important and restrictive. The Fireworks (Safety) Regulations of 1996-1997 regulated the type of fireworks that need to be supplied to the public and that fireworks should only be supplied to those aged 18 years and over. However, it became illegal to sell fireworks to anyone less than 18 years in 2003 and for under 18s to possess a firework in a public place. These regulations were further supplemented by the Fireworks Act 2003 and the Fireworks Regulations 2004, which limited the sale of fireworks to special times of the year,

including the run up to Bonfire night. In addition, air-bombs and mini-rockets were banned.

4.4.1 Firework Legislation: Study Characteristics

The study characteristics of the three studies are shown in **Table 14**.

Table 14: Fireworks study characteristics

Reference	*Aim*	*Method*	*Population*	Location
D'Argenio et al. 1996 Italy	To study the effects of a comprehensive, multifaceted intervention program to reduce fireworks-related injuries	Before and after	Children and adults in metropolitan Naples	Metropolitan Naples, Italy
Fogarty et al. 1999 UK	To examine effect of change in the pattern of firework-related injury following liberalisation of the law	Before and after	Children in Northern Ireland	Northern Ireland, UK
Edwin et al. 2008 UK	To assess the possible impact of the legislative changes on injuries in paediatric population	Retrospective time series	Paediatric population in Newcastle upon Tyne	Newcastle upon Tyne, UK

In the Naples study (D'Argenio et al. 1996), surveillance of fireworks injury in 18 emergency rooms was initiated by the Regional Epidemiologic Observatory of Campania in December 1992, a year before the study. The surveillance gave information on the injured in terms of time, place and person as well as the site, type and the circumstances of the injury.. This informed the process for an enforcement and publicity program (*Capodanno Senza Danno* – New Year's without Harm) that was implemented the following year.

To determine the impact of the program in the Naples study, records of intentional and unintentional injuries (date and hour of arrival, age, sex, commune of residence, expected duration of recovery, and the location and type of lesion) from the same 18 emergency rooms from the province of Naples as well as the Civil Hospital of Aversa were obtained between December 24, 1993 and January 6, 1994. The denominator data for rate calculations were obtained from national census data. The injuries rates were

compared before (December 1992 to January 1993) and after (December 1993 to January 1994) the intervention program was implemented.

The study by Fogarty and colleagues compared the effect of relaxation of firework legislation in Northern Ireland on the pattern of severe firework related trauma. Data on patients admitted to hospital during the six week period extending from October 14th to November 30th in 1996 and 1997 were obtained. This was compared with data obtained retrospectively on the number of patients admitted for firework related injury over the same six week period between 1993 and 1995. This period was considered because fireworks are mainly used in the United Kingdom around Halloween (October 30th) and Guy Fawkes night (November 5th) when the incidence of firework injuries peak dramatically. A total of 30 patients were admitted over the 5 year study period, with a mean annual number of admissions of 5.6 before the law change and 6.5 after it.

Edwin and colleagues (2008) reviewed the Northern Regional Paediatrics Burns Centre registers and the Newcastle Paediatric Hand Trauma database to identify all patients that sustained firework injuries between 1 January 1995 and 1 January 2005. The patients' hospital notes were reviewed to identify the nature/pattern of injury, burn management and outcome to compare with changes in legislation. The legislation changes over the years were identified from the Her Majesty's Stationery Office website and the Newcastle University Law Library, and their impact was assessed. They were also compared with that of other published studies and the UK government accident statistics.

4.4.2 Firework Legislation: Results

D'Argenio and colleagues found that fireworks injury was significantly lower during the 1993-1994 season when the enforcement and publicity programme was implemented. The overall number of persons injured by fireworks during this period was 183, 48% lower than the previous year ($p<10^{-9}$), and an overall injury rates of 6.1/100,000 compared to 10.0/100,000 the previous year (1992-1993) when the intervention programme was not in place.

In the Naples study, although age-specific case rates declined for all age groups during the intervention period (1993-1994), a higher rate of decline was reported in the 10-12

year-old group, which recorded a 51% decline from 45.9/100,000 children in the season before the intervention programme to 22.3/100,000 children. Boys and men were more likely to experience fireworks injury than girls and women, however the male: female ratio changed from 9:1 in 1992-1993 to 15:1 in 1993-1994 (i.e. an increase in the inequality between the sexes in experiencing this type of injury). The most frequently affected part of the body was the hand (44.7%) and children were more likely to have facial injuries than adults. In addition, severe injury declined by 32% after the intervention. The number of hospitalization from fireworks related injury in 1993-1994 dropped by 43% from 102 to 58 while the rate of hospitalization among those who were injured remained constant.

Table 15 shows the nature of the injuries sustained and the total numbers before and after the legislation was changed (Fogarty & Gordon 1999). The average age for patients admitted for fireworks related injury was 14 years both before and after the legislation was relaxed. Boys were mostly affected (76%) and most of the injuries were as a result of use of bangers in both series (retrospective and prospective studies). The study by Fogarty and colleagues identified the mean annual number of admissions during the retrospective and prospective period as 5.6 and 6.5 respectively, giving the incidence of fireworks admission as 0.38 per 100,000 in the retrospective study and 0.43 per 100,000 in the (i.e. after) prospective study period. However, the annual number of patients admitted in the study was very small so a statistical significance test was not possible.

Table 15: Number of admissions and nature of injury

	Number of patients					
	Retrospective period			Prospective period		
Nature of Injury	1993	1994	1995	1996	1997	All years (No./%)
Blast Injury	4	5	0	7	0	16(53%)
Burn-to upper limb	0	0	0	2	1	3(10%)
Burn-to multiple sites	0	2	4	0	0	6(20%)
Eye Injury	N/A	1	1	1	2	5(17%)
No of admissions(/yr)	4	8	5	10	3	30

Please note: (The authors did not specify if the data presented is for children or adults)

Source: Fogarty et al. 1998

In the study by Edwin and colleague, a total of 54 children were identified with firework related injuries during the 10 year period of study (1995-2005) in the Northern Regional Paediatric Burn Centre (Edwin et al. 2008). The average age of the injured was 11.4 years and male children were more likely to be injured (82% of those injured). 43% of the children required admission while the hand was the most commonly affected part of the body (61%).

Edwin et al. 2008 identified that the paediatric regional data for UK (**Table 16**) also show a drop in the numbers of firework injuries seen in UK regions (except for eastern region) between 2001 and 2004. The North & Yorkshire region and the North West region recorded the greatest decreases in the UK. In contrast, injuries appeared not to decline in Scotland and Wales. The nature of fall recorded between 2001 and 2004 for the regions could not be explained further as full data were not made available. Before 2003, 28 (52%) children with firework injuries were burned outside the restricted period (before 21st October or after 14th November). However, in 2004 after the 2003 Fireworks Act which restricted the period of availability of fireworks was introduced, only 1(2%) child was injured outside the 3-week period.

Table16: Firework injuries by region

Year	UK	North & Yorks	Scotland	Trent	Eastern	Greater London	South East	South & West	West Midlands	North West	Wales
2001	707	134	57	71	31	50	52	45	65	170	32
2002	583										
2003	588										
2004	565	82	37	61	48	33	49	44	42	128	41
2005	494	82	54	64	28	27	47	20	37	102	33
Total	2937	298	148	196	107	110	148	109	144	400	106

Source: Edwin et al. 2008

4.4.3 Firework Legislation: Considerations:

D'Argenio and colleagues found that the intervention programme (which consisted of combination of enforcement of fireworks law, media campaign, education, and street cleaning) was effective in substantially reducing the number of persons seeking treatment for fireworks injuries during the intervention period. They also identified that the age group (10-12 years) with the greatest risk of injury in the preceding year recorded the highest decrease in injury during the intervention period. The authors

suggested that in addition to the enforcement and publicity programme, other factors including the depressed economic situation of the area, which may have decreased the number of fireworks purchased, and a major rainstorm that took place on New Year's day, which may have impeded the collection of unexploded fireworks by children may have influenced the findings to indicate a positive reduction in fireworks injury. The authors also considered that the observed differences in injury rates between this study and other similar published reports despite having similar socio-demographic characteristics may be partly due to differences in surveillance methodologies used. The authors concluded that the programme was effective because it was a more focal programme that emphasized an extensive media campaign with a limited number of messages.

Fogarty and colleagues (1999) noted that the fact that the outcomes been considered in their study (firework related injury requiring hospital admissions) were small in number it did not allow for a statistical significant increase in the number of fireworks associated injuries following relaxation of the law nor a change in the pattern of injury. However, the cause of fireworks related injury has been largely attributed to use of bangers, often being purchased by children illegally from unlicensed traders. They conclude that liberal legislation does not significantly increase severe fire work injuries neither does a restrictive law necessary leads to decrease in firework injury. Based on this study and other reports, the authors suggest that legislative control can only be effective if there is enforcement of the law.

Edwin et al. (2008) and colleagues noted that the Fireworks (Safety) Regulations 1997 did not have a significant impact in reducing the number of injuries related to fireworks in Northern Regional Paediatric Burn Centre in 1997 until the following year when a slight reduction was reported. Injuries from the use of bangers, however, have not been seen by the centre since then. Edwin et al. (2008) conclude that the 2003 fireworks act, that confined the sale period to a 3-week window, led to a reduction in the number of children injured by fireworks. However, in between the 2003 and the 2004 legislative changes, the authors observed a steady increase in the number of children treated for fireworks injury. They were of the opinion that it could have been due to increased availability of imported fireworks and from their sale in supermarkets as reflected in the total revenue received from the importation of fireworks in the years following 2003. For the legislation

to be effective, the authors suggest stricter enforcement of existing laws and awareness of the dangers of fireworks to the general public and children.

Evidence statement 5: Impact of fireworks legislation on fireworks related injuries among children during outdoor play and leisure
There is weak evidence from two before and after studies (from UK and Italy) and one retrospective time series (from UK) on the effect of fireworks legislation and enforcement activities on firework related injuries.(D'Argenio et al. 1996; Edwin et al. 2008; Fogarty & Gordon 1999) One study in Italy reported that a comprehensive, multifaceted programme, comprising the combination of enforcement of fireworks law, media campaign and education reduced the rate of fireworks related injury from 10.0/100 000 before the intervention programme to 6.1/100 000 after it was implemented (D'Argenio et al. 1996), and a time-series based study found that amendments to restrictive fireworks legislation led to a reduction of firework related injury in children (Edwin et al. 2008). The other study from Northern Ireland, however (Fogarty & Gordon 1999), did not find a significant increase in fireworks related injuries requiring hospital admission following liberalisation of the law on fireworks sale (incidence of admissions before: 0.38/100000; after: 0.43/100000). However, the annual number of injuries in this study was already very small relative to annual variations. Applicability: The Italian study (D'Argenio 1996, Italy) is partially applicable to current UK context while the Fogarty & Gordon 1999 and Edwin et al 2008 (UK) findings are directly applicable. The Northern Ireland study (Fogarty & Gordon 1999, UK) may not be directly applicable to the rest of UK because of the civil unrest reported in that part of the kingdom.

4.5 Drowning Prevention

We identified one before and after study that described a regional drowning prevention campaign (Bennett et al. 1999). The study was set in USA and it

aimed to increase general water safety awareness, increase life vest use among children 1-14 years on boats, docks, beaches, or at pools, and increase life vest ownership. The drowning prevention campaign, called “Stay on Top of it” focused on life vest use as the primary prevention method and lasted three years. The following programmes were developed to increase general water safety and life vest awareness: coalition support and involvement, community partnerships, sponsor relationships, news reporting and public service advertising, educational materials, interactive displays. Programmes to increase life vest availability included loan programs, discount coupons, retail displays and bulk buy for public pools. The campaign elements were disseminated through organizations and care providers who had direct contact with families.

4.5.1 Drowning Prevention: study characteristics

This study was set up in King County, Washington, USA. Key study characteristics are presented in **Table 17**. Social marketing provided overall structure for the surveys, planning and tracking, target groups, and use of multimedia channels. The study used before and after study design to evaluate impact of the programme’s effectiveness.

Four telephone surveys were conducted to determine if parental knowledge, attitudes, and reported use and ownership of life vests by children changed as a result of exposure to the campaign: a baseline (pre-campaign) survey in March 1992, two tracking surveys in September 1992 and 1993, and a post-campaign survey in September 1994. The baseline survey assessed behaviours, attitudes, and potential strategies. The tracking surveys measured awareness, and the post-campaign survey assessed awareness, behaviours, attitudes, and factors associated with life vest use.

Table 17: Drowning prevention campaign study characteristics

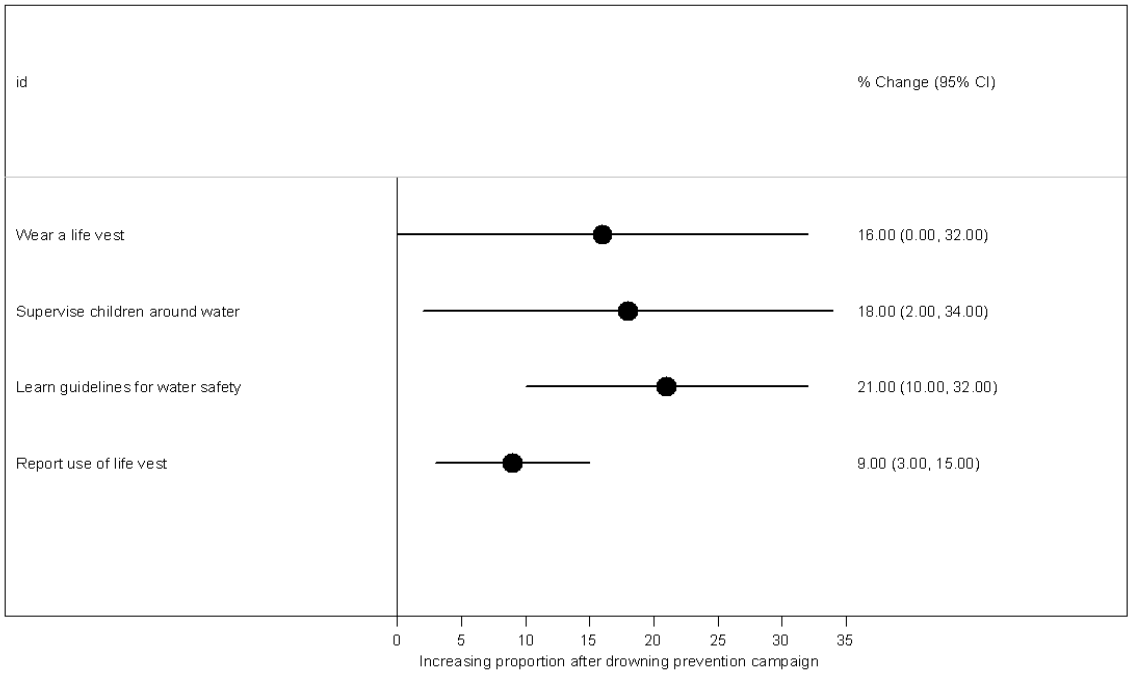
Reference	Aim	Method	Population	Location
Bennet et al. 1999 USA	To increase life vest use among 1-14 year old children on boats, docks, at beaches, and	Uncontrolled before and after	Children up to 9 years with some elements extending to children up to 14 years	King County, Washington

	swimming pools, and to increase general water safety awareness.			

4.5.2 Drowning Prevention: Results

Figure 8 shows results of the impact evaluation for the study by Bennett and colleagues. There was reported increase in parent's awareness of the campaign in both prompted and unprompted responses. Those who recalled the campaign, without prompting, reported three campaign messages most frequently: wear a life vest, supervise children around water and learn guidelines for water safety. "Wear a life vest" recall increased from 31% to 47% from the first to third year, a change of +16% (95% CI 0% to +32%). "Supervise children around water" was the second most frequently mentioned message, increasing from 26% to 44%, a change of +18% (95% CI +2% to +34%). "Learn guidelines for water safety" increased from 7% to 28%, a +21% change (95% CI +10% to +32%). Reported use of life vest at a beach, lake, river or dock and in or around a swimming pool for all child age groups increased significantly, from 20% to 29% (+9%, 95% CI +3% to +15%, $p<0.01$).

Figure 8: Results of impact evaluation of drowning prevention campaign



Source: Bennett et al. 1995

The odds for reported use of a life vest by a child at beaches, pools, or docks were greater among those surveyed after the campaign compared with the baseline survey: odds ratio 1.6 (95% CI 1.1 to 2.5). The association remained significant after controlling for other potential confounders - child vest ownership, parent age, parent's confidence fitting a vest, child's swimming ability, parent use of vest, perceived susceptibility to drowning, parent's education and income, and perceived efficacy of vest. Childhood drowning could not be determined because the total numbers of drowning was small, making statistical test difficult. During the three years before the campaign, 12 children aged 1-14 years drowned in King County, compared with eight deaths in the campaign. The rate ratio for drowning mortality during the campaign, compared with what it might have been if King County had followed the trend of the state, was 0.58 (95% CI 0.21 to 1.58).

4.5.3 Drowning Prevention: considerations

The authors found that three year drowning prevention campaign was associated with a significant increase in reported use of life vests at beaches, docks, and pools among children age 1–14 years. Similarly, life vest ownership by children increased significantly among families aware of the campaign. In addition, children were more often reported by their parents to wear a life vest if a parent knew of the campaign, was comfortable fitting a vest, felt the child could not swim well, if the child was younger, and if the child owned a life vest.

The authors noted some limitations that may bias the study findings. Some of the increase in use may be attributable to other educational efforts. The use of non-random digit dialling sampling method could have biased results irrespective of the intervention. Similarly, the use of self-reported information may also bias the results, because people tend to exaggerate positive behaviours. It is possible that people who were aware of the prevention campaign were more likely to exaggerate use of life vests. The proportion of interviewed families with high incomes was greater than for all King County families, so our findings may not apply to low income families. The pre-campaign survey used a different sampling method than the tracking and post-campaign surveys. It is therefore possible that the post-campaign survey population was more likely to use life vests than the pre-campaign population.

The authors concluded that comprehensive, community based campaign, with a focus on increasing the use of life vests, may be one method of decreasing drowning among children; and suggested that programmes targeting life vest use may want to consider multiple strategies that include targeted audiences and messages by water site, increasing parent confidence in fitting a life vest and life vest availability through discount and loan programmes.

Evidence statement 6: Impact of drowning prevention campaign on life vests use and ownership among children
There is weak evidence from one before and after study (Bennett et al. 1999; Fogarty & Gordon 1999)[-]) in the USA that comprehensive, community based campaign

programme (coalition support and involvement, community partnerships, sponsor relationships, news reporting and public service advertising, educational materials and interactive displays) with a focus on increasing the use of life vests, increase the use of life vest.

One study from USA found a significant, although modest, increase in self reported life vest use (OR=1.6; 95% CI 1.1 to 2.5) and ownership (pre-campaign=69%; post-campaign=75%) among children aged 1 to 14 years at beaches, pools, or docks after three year drowning prevention campaign. Programmes targeting life vest use may want to consider multiple strategies that could include targeted audiences and messages by water site, increasing parent confidence in fitting a life vest, and life vest availability through discount and loan programmes. . During the three years before the campaign, 12 children aged 1-14 years drowned in King County, compared with eight deaths in the campaign.

Applicability: The study is deemed to be partially applicable to the UK as it was carried out in the USA a country of similar economic development and probable exposure of children to leisure activities by lakes, sea, rivers and other waterways.

5 Discussion

5.1 Principal findings

Compulsory wearing of bicycle helmets

We found eight evaluations of legislative, strategic or mass-media initiatives to increase the use of bicycle helmets by children. The five controlled before and after studies of introducing legislation to make the wearing of bicycle helmets by children compulsory showed comparatively higher rates of helmet wearing (in 3 studies) and/or lower rates of head injuries than in comparator areas/groups (in 3 studies). These studies were all in the USA or Canada and did not describe specific enforcement strategies alongside the new legislation. Another study from the USA (Gilchrist et al. 2002) showed that active police enforcement of existing bicycle helmet laws, in combination with a helmet give-away and education programme, also increased helmet use by children – although it was not possible to identify which component of this programme contributed most to the increased helmet-wearing.

Such positive evidence of the effectiveness of legislation to make bicycle helmets compulsory should, some believe, be considered alongside other priorities of society and individuals, such as personal liberty, public acceptability and the possible adverse impacts on the public health benefits of cycling (Unwin, 1996).

There were only two evaluations of non-legislative strategies to increase bicycle helmet use by children: one of a mass-media campaign in the USA, and the other in the UK of a hospital-led bicycle helmet promotion programme based on school educational visits with a low cost helmet purchase scheme (Bergman et al. 1990; Lee et al. 2000). They

were both controlled before and after studies, and showed significantly greater increases in helmet wearing by children in the campaign/programme areas than in control areas (although helmet wearing was self-reported rather than observed in the UK study). The UK study, in the city of Reading, also showed that the rate of cycle-related head injuries in under 16 year-olds almost halved following the hospital-led educational programme.

Implementing playground safety standards

There was mixed evidence from two controlled before and after studies that the replacement of unsafe safety equipment is an effective strategy for preventing playground injuries. This evidence related to both school playgrounds (in Canada) and public playgrounds (in Cardiff, Wales). In the Canadian study the control group comprised school playgrounds which were judged to already meet the Canadian safety standards, so this may not be regarded as an equivalent control group.

Firework sale legislation and safety promotion

There was weak evidence from two uncontrolled before and after studies and one retrospective time series study of the effect of fireworks legislation, enforcement activities and educational activities on firework-related injuries. One of the studies, in Northern Ireland, evaluated the impact on fireworks-related admissions to hospital of a relaxation in the laws relating to the sale of fireworks. Although this study showed no resultant increase in such injuries, the other two studies showed reductions in relevant injuries following the introduction of or tightening of laws restricting the availability of fireworks.

Drowning prevention through promoting the use of life vests

There was weak evidence from one uncontrolled before and after study, in the USA, that a comprehensive, community-based campaign to increase the use of life vests (buoyancy aids) increased their use by children. However, the main outcomes were both self-reported – life vest use and life vest ownership, and there was no control area/group in the study.

5.2 Strengths and limitations

5.2.1 Strengths of the review methods

This review has been conducted by experienced researchers and information scientists and according to a pre-agreed and detailed review protocol, including well specified review questions. The search strategy was developed and agreed through discussion between information scientists at WMHTAC and NICE, to best meet the review protocol's requirements without creating an unrealistically large number of titles and abstracts to screen.

There has been checking by a second reviewer of: study inclusion/exclusion decisions at full text; data extraction to evidence tables, and; the critical appraisal checklist completion for each study. The searches were run on all the relevant bibliographic databases. In addition, members of the CPHE team also suggested relevant papers for possible inclusion.

5.2.2 Limitations of the review methods

Restricting the searches of the core databases to children only may have risked missing some relevant studies relating to events and activities for all age groups. However, no restrictions by age or population group were applied to the searches of the 'topic specific' databases in an effort to make the searches more inclusive without resulting in an unmanageable yield of references.

A key potential limitation of this review is the lack of data extraction and critical appraisal of all includable studies relevant to promoting the use of bicycle helmets and the monitoring and implementation of playground safety standards. After screening all titles and abstracts 46 studies met the review's inclusion criteria, which would have been too many to properly data extract, quality assess and synthesise within the time and other resources available. Therefore, with the agreement of the analysts at NICE, 18 of the lower quality (study design) studies about bicycle helmets, and 14 of the studies originally included about playground standards were not data extracted or quality assessed. (The abstracts and titles of these excluded studies are shown in Appendix 6.)

While data extraction from the included studies to evidence tables was straightforward, the preponderance and variety of non-randomised study designs made application of the

generic study quality assessment checklist difficult. In particular, in the absence of random allocation, and where control groups may be defined by area or by age-group, many of the checklist questions on 'method of allocation to treatment' are often irrelevant or difficult to interpret. Many of these critical appraisal questions are worded in a way that implies that particular study participants are recruited and followed up over the study period (as they would be in a clinical trial); however, all of the studies in this review actually rely on repeat cross-sectional data (either before and after or interrupted time-series) relating to areas, making the interpretation of such questions difficult.

5.2.3 Limitations of the studies found

Number and quality of studies included

Perhaps the most obvious limitation of the studies found is that - apart from those about bicycle helmet legislation or promotion campaigns – there are very few effectiveness studies overall, and relatively few which have used a rigorous research design. The highest quality study design used was controlled before and after studies (all eight studies about bicycle helmet promotion or legislation, and the two studies about enforcing playground standards). While it is often impossible to randomise areas or communities to different legislation, or to different regional strategic policies for preventing injury, there may sometimes be opportunities for more rigorous designs (e.g. to use a 'step-wedge' design for auditing compliance with playground standards). Also, as discussed below, there are a number of ways of increasing the internal validity of non-randomised controlled studies which could have improved the studies included in this review.

The three studies about firework legislation and safety promotion, and the one study about a campaign to reduce drowning by promoting life vests, were all uncontrolled before and after studies. This is a level of evidence which would normally be excluded by most systematic reviews of medical treatments or of the effectiveness of organisational interventions (e.g. by Cochrane Collaboration review groups).

Because of this, it cannot be ruled out that some of the policy-outcome associations found in these studies could be due to other factors changing over time, rather than the introduction (or enforcement or cutting back) of the legislation or promotional programme of interest. Also, while the studies of legislation or other strategic approaches to

increase bicycle helmet usage did present data from areas or groups not exposed to the law or strategy, the extent to which these control areas or groups are adequate is sometimes questionable. For example, in the Howard et al. 2005 study of a programme of replacing school playground equipment, the control (non-intervention) schools were those which by definition already met the Canadian safety standards for play equipment, and therefore were inherently non-comparable. Also, in at least one of the included studies (Lee et al. 2000), the before and after data for the intervention and control area was only reported for one of the study outcomes (self-reported bicycle helmet use) but not reported for other important outcomes of interest (head injury rates). Such a study is therefore strictly both a controlled and an uncontrolled study, depending on which outcome is seen as most important. Lastly, a number of the studies used before and after outcomes in adults as control group data (Ji et al. 2006, Li et al. 2005, and Hagel et al. 2002), even though there would be differences between adults and children in cycling exposure, cycling purpose (play vs other reasons), procedures for admission for treatment, and possibly even the protective effect of the helmets themselves (see the relevant Considerations section, 4.2.1.3).

For the evidence on promoting the use of bicycle helmets and on playground safety standards – where control area/group data was generally available – we believe that it is unlikely that the exclusion of the studies with a weaker design would alter our conclusions about the impact of legislation, mass media, and their enforcement or promotion. However, even though the validity of their findings would have been given less weight, it is still a limitation of this review that there was insufficient time to include the results of the 18 uncontrolled studies about bicycle helmet legislation or mass media campaigns or the 14 studies about the impact of playground standards (see Appendix 6).

Country and settings of the studies

Only four of the included studies had been conducted in the UK (including one in Cardiff, and one in Northern Ireland), potentially limiting the applicability of the included studies to current UK policy. However, there is a paradoxical trade-off here, in that research about jurisdiction-wide policies (like legislation) will sometimes intrinsically be *less applicable* to the UK when the research has been conducted in the UK, since this will often mean that the specific policy or legislation has already been rolled out (or even

superseded). In these circumstances, it is only if the research shows convincingly that the already adopted strategic policy or law has no effect, and/or adverse effects, that it would be deemed applicable to the UK setting (i.e. if the implied policy change is repeal of the law or policy reversal).

Variation in impact by subgroup or co-factors

Not counting those studies which used outcome data for adults as control group data, few of the studies reported any outcomes for different subgroups of children in the study areas. If they had, it may have helped us to answer review question 3 ('*Which other activities or circumstances are associated with greater or lower effectiveness of mass media approaches to managing risk and safety during play and leisure*?').

However, two studies which examined time series data pre- and post- bicycle helmet legislation (Ji et al 2006 and Lee 2005) both found the impact of the legislation to be lower amongst black people than white people and Asians. However, while the Ji et al study showed Hispanics as responding poorly compared with other ethnic groups, in the Lee study Hispanic ethnicity was associated with greater changes in the proportion of head-TBI following legislation. As well as having potentially different socio-cultural attitudes towards obeying the law, it may be possible that bicycle safety helmets are less affordable to some ethnic and socio-economic groups. However, in a small rural community in Georgia USA (Gilchrist et al 2000), they reported that children's helmet use increased significantly in all race–gender strata (although they did note indicate whether the size of the increase varied by race or gender).

Since legislation, regulations or standards of which noone is aware cannot be effective, it is particularly important that studies which evaluate these strategies always describe and preferably also measure how the legislation was *enforced* and how it was otherwise *promoted* or publicised. These are co-factors which will always condition the effectiveness of these strategies, so the specific types, intensity and duration of enforcement and promotion activities should always be documented alongside descriptions of the legislative or regulatory changes made.

Variation in impact by setting/location

In general, most included studies had only one intervention area and one control area, and did not report outcomes for different sub-areas within a region or country. This limits any conclusions that can be made about whether the legislation or other strategic programme might have a different impact in different types of community or regional setting. However, the study by Edwin et al 2008 on the impact of firework-related legislation in the UK, suggested that there were substantial inter-regional differences in the reductions in firework-related injuries over the period from 2000 to 2005, with the greatest percentage reductions in those regions that had the highest number of injuries.

Also, the Macpherson et al study 2002 (which compared annual head injury rates for 1994 to 1998 from four Canadian provinces that implemented bicycle helmet legislation, and from seven provinces that didn't), showed both that the impact was greater in some provinces more than others, and that the reductions in head injury rates in some no-legislation provinces (e.g. Saskatchewan) were greater than those in all of the legislation provinces. However, it was not possible to link these variations to any particular environmental, socio-demographic or other characteristics of the provinces. Also in Canada, the Hagel et al 2006 study estimated that bicycle helmet use increased in residential areas and on commuter routes in both males and females, regardless of average annual income.

Other review questions for which evidence was lacking

Our review question 4 asked *in what ways* the relevant strategies, policies and regulatory or legal frameworks improve the planning, implementation and effectiveness of programmes/initiatives to manage the risks to and safety of children during play and leisure outdoors. In general, studies provided little or no evidence in relation to this question, instead reporting just the main compliance or injury outcomes for the before vs after and/or intervention vs control comnparison. For example, as already noted in the considerations section (4.2.1.3), it was unfortunate that those studies which reported bicycle-related head injury tended not to also measure changes actual observed helmet use. Had they done so, it would strengthen inferences that it was increased helmet wearing, as a result of the legislation, which caused any reduction in head injuries found.

Review question 5 asked how mass media strategies may improve the effectiveness of legislation, regulation or standards. Again, we were unable to find reliable evidence

about this from the studies included in the review. To answer this question adequately would either require some kind of 'factorial design' study (e.g. in which study areas were selected which were exposed to either legislation alone, the same legislation with a mass-media campaign, or neither), or for there to be subgroups within an intervention area covered by legislation which had different levels of measured exposure to a mass-media campaign about legislation or regulations. We found no studies which explored the impact of mass-media strategies in such ways.

5.2.4 Research recommendations

Our main research recommendation is that more research and better quality research should be conducted into the effectiveness (and cost-effectiveness) of legislation, regulations, standards and/or other strategic approaches to their enforcement or promotion.

Strategic policy or legislation is inevitably applicable at a regional or national geographical level, and therefore random allocation to different policies or legislation is generally neither feasible nor appropriate. However, there are clearly other opportunities in this area of policy evaluation to improve how such policies are evaluated.

Given that before and after studies are likely to remain the most feasible evaluation design in most cases, the lessons from the research included in this review show scope for:

- Greater attention to choosing control groups which are more demonstrably equivalent to the localities or communities where the programme or legislation has been implemented.
- More standardised and, wherever possible, the prospective collection of outcome data from both intervention and control areas/groups.
- The greater use of systematically observed rather than self-reported safety behaviours or compliance.
- Where events are relatively rare (e.g. serious head injuries) to collect data for sufficiently long time periods before and after the change in policy/legislation, or from more communities, and in the same way in intervention and control areas.
- Wherever possible, to collect outcome data for different population subgroups who may respond to or comply with the programme/policy differently.

- Alongside the outcome data, there is a need to collect data on relevant potential confounders, or exposure to other programme components or policy changes (e.g. changes in the minimum design standards, or the price of child bicycle helmets over time). In particular, with legislative or regulatory changes, the specific types, intensity and duration of related enforcement and promotion activities should *always* be fully documented alongside descriptions of the legislative or regulatory changes introduced.

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7 Appendices

Appendix 1 – Review Protocol

Strategies, policies and regulatory or legal frameworks and/or mass media campaigns to prevent unintentional injury to children during play and leisure in the external environment

PH Programme or PH Intervention process:	**PROGRAMME**
Name of Programme or Intervention:	Strategies to prevent unintentional injuries among under 15s
Programme Report No.:	PDG 6
CPHE Collaborating Centre:	PenTAG
Project led by Collaborating Team:	PenTAG
Project manager at PenTAG	Rob Anderson Rob.Anderson@pms.ac.uk 01392 406967
CPHE Technical Lead	Louise Millward
CPHE Associate Director	Simon Ellis

Long title: A review and synthesis of evidence relating to:

(i) Strategies, policies and regulatory or legal frameworks for planning, implementing, enforcing or promoting activities to prevent unintentional injury to children and young people during play, sport and leisure in the external environment.

(ii) Mass media campaigns.

Short title: Strategies, policies and regulatory or legal frameworks and mass media campaigns for guiding, enforcing or promoting activities to manage risk and safety during play and leisure, to prevent unintentional injury to children and young people.

Overall PUIC Programme details outlined by the CPHE Scope

This project is one of five pieces of work informing NICE guidance on how to prevent unintentional injuries among children and young people aged under 15. The others are:

- Preventing unintentional road injuries among under 15s: road design'. This guidance will focus on the design and modification of highways, roads and streets. It is being developed using the public health intervention process.
- Preventing unintentional injuries among under 15s: home environment'. This guidance will focus on the supply and/or installation of safety equipment and the provision and conduct of home risk assessments. It is being developed using the public health intervention process.
- Preventing unintentional injuries among under 15s in the external environment'. This guidance is expected to cover sports and leisure. Is being developed using the public health intervention process. A scope is currently out for consultation (NB: as at June 2009).
- 'Preventing unintentional road injuries among under 15s: education and protective equipment'. This guidance is expected to cover safety equipment such as helmets and visibility clothing. It will be developed using the public health intervention process. A scope will be developed

Population groups that will be covered

- Children and young people aged under15, particularly those in disadvantaged circumstances (for example, those living with families on a low income, living in overcrowded housing or with a lone parent).
- Parents and carers of children and young people aged under15.

Population groups that will not be covered

- Anyone aged 15 or over, except the parents or carers of children and young people.

Interventions/Activities that will be covered

- Activities/interventions that will be covered by the Programme guidance

This guidance will focus on: in the external environment. It will cover the following measures:

- primary and secondary legislation
- regulation and standards
- enforcement.

The guidance will also cover compliance with the above and supporting mass-media campaigns.

In addition, it will cover the following in relation to preventing unintentional injuries in children under 15:

- injury surveillance, data collection and analysis
- workforce training, support and capacity building.

Steps will be taken to identify ineffective as well as effective approaches.

Activities/measures that will not be covered by the Programme guidance

Legislation, regulation, standards, enforcement and compliance relating to:

The technical efficacy of products (including, for example, airbags, brakes and smoke detectors).

Tertiary prevention, including emergency services, treatment and rehabilitation to limit long-term impairments and disability caused by injury.

Review team

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

Rob Anderson, Deputy Director, PenTAG	Key contact and overall responsibility for delivery to NICE, ensuring report meets agreed protocol, discussing and agreeing with CPHE any divergences from protocol. Writing and editing drafts and final report.
Khalid Ashfaq Ismail Yahaya Research Fellows at WMHTAC	Study inclusion/exclusion checking; data extraction checking; quality appraisal checking; summary and synthesis of selections of studies. Writing and editing sections of draft report.
Ann Fry-Smith and Sue Bayliss Information Specialists, WMHTAC	Conducting any formal searches (web-based, grey literature) for relevant reports, advising on search process.

Key deliverables and dates

Draft review protocol	8th June 2009
Final protocol agreed	17th July 2009
Draft search protocol and strategy	22th July 2009
Final search protocol agreed	24rd July 2009
Interim progress teleconference/meeting: To discuss the nature and volume of the emerging evidence, decisions that may arise and how best to summarise and synthesise the data.	6th Aug 2009
Draft Report (with draft evidence statements)	15th Sep 2009
Final Report	29th Sep 2009

Keys terms/ glossary used throughout the review	Definition
Children and young people	Those aged under 15
Compliance	"Compliance" in this protocol relates to those at whom legislation, regulation or standards are aimed. For example, in the case of fire alarms, this may be practitioners, such as fire office departments, who may be required to comply with regulation for their installation; or it may relate to parents or other carers, at whom standards about checking and maintaining the alarms are aimed.
External environment	Physical environments not part of the home or school boundary or road and street network that are used by children and young people.
Leisure	Time spent in, or free for relaxation or enjoyment
Leisure activities	Including activities in public external settings such as parks, countryside, seaside and beaches, waterparks and natural water (e.g. ponds, lakes, rivers and canals); visitor attractions such as theme parks, amusement parks, farms and zoos; skate parks, nature trails. Activities may include family outings, bike rides, swimming, bonfire and firework parties, etc
Play	" …freely chosen, personally directed, intrinsically motivated behaviour that actively engages the child…" (Play England). This would include games and sports played informally and without adult supervision such football, cricket, rounders.
Mass Media	For the purposes of this strategic programmes guidance, advertising communications and publicity targeted at and designed to reach the whole population within a country or large region within a country. (NB. The intervention guidance, in contrast, will focus on education designed targeted at and designed to reach sub population at community and/or smaller group level.)
Mass media strategies	A strategic action to disseminate information
Strategies and regulatory or legal frameworks	Legislation (primary and secondary), regulation, standards and their enforcement
Standard	An agreed, repeatable way of doing something. It is a published document that contains a technical specification or other precise criteria designed to be used consistently as a rule, guideline, or definition. They are voluntary,

	but may be referred to or made compulsory by other laws or regulations. (Source: BSI)
Unsafe incidents	Near misses or non-compliance identified or defined by risk assessments that do *not* result in actual unintentional injury.

Aim

To locate, review and synthesise studies about the performance of:

i) strategies, policies and regulatory or legal frameworks, and

ii) mass media campaigns (that may or may not support strategies, policies and regulatory or legal frameworks)

that aim to manage risk in play and leisure

Audience

The audience for this review will be the Programme Development Group (PDG) members convened for this CPHE programme topic.

Questions to be addressed

6. Can strategies, policies and regulatory or legal frameworks (either with or without specific activities or factors which may enforce them or encourage compliance with them), improve the planning, implementation and effectiveness of programmes/initiatives to manage risk and safety, and prevent unintentional injuries to children and young people in the external environment during play and leisure?
7. Are mass media campaigns effective as a tool to deliver information about how to manage risk and safety, to change behaviour and to prevent unintentional injuries to children and young people in the external environment during play and leisure?
8. Which other activities or circumstances are associated with greater or lower effectiveness of mass media approaches to managing risk and safety during play and leisure?

9. In what ways can strategies, policies and regulatory or legal frameworks (either with or without specific activities or factors which may enforce them or encourage compliance with them), improve the planning, implementation and effectiveness of programmes/initiatives to manage risk and safety, and prevent unintentional injuries to children and young people in the external environment during play and leisure?
10. In what ways can mass media improve the operation/effectiveness of legislation, regulation and/or standards?

Given this range of questions, it may be necessary to refine this list in response to the amount and quality of identified study reports, to allow meaningful analysis and synthesis of their findings. This may be achieved by, for example, focussing on the first two questions only, if sufficient quality data is found for these. Decision about such approaches will be made in response to the studies identified and in discussion with CPHE.

Key outcomes

Measures of compliance with legislation, regulation, standards that are relevant to the aim of the policy/regulatory change.

Rates of unintentional injuries, severity of unintentional injuries, or number of care episodes (e.g. hospitalisations) resulting from unintentional injuries in the external environment.

Rates of relevant safety behaviours or compliance rates (e.g. number/proportion of facilities complying with standards (e.g. playgrounds complying with EN 1176 and 1177 or Local Play Indicator 3), measures of use of safety equipment for example life-vests during activities on the water).

Knowledge of and attitudes to risk factors and safety behaviours (e.g change in risk attitude scale score, hazard recognition)

Factors impacting on compliance

Again, given the breadth of this review, it may be appropriate to prioritise outcomes considered in the final report. For example, if sufficient research is

identified which reports the key outcomes of unintentional injury, we may downgrade the reporting of intermediate outcomes such as rates of safety behaviours, or, if sufficient information is found about the compliance of organisations to playground standards from within the UK, we may not report less relevant information about other countries. Decision about such approaches will be made in response to the studies identified and in discussion with CPHE.

Methods

Systematic review of published and unpublished studies.

Inclusion criteria for studies

Studies will be included provided that they evaluate strategies, policies and regulatory or legal frameworks, and/ mass media campaigns (that may or may not support strategies, policies and regulatory or legal frameworks) that aim to manage risk and reduce injury in play and leisure.

Population

Children aged under 15, parents/ carers, practitioners and organisations.

Time period to be covered

Studies conducted or published since 1990.

Study design

Any quantitative study design (randomised and non-randomised controlled trials, before and after studies, case control studies, ecological studies, cross-sectional studies, prospective and retrospective cohort studies) where there are comparisons within or between groups of people or places or activities.

Again, given the breadth of this review, it may be appropriate to prioritise study designs from higher up the evidence hierarchy so that, for example, where RCTs exist we may not include studies using less robust study designs on the same

topic. Decision about such approaches this will be made in response to the studies identified and in discussion with CPHE.

Language

English

Quality assessment and Data Extraction

Included studies will be quality assessed using a structured format appropriate for the study design. Where appropriate, these will be based on those found in the CPHE Methods Guidance 2009 documentation and agreed with the team at CPHE.

Key data about methodology and results will be extracted for each included study into an evidence table, modeled on those found in the NICE CPHE methods guidance and adapted where appropriate to the identified study designs.

Quality assessment and data extraction will be undertaken by a single reviewer and 10% checked by a second reviewer.

Data synthesis and presentation

Data from the included studies will be analysed and synthesised, and evidence statements will be produced. We anticipate that narrative synthesis methods will be used rather than formal data pooling.

Initial documents identified

Background

A Green Alliance / Demos report by Gillian Thomas and Guy Thompson (2004) A Child's Place: Why environment matters to children

http://www.green-alliance.org.uk/publications/PubAChildsPlace_page195.aspx

Focus - Children's attitudes towards their environment and how it affects them: to establish, via the children's perspective, what the lessons are for policy-makers.

• Assessing danger is children's top priority when thinking about outdoor spaces.

Soori H, Bhopal RS (2002) **Parental permission for children's independent outdoor activities - Implications for injury prevention**. *European Journal of Public Health* 12 (2): 104-109.

Comparative studies

Briss, PA et al. Injuries From Falls on Playgrounds: Effects of Day Care Center Regulation and Enforcement Arch Pediatr Adolesc Med, August 1, 1995; 149(8): 906 - 911. http://archpedi.ama-assn.org/cgi/content/abstract/149/8/906

Pressley JC, Barlow B, Durkin M et al. (2005) **A national program for injury prevention in children and adolescents: The injury free coalition for kids**. *Journal of Urban Health Bulletin of the New York Academy of Medicine* 82 (3): 389-402.

Annex A – Other websites that could be searched

To be developed

Annex B – NICE review format

(see page 260 of NICE CPHE 2008 revised (draft) methods manual: http://www.nice.org.uk/media/AD7/53/CPHEMethodsManualConsultationOctober2008.pdf **)**

'While there is no strict guidance for the way an evidence review is structured, it is important that it sets out as clearly as possible the information that PHIAC/the PDG will need to use to inform its deliberations and recommendations.

The exact structure of the review should be agreed with the CPHE project team on a review by review basis, however, in general we would expect a review to report the following:

Summary
Brief summary of the aims and objectives, methods, main findings and conclusions. It should include all of the evidence statements and the related references.

Contents/structure for main report
1. Introduction

• Context in which the review is set, this may include:
  reference to the scope
  epidemiological background
  policy context
  organisational context
  theoretical perspectives
  summary of effectiveness review.

  All to be supported by current literature.

• Aims and objectives of the review.

• Research questions.

• Operational definitions.

• Identification of possible equality and equity issues.

• Review team:

  − expertise (both in reviewing and subject area) and perspective brought to the review, for example:

    ◊ researcher

◊ professional/end user of guidance – clinician/practitioner/from heath/social/local authority/private sector

◊ target population – general public/patient, carer

− roles in the review process

− conflicts of interest.

2. Methodology
Identification of evidence – for example, databases, websites, search strategies, hand-searching, contacts with experts in the field, author contacting.

Inclusion/exclusion criteria for review – type of studies, years, country, population, implementation process, moderation process. Minimum of two people undertaking screening or percentage checking – minimum percent to be checked.

Flow chart of number of studies identified from different sources and numbers excluded at different stages of process and reasons for exclusion.

Quality appraisal processes including consistency checking within and between appraisers, moderation at data extraction and analysis stages.

Software used for screening and coding of studies, data extraction, analysis and synthesis, managing the bibliography.

Criteria for appraising for applicability. Sample characteristics, context, conceptual and theoretical focus.

Methods of synthesis and data presentation.

3. Findings

• Overview of the studies for each research question, such as, sub-question, population and outcome.

• Narrative summary and evidence statements for each question, such as, sub-question, population, outcome:
quality, quantity and consistency of evidence
applicability of the evidence.

• Meta-analyses, if applicable.

4. Discussion
Findings into context.
Implications of findings.
Limitations of the evidence, gaps.
Limitations of the review and potential impact on findings.

5. Conclusion and recommendations
Appendices

Sample search strategies.
Bibliography of included studies.
Bibliography of excluded studies with reasons for each study.
Evidence tables.
Examples of methodology checklists used.

Appendix 2 – Search Strategy

Mass media

Database: Cochrane Library (Wiley) 2009 Issue 3

#1 MeSH descriptor Mass Media explode all trees
#2 mass next media:ti,ab
#3 (public* near/3 campaign*):ti,ab
#4 social next marketing:ti,ab
#5 mass next campaign*:ti,ab
#6 media:ti,ab
#7 broadcast*:ti,ab
#8 (video* or dvd* or film* or movie*):ti,ab
#9 television* or tv:ti,ab
#10 radio*:ti,ab
#11 newspaper* or press or magazine*:ti,ab
#12 MeSH descriptor Television, this term only
#13 MeSH descriptor Newspapers explode all trees
#14 internet or website or online or web or www:ti,ab
#15 MeSH descriptor Computer Communication Networks, this term only
#16 cell* next phone*:ti,ab
#17 MeSH descriptor Cellular Phone, this term only
#18 mobile next phone*:ti,ab
#19 pamphlet* or book* or literature or leaflet*:ti,ab
#20 MeSH descriptor Pamphlets, this term only
#21 MeSH descriptor Publications, this term only
#22 advert* or campaign*:ti,ab
#23 (#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22)
#24 MeSH descriptor Wounds and Injuries, this term only
#25 MeSH descriptor Accident Prevention explode all trees
#26 MeSH descriptor Accidental Falls, this term only
#27 ((accident* or injur* or death* or fatal*) near/3 (reduc* or prevent*)):ti,ab
#28 ((accident* or unintention*) near/3 (wound* or injur* or death* or fatal*)):ti,ab
#29 (#24 OR #25 OR #26 OR #27 OR #28)
#30 (#23 AND #29)
#31 MeSH descriptor Leisure Activities explode all trees
#32 MeSH descriptor Sports explode all trees
#33 leisure* or sport* or game* or play* or recreation* or holiday* or garden* or outdoor* or countryside* or adventure*:ti,ab
#34 amusement* or water* or swim* or sea* or park* or outing* or beach* or farm* or zoo* or display*:ti,ab
#35 firework* or fair or fairs or fete or fetes:ti,ab

#36 (physical next environment) or (external next environment):ti,ab
#37 (#31 OR #32 OR #33 OR 3#4 OR #35 OR #36)
#38 (#30 AND #37)
#39 MeSH descriptor Child explode all trees
#40 MeSH descriptor Infant explode all trees
#41 MeSH descriptor Adolescent, this term only
#42 (child* or infant* or toddler* or preschool* or young or youth* or adolesc* or teen* or paediatr* or pediatr* or minor* or boy* or girl* or baby or babies):ti,ab
#43 pre next school*:ti,ab
#44 (#39 OR #40 OR #41 OR #42 OR #43)
#45 (#38 AND #44)
#46 (#45), from 1990 to 2009

Databases: DARE, HTA and NHS EED via CRD web site

#1 MeSH Mass Media explode
#2 "mass media"
#3 "public* campaign*"
#4 "social marketing"
#5 "mass campaign*"
#6 media
#7 broadcast*
#8 video* or dvd* or film* or movie*)
#9 television* or tv
#10 radio*
#11 newspaper* or press or magazine*
#12 MeSH descriptor Television,
#13 MeSH descriptor Newspapers explode
#14 internet or website or online or web or www:ti,ab
#15 MeSH descriptor Computer Communication Networks
#16 "cell* phone*"
#17 MeSH descriptor Cellular Phone
#18 "mobile phone"
#19 pamphlet* or book* or literature or leaflet*
#20 MeSH descriptor Pamphlets
#21 MeSH descriptor Publications
#22 advert* or campaign*
#23 (#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22)
#24 MeSH descriptor Wounds and Injuries
#25 MeSH descriptor Accident Prevention explode
#26 MeSH descriptor Accidental Falls, this term only
#27 ((accident* or injur* or death* or fatal*) near (reduc* or prevent*))
#28 ((accident* or unintention*) near (wound* or injur* or death* or fatal*))
#29 (#24 OR #25 OR #26 OR #27 OR #28)
#30 (#23 AND #29)

#31 MeSH descriptor Leisure Activities explode
#32 MeSH descriptor Sports explode
#33 leisure* or sport* or game* or play* or recreation* or holiday* or garden* or outdoor* or countryside* or adventure*:
#34 amusement* or water* or swim* or sea* or park* or outing* or beach* or farm* or zoo* or display*:
#35 firework* or fair or fairs or fete or fetes
#36 "physical environment" or "external next environment"
#37 (#31 OR #32 OR #33 OR 3#4 OR #35 OR #36)
#38 (#30 AND #37)
#39 MeSH descriptor Child explode
#40 MeSH descriptor Infant explode
#41 MeSH descriptor Adolescent
#42 child* or infant* or toddler* or preschool* or young or youth* or adolesc* or teen* or paediatr* or pediatr* or minor* or boy* or girl* or baby or babies
#43 "pre school*"
#44 (#39 OR #40 OR #41 OR #42 OR #43)
#45 (#38 AND #44)
#46 (#45), from 1990 to 2009

Database: Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations July 29, 2009

1 media.tw.
2 (public$ adj3 campaign$).mp.
3 social marketing.tw.
4 campaign$.tw.
5 broadcast$.tw.
6 (video$ or dvd$ or film$ or movie$).tw.
7 (television$ or tv$).tw.
8 radio$.tw.
9 (newspaper$ or press).tw.
10 magazine$.tw.
11 (internet or website).tw.
12 (online or web or www).tw.
13 computer$.tw.
14 cell$ phone$.tw.
15 (mobile adj phone$).tw.
16 (pamphlet$ or book$ or literature).tw.
17 leaflet$.tw.
18 publication$.tw.
19 advert$.tw.
20 or/1-19
21 wound$.tw.
22 (injury or injuries).tw.

23 ((accident$ or injur$ or death$ or fatal$) adj3 (reduc$ or prevent$)).tw.
24 ((accident$ or uninten$) adj3 (wound$ or injur$ or death$ or fatal$ or fall$)).tw.
25 or/21-24
26 20 and 25
27 leisure$.tw.
28 sport$.tw.
29 game$.tw.
30 play$.tw.
31 recreation$.tw.
32 holiday$.tw.
33 garden$.tw.
34 outdoor$.tw.
35 countryside$.tw.
36 adventure$.tw.
37 amusement$.tw.
38 water$.tw.
39 swim$.tw.
40 sea$.tw.
41 park$.tw.
42 outing$.tw.
43 beach$.tw.
44 farm$.tw.
45 zoo$.tw.
46 display$.tw.
47 firework$.tw.
48 fair$.mp. or funfair$.tw.
49 fete$.tw.
50 ((physical or external) adj environment$).tw.
51 or/27-50
52 51 and 26
53 (child$ or infan$ or toddler$ or pre-school or preschool or pre school or young or youth$ or adolesc$ or teen$ or paediatr$ or pediatr$ or minor$ or boy$ or girl$ or baby or babies).tw.
54 52 and 53
55 limit 54 to (english language and yr="1990 -Current")

Database: Ovid MEDLINE(R) 1950 to July Week 3 2009

1 exp Mass Media/
2 mass media.tw.
3 (public$ adj3 campaign$).tw.
4 social marketing.tw.
5 mass campaign$.tw.
6 media.tw.
7 broadcast$.tw.
8 (video$ or dvd$ or film$ or movie$).tw.

9 television$.mp. or tv.tw.
10 radio$.tw.
11 (newspaper$ or press).mp. or magazine$.tw.
12 (internet or website).tw.
13 (online or web or www).tw.
14 Computer Communication Networks/
15 cell$ phone$.tw.
16 Cellular Phone/
17 (mobile adj phone$).tw.
18 (pamphlet$ or book$ or literature).tw.
19 leaflet$.tw.
20 Pamphlets/
21 Publications/
22 advert$.tw.
23 campaign$.tw.
24 or/1-23
25 "Wounds and Injuries"/
26 exp Accident Prevention/
27 Accidental Falls/
28 ((accident$ or injur$ or death$ or fatal$) adj3 (reduc$ or prevent$)).tw.
29 ((accident$ or unintention$) adj3 (wound$ or injur$ or death$ or fatal$)).tw.
30 or/25-29
31 24 and 30
32 exp Leisure Activities/
33 exp Sports/
34 leisure$.tw.
35 sport$.tw.
36 game$.tw.
37 play$.tw.
38 recreation$.tw.
39 holiday$.tw.
40 garden$.tw.
41 outdoor$.tw.
42 countryside$.tw.
43 adventure$.tw.
44 amusement$.tw.
45 water$.tw.
46 swim$.tw.
47 sea$.tw.
48 park$.tw.
49 outing$.tw.
50 beach$.tw.
51 farm$.tw.
52 zoo$.tw.
53 display$.tw.
54 firework$.tw.

55 fair$.tw.
56 fete$.tw.
57 ((physical or external) adj environment).tw.
58 or/32-56
59 31 and 58
60 exp Child/
61 Infant/
62 Adolescent/
63 (child$ or infan$ or toddler$ or pre-school$ or preschool$ or pre school$ or young or youth$ or adolesc$ or teen$ or paediatr$ or pediatr$ or minor$ or boy$ or girl$ or baby or babies).tw.
64 or/60-63
65 64 and 59
66 limit 65 to (english language and yr="1990 -Current")

Database: EMBASE (Ovid) 1980 to 2009 Week 30

1 exp mass medium/
2 mass media.tw.
3 (public$ adj campaign$).tw.
4 social marketing.tw.
5 mass campaign$.tw.
6 media.tw.
7 (video$ or dvd$ or film$ or movie$).tw.
8 exp television/
9 (television or tv).tw.
10 radio.tw.
11 newspaper$.mp.
12 press.tw.
13 magazine$.tw.
14 (internet or website).tw.
15 (online or web or www).tw.
16 exp computer network/
17 cell$ phone$.tw.
18 exp mobile phone/
19 (mobile adj phone$).tw.
20 (book$ or literature).tw.
21 leaflet$.tw.
22 exp publication/
23 pamphlet$.tw.
24 advert$.tw.
25 campaign$.tw.
26 or/1-25)
27 exp injury/
28 exp accident prevention/
29 exp falling/

30 ((accident$ or injur$ or death$ or fatal$) adj (reduc$ or prevent$)).tw.
31 ((accident$ or unintention$) adj (wound$ or injur$ or death$ or fatal$)).tw.
32 or/27-31
33 32 and 26
34 exp leisure/
35 exp sport/
36 leisure$.tw.
37 sport$.tw.
38 game$.tw.
39 play.tw.
40 recreation$.tw.
41 holiday$.tw.
42 garden$.tw.
43 outdoor$.tw.
44 countryside$.tw.
45 adventure$.tw.
46 amusement$.tw.
47 water.tw.
48 swim$.tw.
49 sea.tw.
50 (park or parks or parkland).tw.
51 outing$.tw.
52 beach$.tw.
53 farm$.tw.
54 zoo$.tw.
55 display.tw.
56 firework$.tw.
57 funfair$.tw.
58 fete$.tw.
59 ((physical or external) adj environment).tw.
60 or/33-59
61 60 and 33
62 exp child/
63 infant/
64 adolescent/
65 (child$ or infan$ or toddler$ or pre-school$ or preschool$ or pre school$ or young or youth$ or adolesc$ or teen$ or paediatr$ or pediatr$ or minor$ or boy$ or girl$ or baby or babies).tw.
66 or/62-65
67 66 and 61
68 limit 67 to (english language and yr="1990 -Current")

Database: Social Science Citation Index (ISI Web of Science) 1990 – 2009

1 TS=”mass media” AND Language=(English)
2 TS=”public* campaign” AND Language=(English)

3 TS=”social marketing” AND Language=(English)
4 TS=”mass campaign*” AND Language=(English)
5 TS=(media OR broadcast* OR video* OR dvd* OR film* OR movie* OR television* OR tv OR radio*) AND Language=(English)
6 TS=(newspaper* OR press OR magazine*) AND Language =(English)
7 TS=(internet OR website OR online OR web OR www) AND Language=(English)
8 TS=”cell* phone*”” AND Language=(English)
9 TS=”mobile phone*” AND Language=(English)
10 TS=(pamphlet* OR book* OR literature OR leaflet*) AND Language=(English)
11 TS=(publication* OR advert* OR campaign*) AND Language=(English)
12 TS=(#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11)
13 TS=(wound* OR injury* OR injuries) AND Language=(English)
14 TS=”accident* reduct*” AND Language=(English)
15 TS=”accident* prevent*” AND Language=(English)
16 TS=”injur* reduct*” AND Language=(English)
17 TS=”injur* prevent*” AND Langauage=(English)
18 TS=”death* prevent*” AND Language=(English)
19 TS=”fatal* reduct*” AND Language=(English)
20 TS=”fatal prevent*” AND Language=(English)
21 TS=”accident* wound*” AND Language=(English)
22 TS=”accident* injur*” AND Language=(English)
23 TS=”accident* death*” AND Language=(English)
24 TS=”accident* fatal*” AND Language=(English)
25 TS=”unintention* wound*” AND Language=(English)
26 TS=”unintention* injur* AND Language=(English)
27 TS=”unintention* death*” AND Language=(English)
28 TS= “unintention* fatal*” AND Language=(English)
29 TS= #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28
30 TS= leisure* AND Langauge=(English)
31 TS=sport* AND Language=(English)
32 TS=game* AND Language=(English)
33 TS= (play* OR recreation* OR holiday*) AND Language=(English)
34 TS= (garden* OR outdoor* OR countryside* OR adventure*) AND Language=(English)
35 TS= (amusement* OR water OR swim* OR sea OR park OR park OR parkland) AND Language=(English)
36 TS= (outing* OR beach* OR farm* OR zoo* OR display*) AND Language=(English)
37 TS= (firework* OR fair OR fairs OR fete OR fetes) AND Language=(English)
38 TS= “physical environment” AND Language=(English)
39 TS= “external environment” AND Language=(English)
40 TS= #30 OR #31 OR #32 OR #33 OR #34 OR #35 OR #36 OR #37 OR #38 OR #39
41 TS= (infant* OR child* OR toddler* OR preschool* OR young OR youth* OR adolesc*) AND Language=(English)
42 TS= (teen* OR paediatr* OR pediatr* OR minor* OR boy* OR girl* OR baby OR babies) AND Language=(English)

43 TS= “pre-school*” AND Language=(English)
44 TS= #41 OR #42 OR #43
45 TS= #44 AND #40 AND#29 AND #12

Database: HMIC (Health Management Information Consortium) (Ovid) May 2009

1 exp MASS MEDIA/
2 media.tw.
3 (public$ adj3 campaign$).tw.
4 social marketing.mp.
5 exp SAFETY CAMPAIGNS/ or campaign$.mp.
6 broadcast$.mp.
7 (video$ or dvd$ or film$ or movie$).tw.
8 exp TELEVISION ADVERTISING/ or television$.mp.
9 tv.tw.
10 exp radio/
11 exp NEWSPAPERS/ or newspaper$.mp.
12 exp press/
13 press$.tw.
14 exp computer networks/
15 (internet or website$ or online or web or www).tw.
16 exp MOBILE TELEPHONES/ or cell phone$.mp.
17 (mobile adj phone$).tw.
18 (literature or pamphlet$ or book$ or leaflet$ or publication$).tw.
19 exp pamphlets/
20 advert$.tw.
21 campaign$.tw.
22 or/1-21
23 wound$.mp. or exp "WOUNDS AND INJURIES"/
24 accident prevention.mp. or exp ACCIDENT PREVENTION/
25 accidental fall$.mp. or exp FALLING/
26 ((accident$ or injur$ or death$ or fatal$) adj3 (reduc$ or prevent$)).tw.
27 ((accident$ or unintention$) adj3 (wound$ or injur$ or death$ or fatal$)).tw.
28 or/23-27
29 22 and 28
30 leisure activity.mp. or exp LEISURE ACTIVITIES/
31 exp SPORT/ or sport$.mp.
32 leisure$.tw.
33 game$.tw.
34 exp play/ or exp play areas/
35 recreation$.tw.
36 holiday$.tw.
37 garden$.tw.
38 outdoor$.tw.
39 countryside.tw.
40 adventure$.tw.

41 amusement$.tw.
42 water$.tw.
43 swim$.tw.
44 sea$.tw.
45 park$.tw.
46 outing$.tw.
47 beach.tw.
48 farm$.tw.
49 zoo$.tw.
50 display$.tw.
51 firework$.tw.
52 fair$.tw.
53 fete$.tw.
54 ((physical or external) adj environment).tw.
55 or/30-54
56 29 and 55
57 exp YOUNG PEOPLE/
58 exp children/
59 (child$ or infan$ or toddler$ or pre-school or preschool or pre school or young or youth$ or adolesc$ or teen$ or paediatr$ or pediatr$ or minor$ or boy$ or girl$ or baby or babies).tw.
60 or/57-59
61 60 and 56
62 limit 61 to yr="1990 -Current"

Database: SPORTDiscus (EBSCOhost) 1990 - 2009

S1 “mass media” OR “public* campaign*”
S2 “social marketing” OR “mass campaign*”
S3 media OR broadcast* OR video* OR DVD* OR film* OR movie*
S4 television OR TV OR radio* OR newspaper* OR press OR magazine*
S5 internet OR website OR online OR web OR www
S6 “cell* phone* OR “mobile phone*” OR pamphlet* OR booklet* OR literature* OR leaflet*
S7 publication* OR advert* OR campaign*
S8 S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7
S9 “accident* reduc*” OR “accident* prevent*”
S10 “injur* reduc*” OR “injur* prevent*”
S11 “death* reduc*” OR “death* prevent*”
S12 “fatal* reduc*” OR “fatal* prevent*”
S13 “accident* wound*” OR “accident injur*”
S14 “accident* death* OR “accident* fatal*”
S15 “unintention* death*” OR “unintention* wound*”
S16 “unintention* injur*” OR “unintention* fatal*”
S17 S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16

S18 leisure* OR sport* OR game* OR play* OR recreation* OR holiday* OR garden* OR outdoor* OR countryside* OR adventure*
S19 amusement* OR water* OR swim* OR sea OR park OR parks OR parkland* OR outing* OR beach* OR farm* OR zoo* OR display*
S20 firework* OR fair* OR fairs OR fete OR fetes
S21 "physical environment" OR "external environment"
S22 S18 OR S19 OR S20 OR S21
S23 child* OR infant* OR toddler* OR preschool* OR young OR youth*
S24 adolesc* OR teen* OR paediatr* OR pediatr* OR minor* OR boy* OR girl* OR baby OR babies
S25 "pre school"
S26 S23 OR S24 OR S25
S27 S8 AND S17 AND S22 AND S26

Database: EPPI Centre databases (Bibliomap, DoPHER and TRoPHI)

1 "mass media" OR "public* campaign*"
2 "social marketing" OR "mass campaign*"
3 "media" OR"broadcast*" OR "video*" OR "DVD*" OR "film*" OR "movie*"
4 "television" OR "TV" OR "radio*2 OR "newspaper*" OR "press" OR "magazine*"
5 "internet" OR "website" OR "online" OR "web" OR "www"
6 "cell* phone* OR "mobile phone*" OR "pamphlet*" OR "booklet*" OR "literature*" OR "leaflet*"
7 "publication*" OR "advert*" OR "campaign*"
8 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7
9 "accident* reduc*" OR "accident* prevent*"
10 "injur* reduc*" OR "injur* prevent*"
11 "death* reduc*" OR "death* prevent*"
12 "fatal* reduc*" OR "fatal* prevent*"
13 "accident* wound*" OR "accident injur*"
14 "accident* death* OR "accident* fatal*"
15 "unintention* death*" OR "unintention* wound*"
16 "unintention* injur*" OR "unintention* fatal*"
17 9 OR 10 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16
18 "leisure*" OR "sport*" OR "game*" OR "play*" OR "recreation*" OR "holiday*" OR "garden*" OR "outdoor*" OR" countryside*" OR "adventure*"
19 "amusement*" OR "water*" OR "swim*" OR "sea" OR "park" OR "parks" OR "parkland*" OR "outing*" OR "beach*" OR "farm*" OR "zoo*" OR "display*"
20 "firework*" OR "fair*" OR "fairs" OR "fete" OR "fetes"
21 "physical environment" OR "external environment"
22 18 OR 19 OR 20 OR 21
23 "child*" OR "infant*" OR "toddler*" OR "preschool*" OR "young" OR "youth*"
24 "adolesc*" OR "teen*" OR "paediatr*" OR "pediatr*" OR "minor*" OR "boy*" OR "girl*" OR "baby" OR "babies"
25 "pre school"
26 23 OR 24 OR 25

27 8 AND 17 AND 22 AND 26

Database: SafetyLit 1990 - 2009

Index terms “Recreational and Sports Issues” combined with Textwords:
media OR campaign* OR broadcast* OR television OR TV OR radio* OR video* or DVD* OR press OR internet OR online OR www OR phone* OR pamphlet* OR literature* OR leaflet* OR publication* OR advert* OR newspaper*

Database: Campbell Collaboration 2002-2009

Textwords: media OR campaign* OR broadcast* OR television OR TV OR radio* OR video* or DVD* OR press OR internet OR online OR www OR phone* OR pamphlet* OR literature* OR leaflet* OR publication* OR advert* OR newspaper*
AND
Textwords: injur* OR wound* OR accident* OR death* or fatal*

Strategic policies

Database: Cochrane Library (Wiley) 2009 Issue 3

#1 MeSH descriptor Wounds and Injuries, this term only
#2 MeSH descriptor Accident Prevention explode all trees
#3 MeSH descriptor Accidental Falls, this term only
#4 ((accident* or injur* or death* or fatal*) near/3 (reduc* or prevent*)):ti,ab
#5 ((accident* or unintention*) near/3 (wound* or injur* or death* or fatal*)):ti,ab
#6 (#1OR #2 OR #3 OR #4 OR #5)
#7 MeSH descriptor Leisure Activities explode all trees
#8 MeSH descriptor Sports explode all trees
#9 leisure* or sport* or game* or play* or recreation* or holiday* or garden* or outdoor* or countryside* or adventure*:ti,ab
#10 amusement* or water* or swim* or sea* or park* or outing* or beach* or farm* or zoo* or display*:ti,ab
#11 firework* or fair or fairs or fete or fetes:ti,ab
#12 (physical next environment) or (external next environment):ti,ab
#13 (#7OR #8 OR #9 OR #10 OR #11 OR #12)
#14 (#6 AND #13)
#15 MeSH descriptor Child explode all trees
#16 MeSH descriptor Infant explode all trees
#17 MeSH descriptor Adolescent, this term only
#18 (child* or infant* or toddler* or preschool* or young or youth* or adolesc* or teen* or paediatr* or pediatr* or minor* or boy* or girl* or baby or babies):ti,ab
#19 pre next school*:ti,ab
#20 (#15 OR #16 OR #17 OR #18 OR #19)
#21 MeSH descriptor Public Policy, this term only

#22 (regulation* or legislation* or law* or statute* or regulatory or legal or framework* or strateg* or directive* or policy or policies or governance or government or practice* or program*):ti,ab
#23 (standard* or control* or compliance or comply or audit* or inspect*):ti,ab
#24 (#21 OR #22 OR #23)
#25 (#14 AND #20 AND #24), from 1990 to 2009

Database: Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations July 29, 2009

1 wound$.tw.
2 (injury or injuries).tw.
3 ((accident$ or injur$ or death$ or fatal$) adj3 (reduc$ or prevent$)).tw.
4 ((accident$ or uninten$) adj3 (wound$ or injur$ or death$ or fatal$ or fall$)).tw.
5 or/1-4
6 leisure$.tw.
7 sport$.tw.
8 game$.tw.
9 play$.tw.
10 recreation$.tw.
11 holiday$.tw.
12 garden$.tw.
13 outdoor$.tw.
14 countryside$.tw.
15 adventure$.tw.
16 amusement$.tw.
17 water$.tw.
18 swim$.tw.
19 sea$.tw.
20 park$.tw.
21 outing$.tw.
22 beach$.tw.
23 farm$.tw.
24 zoo$.tw.
25 display$.tw.
26 firework$.tw.
27 fair$.mp. or funfair$.tw.
28 fete$.tw.
29 ((physical or external) adj environment$).tw.
30 or/6-29
31 (child$ or infan$ or toddler$ or pre-school or preschool or pre school or young or youth$ or adolesc$ or teen$ or paediatr$ or pediatr$ or minor$ or boy$ or girl$ or baby or babies).tw.
32 30 and 31 and 5

33 (regulation$ or legislation$ or law$ or statute$ or regulatory or legal or framework$ or strateg$ or directive$ or policy or policies or governance or government or practice$ or program$).tw.
34 (standard$ or control$ or compliance or comply or audit$ or inspect$).tw.
35 or/33-34
36 35 and 32
37 limit 36 to (english language and yr="1990 -Current")

Database: Ovid MEDLINE(R) 1950 to July Week 3 2009

1 "Wounds and Injuries"/
2 exp Accident Prevention/
3 Accidental Falls/
4 ((accident$ or injur$ or death$ or fatal$) adj3 (reduc$ or prevent$)).tw.
5 ((accident$ or unintention$) adj3 (wound$ or injur$ or death$ or fatal$)).tw.
6 or/1-5
7 exp Leisure Activities/
8 exp Sports/
9 leisure$.tw.
10 sport$.tw.
11 game$.tw.
12 play$.tw.
13 recreation$.tw.
14 holiday$.tw.
15 garden$.tw.
16 outdoor$.tw.
17 countryside$.tw.
18 adventure$.tw.
19 amusement$.tw.
20 water$.tw.
21 swim$.tw.
22 sea$.tw.
23 park$.tw.
24 outing$.tw.
25 beach$.tw.
26 farm$.tw.
27 zoo$.tw.
28 display$.tw.
29 firework$.tw.
30 fair$.tw.
31 fete$.tw.
32 ((physical or external) adj environment).tw.
33 or/7-32
34 exp Child/
35 Infant/
36 Adolescent/

37 (child$ or infan$ or toddler$ or pre-school$ or preschool$ or pre school$ or young or youth$ or adolesc$ or teen$ or paediatr$ or pediatr$ or minor$ or boy$ or girl$ or baby or babies).tw.
38 or/34-37
39 6 and 33 and 38
40 legislation/
41 public policy/
42 (regulation$ or legislation$ or law$ or statute$ or regulatory or legal or framework$ or strateg$ or directive$ or policy or policies or governance or government or practice$ or program$).tw.
43 (standard$ or control$ or compliance or comply or audit$ or inspect$).tw.
44 or/40-43
45 39 and 44
46 limit 45 to (english language and yr="1990 -Current")

Database: EMBASE (Ovid) 1980 to 2009 Week 30

1 exp injury/
2 exp accident prevention/
3 exp falling/
4 ((accident$ or injur$ or death$ or fatal$) adj (reduc$ or prevent$)).tw.
5 ((accident$ or unintention$) adj (wound$ or injur$ or death$ or fatal$)).tw.
6 or/1-5
7 exp leisure/
8 exp sport/
9 leisure$.tw.
10 sport$.tw.
11 game$.tw.
12 play.tw.
13 recreation$.tw.
14 holiday$.tw.
15 garden$.tw.
16 outdoor$.tw.
17 countryside$.tw.
18 adventure$.tw.
19 amusement$.tw.
20 water.tw.
21 swim$.tw.
22 sea.tw.
23 (park or parks or parkland).tw.
24 outing$.tw.
25 beach$.tw.
26 farm$.tw.
27 zoo$.tw.
28 display.tw.
29 firework$.tw.

30 funfair$.tw.
31 fete$.tw.
32 ((physical or external) adj environment).tw.
33 or/7-32
34 exp child/
35 infant/
36 adolescent/
37 (child$ or infan$ or toddler$ or pre-school or preschool or pre school or young or youth or adolesc$ or teen$ or paediatr$ or pediatr$ or minor$ or boy$ or girl$ or baby or babies).tw.
38 or/34-37
39 6 and 33 and 38
40 exp law/
41 exp policy/
42 (regulation$ or legislation$ or law$ or statute$ or regulatory or legal or framework$ or strateg$ or directive$ or policy or policies or governance or government or practice$ or program$).tw.
43 (standard$ or control$ or compliance or comply or audit$ or inspect$).tw.
44 or/40-43
45 39 and 44
46 limit 45 to (english language and yr="1990 -Current")

Databases: DARE, HTA and NHS EED via CRD web site

#1 MeSH descriptor Wounds and Injuries
#2 MeSH descriptor Accident Prevention explode
#3 MeSH descriptor Accidental Falls
#4 ((accident* or injur* or death* or fatal*) near (reduc* or prevent*))
#5 ((accident* or unintention*) near (wound* or injur* or death* or fatal*))
#6 (#1 OR #2 OR #3 OR #4 OR #5)
#7 MeSH descriptor Leisure Activities explode
#8 MeSH descriptor Sports explode
#9 leisure* or sport* or game* or play* or recreation* or holiday* or garden* or outdoor* or countryside* or adventure*
#10 amusement* or water* or swim* or sea* or park* or outing* or beach* or farm* or zoo* or display*
#11 firework* or fair or fairs or fete or fetes
#12 “physical environment” or “external environment”
#13 (#7 OR #8 OR #9 OR #10 OR #11 OR #12)
#14 (#6 AND #13)
#15 MeSH descriptor Child explode
#16 MeSH descriptor Infant explode
#17 MeSH descriptor Adolescent
#18 child* or infant* or toddler* or preschool* or young or youth* or adolesc* or teen* or paediatr* or pediatr* or minor* or boy* or girl* or baby or babies
#19 pre next school*:

#20 (#15 OR #16 OR #17 OR #18 OR #19)
#21 MeSH descriptor Public Policy
#22 regulation* or legislation* or law* or statute* or regulatory or legal or framework* or strateg* or directive* or policy or policies or governance or government or practice* or program*
#23 standard* or control* or compliance or comply or audit* or inspect*
#24 (#21 OR #22 OR #23)
#25 (#14 AND #20 AND #24), from 1990 to 2009

Database: Social Science Citation Index (ISI Web of Science) 1990 – 2009

1 TS=(wound* OR injury* OR injuries) AND Language=(English)
2 TS=”accident* reduct*” AND Language=(English)
3 TS=”accident* prevent*” AND Language=(English)
4 TS=”injur* reduct*” AND Language=(English)
5 TS=”injur* prevent*” AND Langauage=(English)
6 TS=”death* prevent*” AND Language=(English)
7 TS=”fatal* reduct*” AND Language=(English)
8 TS=”fatal prevent*” AND Language=(English)
9 TS=”accident* wound*” AND Language=(English)
10 TS=”accident* injur*” AND Language=(English)
11 TS=”accident* death*” AND Language=(English)
12 TS=”accident* fatal*” AND Language=(English)
13 TS=”unintention* wound*” AND Language=(English)
14 TS=”unintention* injur* AND Language=(English)
15 TS=”unintention* death*” AND Language=(English)
16 TS= “unintention* fatal*” AND Language=(English)
17 TS= #1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16
18 TS= leisure* AND Language=(English)
19 TS=sport* AND Language=(English)
20 TS=game* AND Language=(English)
21 TS= (play* OR recreation* OR holiday*) AND Language=(English)
22 TS= (garden* OR outdoor* OR countryside* OR adventure*) AND Language=(English)
23 TS= (amusement* OR water OR swim* OR sea OR park OR park OR parkland) AND Language=(English)
24 TS= (outing* OR beach* OR farm* OR zoo* OR display*) AND Language=(English)
25 TS= (firework* OR fair OR fairs OR fete OR fetes) AND Language=(English)
26 TS= “physical environment” AND Language=(English)
27 TS= “external environment” AND Language=(English)
28 TS= #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27
29 TS= (infant* OR child* OR toddler* OR preschool* OR young OR youth* OR adolesc*) AND Language=(English)

30 TS= (teen* OR paediatr* OR pediatr* OR minor* OR boy* OR girl* OR baby OR babies) AND Language=(English)
31 TS= “pre-school*” AND Language=(English)
32 TS= #29 OR #30 OR #31
33 TS= (policy OR regulation* OR law* OR statute* OR regulatory OR legal OR framework* OR strateg* OR directive* OR policies OR governance OR government OR practice* OR program*) AND Language =(English)
34 TS= (standard* OR control* OR compliance OR comply OR audit* OR inspect*) AND Language=(English)
35 TS= #33 OR #34
36 TS=#17 AND #28 AND #32 AND #35

Database: HMIC Health Management Information Consortium (Ovid) May 2009

1 wound$.mp. or exp "WOUNDS AND INJURIES"/
2 accident prevention.mp. or exp ACCIDENT PREVENTION/
3 accidental fall$.mp. or exp FALLING/
4 ((accident$ or injur$ or death$ or fatal$) adj3 (reduc$ or prevent$)).tw.
5 ((accident$ or unintention$) adj3 (wound$ or injur$ or death$ or fatal$)).tw.
6 or/1-5
7 leisure activity.mp. or exp LEISURE ACTIVITIES/
8 exp SPORT/ or sport$.mp.
9 leisure$.tw.
10 game$.tw.
11 exp play/ or exp play areas/
12 recreation$.tw.
13 holiday$.tw.
14 garden$.tw.
15 outdoor$.tw.
16 countryside.tw.
17 adventure$.tw.
18 amusement$.tw.
19 water$.tw.
20 swim$.tw.
21 sea$.tw.
22 park$.tw.
23 outing$.tw.
24 beach.tw.
25 farm$.tw.
26 zoo$.tw.
27 display$.tw.
28 firework$.tw.
29 fair$.tw.
30 fete$.tw.
31 ((physical or external) adj environment).tw.

32 or/7-31
33 exp YOUNG PEOPLE/
34 exp children/
35 (child$ or infan$ or toddler$ or pre-school or preschool or pre school or young or youth$ or adolesc$ or teen$ or paediatr$ or pediatr$ or minor$ or boy$ or girl$ or baby or babies).tw.
36 or/33-35
37 6 and 32 and 36
38 exp legislation/
39 exp policy/
40 (regulation$ or legislation$ or law$ or statute$ or regulatory or legal or framework$ or strateg$ or directive$ or policy or policies or governance or government or practice$ or program$).tw.
41 (standard$ or control$ or compliance or comply or audit$ or inspect$).tw.
42 or/38-41
43 42 and 37
44 limit 43 to yr="1990 -Current"

Database: SPORTDiscus (EBSCOhost) 1990 – 2009

S1 "accident* reduc*" OR "accident* prevent*"
S2 "injur* reduc*" OR "injur* prevent*"
S3 "death* reduc*" OR "death* prevent*"
S4 "fatal* reduc*" OR "fatal* prevent*"
S5 "accident* wound*" OR "accident injur*"
S6 "accident* death* OR "accident* fatal*"
S7 "unintention* death*" OR "unintention* wound*"
S8 "unintention* injur*" OR "unintention* fatal*"
S9 S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8
S10 leisure* OR sport* OR game* OR play* OR recreation* OR holiday* OR garden* OR outdoor* OR countryside* OR adventure*
S11 amusement* OR water* OR swim* OR sea OR park OR parks OR parkland* OR outing* OR beach* OR farm* OR zoo* OR display*
S12 firework* OR fair* OR fairs OR fete OR fetes
S13 "physical environment" OR "external environment"
S14 S10 OR S11 OR S12 OR S13
S15 child* OR infant* OR toddler* OR preschool* OR young OR youth*
S16 adolesc* OR teen* OR paediatr* OR pediatr* OR minor* OR boy* OR girl* OR baby OR babies
S17 "pre school"
S18 S15 OR S16 OR S17
S19 regulation* OR legislation* OR law* OR statute* OR regulatory OR legal OR framework* OR strateg* OR direct* OR policy OR policies OR governance OR government OR practice* OR program*
S20 S9 AND S14 AND S18 AND S19

Database: EPPI Centre databases (Bibliomap, DoPHER and TRoPHI)

1 "accident* reduc*" OR "accident* prevent*"
2 "injur* reduc*" OR "injur* prevent*"
3 "death* reduc*" OR "death* prevent*"
4 "fatal* reduc*" OR "fatal* prevent*"
5 "accident* wound*" OR "accident injur*"
6 "accident* death* OR "accident* fatal*"
7 "unintention* death*" OR "unintention* wound*"
8 "unintention* injur*" OR "unintention* fatal*"
9 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8
10 "leisure*" OR "sport*" OR "game*" OR "play*" OR "recreation*" OR "holiday*" OR "garden*" OR "outdoor*" OR" countryside*" OR "adventure*"
11 "amusement*" OR "water*" OR "swim*" OR "sea" OR "park" OR "parks" OR "parkland*" OR "outing*" OR "beach*" OR "farm*" OR "zoo*" OR "display*"
12 "firework*" OR "fair*" OR "fairs" OR "fete" OR "fetes"
13 "physical environment" OR "external environment"
14 10 OR 11 OR 12 OR 13
15 "child*" OR "infant*" OR "toddler*" OR "preschool*" OR "young" OR "youth*"
16 "adolesc*" OR "teen*" OR "paediatr*" OR "pediatr*" OR "minor*" OR "boy*" OR "girl*" OR "baby" OR "babies"
17 "pre school"
18 15 OR 16 OR 17
19 9 AND 14 AND 18

Database: SafetyLit 1990-2009

Index terms "Recreational and Sports Issues" combined with Textwords:
legislation OR policy OR law* OR strateg* OR statute* OR legal OR framework* OR program* OR standard* OR inspect* OR audit* OR practice* OR program* OR control* OR compliance OR comply

Database: Campbell Collaboration 2002 -2009

Textwords: legislation OR policy OR law* OR strateg* OR statute* OR legal OR framework* OR program* OR standard* OR inspect* OR audit* OR practice* OR program* OR control* OR compliance OR comply
AND
Textwords: injur* OR wound* OR accident* OR death* or fatal*

Additional searches

Community setting

Database: Ovid MEDLINE(R) 1950 to July Week 4 2009
Search Strategy:

1 exp Mass Media/
2 mass media.tw.
3 (public$ adj3 campaign$).tw.
4 social marketing.tw.
5 mass campaign$.tw.
6 media.tw.
7 broadcast$.tw.
8 (video$ or dvd$ or film$ or movie$).tw.
9 television$.mp. or tv.tw
10 radio$.tw.
11 (newspaper$ or press).mp. or magazine$.tw
12 (internet or website).tw.
13 (online or web or www).tw.
14 Computer Communication Networks/
15 cell$ phone$.tw.
16 Cellular Phone/
17 (mobile adj phone$).tw.
18 (pamphlet$ or book$ or literature).tw.
19 leaflet$.tw.
20 Pamphlets/
21 Publications/
22 advert$.tw.
23 campaign$.tw.
24 or/1-23
25 "Wounds and Injuries"/
26 exp Accident Prevention/
27 Accidental Falls/
28 ((accident$ or injur$ or death$ or fatal$) adj3 (reduc$ or prevent$)).tw.
29 ((accident$ or unintention$) adj3 (wound$ or injur$ or death$ or fatal$)).tw.
30 or/25-29
31 24 and 30
32 ((community or neighbourhood or neighborhood or local or village or town or youth or child$ or school$ or church$) adj2 (event$ or fair$ or fete$ or club$ or activit$ or display$ or parade$ or celebr$ or party or parties)).tw.
33 32 and 31
34 limit 33 to (english language and yr="1990 -Current")

Database: Ovid MEDLINE(R) 1950 to July Week 4 2009

1 "Wounds and Injuries"/
2 exp Accident Prevention/
3 Accidental Falls/
4 ((accident$ or injur$ or death$ or fatal$) adj3 (reduc$ or prevent$)).tw.
5 ((accident$ or unintention$) adj3 (wound$ or injur$ or death$ or fatal$)).tw.
6 or/1-5

7 ((community or neighbourhood or neighborhood or local or village or town or youth or child$ or school$ or church$) adj2 (event$ or fair$ or fete$ or club$ or activit$ or display$ or parade$ or celebr$ or party or parties)).tw.
8 6 and 7
9 legislation/
10 public policy/
11 (regulation$ or legislation$ or law$ or statute$ or regulatory or legal or framework$ or strateg$ or directive$ or policy or policies or governance or government or practice$ or program$).tw.
12 (standard$ or control$ or compliance or comply or audit$ or inspect$).tw.
13 or/9-12
14 8 and 13
15 limit 14 to (english language and yr="1990 -Current")

Specific activities

Database: Ovid MEDLINE(R) 1950 to July Week 4 2009

1 "Wounds and Injuries"/
2 exp Accident Prevention/
3 Accidental Falls/
4 ((accident$ or injur$ or death$ or fatal$) adj3 (reduc$ or prevent$)).tw. 1)
5 ((accident$ or unintention$) adj3 (wound$ or injur$ or death$ or fatal$)).tw.
6 or/1-5
7 aerial walkway$.tw.
8 ((fitness or trim or adventure) adj trail$).tw.
9 (snowboard* or snow board$ or skating or skater$ or skiing or skier$ or ski-ing or toboggan$ or sledge$ or sledd$).tw.
10 or/7-9
11 6 and 10
12 exp Mass Media/
13 mass media.tw.
14 (public$ adj3 campaign$).tw.
15 social marketing.tw.
16 mass campaign$.tw.
17 media.tw.
18 broadcast$.tw.
19 (video$ or dvd$ or film$ or movie$).tw.
20 television$.mp. or tv.tw.
21 radio$.tw.
22 (newspaper$ or press).mp. or magazine$.tw.
23 (internet or website).tw.
24 (online or web or www).tw.
25 Computer Communication Networks/
26 cell$ phone$.tw.
27 Cellular Phone/

28 (mobile adj phone$).tw.
29 (pamphlet$ or book$ or literature).tw.
30 leaflet$.tw.
31 Pamphlets/
32 Publications/
33 advert$.tw.
34 campaign$.tw.
35 or/12-34
36 35 and 11
37 limit 36 to (english language and yr="1990 -Current")

Database: Ovid MEDLINE(R) 1950 to July Week 4 2009

1 "Wounds and Injuries"/
2 exp Accident Prevention/
3 Accidental Falls/
4 ((accident$ or injur$ or death$ or fatal$) adj3 (reduc$ or prevent$)).tw.
5 ((accident$ or unintention$) adj3 (wound$ or injur$ or death$ or fatal$)).tw.
6 or/1-5
7 legislation/
8 public policy/
9 (regulation$ or legislation$ or law$ or statute$ or regulatory or legal or framework$ or strateg$ or directive$ or policy or policies or governance or government or practice$ or program$).tw.
10 (standard$ or control$ or compliance or comply or audit$ or inspect$).tw.
11 or/7-10
12 6 and 11
13 aerial walkway$.tw.
14 ((fitness or trim or adventure) adj trail$).tw.
15 (snowboard* or snow board$ or skating or skater$ or skiing or skier$ or ski-ing or toboggan$ or sledge$ or sledd$).tw.
16 or/13-15
17 16 and 12
18 limit 17 to (english language and yr="1990 -Current")

Appendix 3 – Evidence Tables

a. Studies relating to bicycle helmets

Authors: Ji, M, Gilchick & R.A., Bender, S.J. **Year (of publication):** 2006 **Aim of study:** to evaluate the local effect of the California Helmet law on bicycyle-related head injuries in San Diego County, USA. **Study design:** Controlled before and after study **Internal validity score** [+] **External validity score** [+]	**Source area/s:** San Diego County, California, USA. **Nature of Law/standard/mass media:** A state-wide bicycle helmet legislation for school-age children (<18 years old) was passed in California in 1993 and came into effect on January 1, 1994. No citations were issued for the first year and unhelmeted cyclists were received only a warning. Beginning January 1, 1995, non-helmeted riders were liable to receive written citations if stopped by the police. **Study year:** 1992 - 1996 **Eligible population:** all bicycle-related injury records in the Trauma Registry from 1992-1996. Because the helmet law only applied to children (<18years), adults (≥18 years) served as controls. **Settings:** San Diego County, California.	**Data sources:** San Diego County Trauma Registry **Statistical analysis:** descriptive statistics/bivariate analysis for helmet use; analysis of trend of helmet use and head injury **Method of allocation:** Not applicable **Measures to minimise confounding:** None **Intervention/s:** Helmet law enacted in 1994 **Comparator/s:** rates of injuries associated with the use of a bicycle in the two-year period before and after the law came into effect (1992-1996) among the adult bicycle riders **Sample sizes:** **Total n=** 1116 **Intervention n=** 510 **Control n=** 606 **Baseline comparisons:** rates of injuries due to the use of a bicycle in the immediate 2-year period prior to the enactment of the helmet law. **Study sufficiently powered?** possibly	**Limitations identified by author:** 1. study period restricted to between 1992 and 1996: a study period of more years may better reveal potential seasonal fluctuations of number of injuries. 2. the Registry biased towards capturing more severe injuries; may lead to an underestimation of the effect of the law to reduce head injuries 3. large amount of missing data: one-fourth of the patients with bicycle-related injuries in the Registry were missing helmet use information 4. poor fit of the final logistic regression model, reducing the strength or reliability of the inference drawn. 5. possibility of the existence of the ecologic fallacy as the study is an ecological study **Limitations identified by review team:** **Evidence gaps and/or recommendations for future research:** **Source of funding:** Not stated **Observation from the Discussion section about barriers & facilitators:** the law significantly increased helmet use among children as well as adults

Results: Trend analysis of helmet use and head injury showed that in the period before the legislation (1992-1993), both variables were rising for both children and adults. After 1993, the curve showed an inverse relationship for both variables in both adults and children.

Logistic Regression analysis, used to assess the trend over time for helmet use and serious head injury, showed a significant ($p < 0.001$) trend for children with OR of 1.84 (95% CI 1.48 – 2.28); for adults, the trend was only marginally significant ($p = 0.051$, OR = 1.17, 95% CI 1.00 – 1.38).

The rate in increase in helmet use for children over the study period averaged 84% per year.

The time trend for serious head injury was not statistically significant for either the overall sub-population ($p = 0.764$) or the individual age categories (adults, $p = 0.4$; children, $p = 0.194$).

Time period showed significant associations for all years post-law (1994-1996), compared to the pre-law period (1992, 1993): patients injured in 1994 were 2.61 times as likely to wear a helmet compared to the pre-law period, those injured in 1995 were 4.42 times as likely and patients in 1996 were 2.86 times as likely. Patients with a serious head injury were 0.43 times as likely to have worn a helmet compared to those without serious head injury.

Study details	Population and setting	Method of allocation to intervention/control	Notes
Authors: Lee, B.H.; Schofer, J.L.; Koppelman, F.S. **Year (of publication):** 2005 **Aim of study:** To determine whether the bicycle safety helmet legislation in California, enacted in 1994, was associated with statistically significant reductions in head injuries among bicyclists aged 17 years and under who were subjected to the law. **Study design:** Controlled before and after study **Internal validity score** [+] **External validity score** [+]	**Source area/s:** State of California, USA **Nature of Law/standard/mass media:** California was one of the first states to mandate the use of bicycle safety helmets in the US. On 1 January 1994, legislation became effective requiring bicyclists with ages 17 and under to wear helmets while riding on public bicycle paths and roads. Violation of this law is punishable by a fine of up to $25. **Study year:** 1991 – 2000 **Eligible population:** patients discharged from all public hospitals in California form 1991-2000. **Settings:** 10 years of patient discharge records from all public hospitals in California, from 1991-2000.	**Data sources:** Patient discharge records from all public hospitals in California, from 1991-2000. There were 44,069 cases in total and each of them represented a non-fatal injury event for a bicyclist. **Statistical analysis:** two methods were applied: (1) aggregate data analysis using Pearson Chi-squared test for independence and a comparison of odds ratios – this approach tested whether the relative injury proportions for the two age groups were significantly different across the two periods (2) pooled disaggregate data fitting technique using multinomial logit (MNL) models – this examined the likelihood of each proportion of injury type outcome before and after the legislation for the two age groups while accounting for the other variables. **Method of allocation:** Two age groups, two time periods, and three injury types were defined. The study cases were young bicyclists, 17 years of age and under, who were required to use helmets (youth) ; the controls were adults who were not required to do so. The two periods were 1991 through 1993, pre-legislation, and 1994 through 2000, post-legislation. The three injury types included two for the head - traumatic brain injuries (Head-TBI), other injuries to the head, face and neck (Head-Other); and one for all other injuries below the neck (Other). **Measures to minimise confounding:** **Intervention/s:** 1994 helmet legislation for youth **Comparator/s:** rates of injuries associated with the use of a bicycle in the period before (1991-	**Limitations identified by author:** (1) lack of exposure data and reliable methods to estimate patterns of bicycling activities (2) data on both enforcement and compliance (helmet use), in combination with injury outcomes, would provide a stronger basis for undertaking the effectiveness of legislation and ways to enhance it. **Limitations identified by review team:** The study was a retrospective analysis of hospital data: a prospective study design could be quite valuable; rates of helmet use not given. **Evidence gaps and/or recommendations for future research:** Additional research and the collection of helmet use data may help target efforts to promote the use of bicycle helmets: worthwhile to pursue more detailed investigations to understand how different segments of the bicycling populations might be targeted for helmet use promotion in conjunction with legislation mandating such use. Future research should also look for any 'carry over' effects among bicyclists who were subjected to bicycle safety helmet legislation in their youth **Source of funding:** **Observation from the Discussion section about barriers & facilitators:**

		1993) and after the law came into effect (1994-2000) among adult cyclists **Sample sizes:** **Total n=** 44,069 bicycle related cases **Intervention n=** **Control n=** **Baseline comparisons:** three years (1991-1993) of pre-intervention data on rates of injury **Study sufficiently powered?** yes	

Results: Aggregate data analysis using Pearson Chi-square showed that there was a significant change among the youth group ($p < 0.001$) but not for the adult group ($p = 0.505$) over the 10-year period, in the distribution of injury type proportions. There was also a significant reduction of 18.2% (99% CI 11.5 – 24.3%) in Head-TBI injuries among youth over this time (OR 0.0818, 99% CI 0.757 – 0.8855) but not among adults during the same period (OR 1.01, 99% CI 0.926 – 1.10). Among others, pooled disaggregate data analysis using MNL models showed that the youngest riders, aged 0-9 years, had the greatest decrease in the proportion of Head-TBI

Age	Type of Injuries	Pre-legislation (1991-1993) [A]	Post-legislation (1994-2000) [B]	Odds Ratios [B/A]
Youth	Head-TBI	0.327[a] (0.313 – 0.341)[b]	0.268 (0.258 – 0.277)	0.818 (0.757 – 0.8855)
	Head-Other	0.0710 (0.0634 – 0.0785)	0.0765 (0.0708 – 0.0823)	1.08 (0.901 – 1.23)
	Other	0.602 (0.588 – 0.612)	0.656(0.646 – 0.666)	1.09 (1.05 – 1.13)
Adult	Head-TBI	0.203 (0.192 – 0.214)	0.205 (0.198 – 0.212)	1.01 (0.926 – 1.10)
	Head-Other	0.0793 (0.0721 – 0.0866)	0.0833 (0.0786 – 0.0880)	1.05 (0.908 – 1.22)
	Other	0.718 (0.705 – 0.730)	0.712 (0.704 – 0.719)	0.992 (0.965 – 1.02)

[a] Proportion of the total number of Youth cases in this period for this injury type
[b] 99.0% CI

Study details	Population and setting	Method of allocation to intervention/control	Notes
Authors: Macpherson, A.K.; To, T.M.; Macarthur, C.; Chipman, M.L.; Wright, J.G. & Parkin, P.C. **Year (of publication):** 2002 **Aim of study:** to measure the impact of mandatory bicycle helmet legislation on the incidence of bicycle-related head injuries among Canadian children. **Study design:** Controlled before and after study **Internal validity score** [+] **External validity score** [+]	**Source area/s:** Country-wide study in Canada **Nature of Law/standard/mass media:** Between 1995 and 1997, four Canadian provinces adopted the bicycle helmet legislation for children. **Study year:** 1994 – 1998 **Eligible population:** All children (5-19 years) with an external injury code related to a pedal cyclist injury **Settings:** Data on Canadian children who were hospitalised because of bicycle-related injuries during the period 1994-1998 inclusive were obtained form the Canadian Institute for Health Information (CIHI).	**Data sources:** Database of all Canadian children who were hospitalised because of bicycle-related injuries during the period 1994-1998, obtained form the Canadian Institute for Health Information (CIHI). **Statistical analysis:** trends in bicycle-related injury rates over time in the legislation provinces (n =4) and no legislation provinces (n = 8); annual rates of bicycle-related head injuries and other injuries for the 4 years of the study (1994 – 1998) were calculated for the two groups (legislation and no legislation provinces); the chi-squared test for trend was used to test for differences over time in head injury rates and other injury rates between the 2 groups. Multivariable logistic regression analysis was also used to model the odds of head injury among injured bicyclists, while controlling for other covariates. **Method of allocation:** Provinces with legislation were cases and without legislation served as control **Measures to minimise confounding:** **Intervention/s:** Bicycle helmet legislation adopted by Canadian provinces between 1995 and 1997 **Comparator/s:** Provinces without helmet legislation **Sample sizes:** **Total n=** 9650 admissions **Intervention n=** 5029	**Limitations identified by author:** **Limitations identified by review team:** Retrospective study design; rates of helmet use not available. **Evidence gaps and/or recommendations for future research:** **Source of funding:** Ontario Ministry of Health and Long Term Care, Canadian Institute of Health Research **Observation from the Discussion section about barriers & facilitators:**

		Control n= 4621 **Baseline comparisons:** Rates of injuries in legislation and no-legislation provinces before legislation was enacted. **Study sufficiently powered?** yes	

Results: Head injury rate was similar in both groups (legislation and no-legislation provinces) before legislation (18.27 and 18.35 per 100,000 for legislation provinces and no-legislation provinces, respectively). There was a 45% reduction in the rate of bicycle-related head injuries in legislation provinces 9from 18.27 per 100,000 in 1994 – 1995 to 9.96 per 100,000 in 1997 – 1998), this being greater than the 27% concurrent decline in no-legislation provinces (from 18.35 per 100,000 in 1994 – 1995 to 13.33 per 100,000 in 1997 – 1998). A chi-square test for trend between groups found that the decline was significantly greater (p = .001) in legislation provinces. The logistic regression analysis showed that legislation was the only significant variable: a significant protective effect of legislation on head injury among injured cyclists was noted (OR 0.77, 95% CI 0.69 – 0.85).

Province	**Date of adoption of legislation**	**Head Injury Rates by Year (Rate per 100,000)**			
		1994 -1995	**1995 - 1996**	**1996 - 1997**	**1997 -1998**
Legislation provinces					
• Ontario	October 1995	16.25	11.85	10.51	8.36
• New Brunswick	December 1995	22.18	22.18	13.70	18.27
• British Columbia	September 1996	24.03	20.00	15.30	13.69
• Nova Scotia	July 1997	15.57	12.35	3.76	6.98
SUBTOTAL		**18.27**	**14.22**	**11.37**	**9.96**
No-legislation provinces					
• Newfoundland		27.24	30.45	23.24	22.44
• Prince Edward Island		13.27	13.27	3.32	9.95
• Quebec		19.77	17.29	15.59	15.73
• Manitoba		7.45	9.10	8.28	8.69
• Saskatchewan		23.39	16.16	17.86	9.78
• Alberta		15.54	14.07	12.43	9.65
• Yukon, NWT		31.45	18.87	12.58	0.00
SUBTOTAL		**18.35**	**16.29**	**14.60**	**13.33**
Canada		18.31	15.15	12.83	11.48

Study details	Population and setting	Method of allocation to intervention/control	Notes
Authors: Cote T.R. **Year (of publication):** 1992 **Aim of study:** To evaluate the effect of legislation and education on bicycle helmet use among children **Study design:** controlled before and after study **Internal validity score**[§] [+] **External validity score**[†] [-]	**Source area/s:** Howard, Montgomery and Baltimore county, USA **Nature of Law/standard/mass media:** Legislation and education promoting helmet use. **Study year:** 1990-1991 **Eligible population:** children less than 16 years **Settings:** school children	**Data sources:** Baseline observations of bicyclists in the intervention (Howard) and control (Montgomery and Baltimore) counties were held in July 1990 and a follow-up in May 1991. Ten routes, each with four sites for observation, were selected for each county, representing various socioeconomic strata. The sites also included arrears near schools, recreational centres or pools, county thoroughfares, residential streets, parks or bicycle paths. **Statistical analysis:** within each of the county, baseline and follow-up helmet use rates were compared by gender, race, census tract type and for bicyclists riding alone and in groups. Results were computed at 95% confidence intervals with continuity corrections around each crude proportion. **Method of allocation:** Not applicable **Measures to minimise confounding:** continuity corrections around each crude proportion. **Intervention/s:** Helmet use legislation and education **Comparator/s:** laissez-faire (No legislation or education) **Sample sizes: 448** **Total n=** **Intervention n=** **Control n=** **Baseline comparisons:** Baseline differences in	**Limitations identified by author:** Baseline and follow-up comparison observations were done in different seasons. Intervention and comparison communities were not randomly chosen leading to differences in baseline characteristics. Lower socioeconomic census tracts were not included in the study as few such census tracts existed in Howard county. The categorisation of children younger than 16 years was not precise **Limitations identified by review team:** Observers were instructed not to leave a blank answers and to guess if they were unsure or do not know the age, gender, race and helmet use in the participants. **Evidence gaps and/or recommendations for future research:** **Source of funding:** Grant H28/CCH 301 618-02 from the Centres for Disease Control **Observation from the Discussion section about barriers & facilitators:** The death of two children and police education about the impending law caused helmet use among children less than 16 years in Howard county.

		helmet use, demographic of riders and the number of riders seen at various locations. **Study sufficiently powered?** Not reported	

Results:

	No. helmeted/No. observed	
	Baseline (%)	**Follow/up (%)**
Howard County (Legislation)	**3/64 (4)**	**24/51 (47)**
Montgomery County (Education)	**11/140 (8)**	**19/102 (19)**
Baltimore County (None)	**7/37 (19)**	**2/49 (4)**

Study details	Population and setting	Method of allocation to intervention/control	Notes
Authors: Gilchrist, J *et al.* **Year (of publication):** 2000 **Aim of study:** to study the effectiveness of adding police enforcement to legislative efforts **Study design:** Controlled before and after study **Internal validity score** [+] **External validity score** [+]	**Source area/s:** a small rural Georgia community (population = 2400), USA. **Nature of Law/standard/mass media:** The US state of Georgia mandated bicycle helmet use for children, effective July 1993. Later that summer, the city council of a rural Georgia community passed an ordinance strengthening the state law by instructing police officers to impound the bicycle of any child (<13 years) seen riding without a helmet. Because this was enforced only briefly and not subsequently, police reinstituted the program by initially issuing warnings to unhelmeted children in April 1997. The distribution program began in late April, after which began impounding the bicycle of any unhelmeted child rider. **Study year:** 1997 **Eligible population:** cycle riders under 16 years of age **Settings:** rural Georgia community, USA	**Data sources:** Helmet use was observed by four trained community workers by way of unobstrusive observation: only public behaviour was observed; no identifying data collected and no interaction with the bicyclists occurred. **Statistical analysis:** Chi squared test for pre-distribution and post-distribution observations **Method of allocation:** Not applicable **Measures to minimise confounding:** **Intervention/s:** police enforcement combined with a helmet giveaway and education program **Comparator/s:** helmet use pre- and post-distribution among adults **Sample sizes:** **Total n=** 777 observed bicycle rides **Intervention n=** 419 children **Control n=** 332 teens + adults **Baseline comparisons:** rate of use of bicycle helmet before the distribution program **Study sufficiently powered?** yes	**Limitations identified by author: (**1) The authors could not be certain that all children in grades 6 and 7 received a helmet. (2) possibility of age group misclassification as part of observer error (3) results from rural community may not be generalizable to an urban/sub-urban community (4) effect of program on teens could not be studied as they were not subject to the local ordinance (5) highly likely that multiple observations were made on the same rider, with the extent of this unknown **Limitations identified by review team:** **Evidence gaps and/or recommendations for future research:** **Source of funding:** **Observation from the Discussion section about barriers & facilitators:**

Results: Observations before distribution found that helmet use among 61 child bicycle riders was 0%; observed helmet use in children increased from 0% predistribution to between 30% and 71% postdistribution (mean: 45%; p = 0.001). By comparison, helmet use in adults did not change significantly, from 0% predistribution to 3% postdistribution. Children's helmet use increased significantly in all race-gender strata for which significance could be determined. Two years after the initiation of the intervention, 21 of 39 (54%) of child riders were observed wearing helmets during 1 afternoon, compared with only 2 (15%) of 13 teens and none of the 23 adults.

Age Group	Predistribution Helmeted/total Observed	%	Postdistribution* Helmeted/Total Observed	%	Range (%)	P value
Children (estimated 5-12 y)	0/61	0	161/358	45	30-71	.001
Teens (estimated 13-15 y)	0/16	0	23/125	18	0-50	.074
Adults (estimated 16+ y)	0/20	0	5/171	3	0-6	1.000
Total	0/97	0	189/654	29	0-71	.001

* Aggregate findings from 7 observational periods from 1 week to 5 months after helmet distribution

Study details	Population and setting	Method of allocation to intervention/control	Notes
Authors: Hagel B.E, Rizkallah J.W, Belton K.L **Year (of publication):** 2006 **Aim of study:** To determine changes in helmet use in cyclists following the introduction of a bicycle helmet law for children under age 18 **Study design:** Before and after study **Internal validity score**[§] [+] **External validity score**[†] [-]	**Source area/s:** Edmonton, Canada **Nature of Law/standard/mass media:** Legislation **Study year:** 2000-2004 **Eligible population:** children under 18 years of age **Settings:** population based	**Data sources:** The first survey was conducted in 2000 to estimate the prevalence of helmet use in Edmonton and Calgary, along with surrounding communities. The locations were divided into six strata: schools, parks, commuter routes, designated cycling paths, universities/colleges, and residential areas. An observer at each site collected information on riding companionship, helmet use, gender and approximate age. In 2004, two observers and project coordinator visited the same sites, in Edmonton only, with the exception of areas with less than 10 riders. Data were collected on age, sex, helmet use, travel mode. **Statistical analysis**: Change in helmet prevalence between 2000 and 2004 was examined by age, sex, location and neighbourhood average annual household income based on 2001 Statistics Canada census data divided into three strata: <$50,000, $50,000-$59,999, and $60,000+. Poisson regression was used to directly model the prevalence ratio, with the robust estimator to account for clustering by size. Main effects and interactions between year of observation and all other variables were included. Interaction terms were simultaneously tested and those that were significant ($p<0.05$) were retained in the model. **Method of allocation:** Not applicable **Measures to minimise confounding:** Adjusted for potential confounders. **Intervention/s:**	**Limitations identified by author:** Some non-differential misclassification of neighbourhood average annual income as the variable was not found to modify the pre- to post- legislation assessment of bicycle helmet prevalence. All variables that could influence helmet use were not adjusted for because cyclists were not stopped to collect information regarding personal trips or cycling characteristics. **Limitations identified by review team:** **Evidence gaps and/or recommendations for future research:** **Source of funding:** Alberta \heritage foundation for Medical Research Summer Studentship, University of Alberta Summer Temporary Employment Program and the Alberta Centre for Injury Control and Research. **Observation from the Discussion section about barriers & facilitators:**

		Comparator/s: **Sample sizes:** **Total n=** **Intervention n=** **Control n=** **Baseline comparisons:** **Study sufficiently powered?** Not reported	

Results:

VARIABLE	2000 HELMET PREVALENCE	2004 HELMET PREVALENCE	2004 VS 2000 PREVALENCE RATIO	2004 VS 2000 ADJUSTED* PREVALENCE RATIO
Age				
<18	46/164	34/41	2.96 (2.22 – 3.94)	3.69 (2.65 – 5.14)
18+	234/474	110/230	0.97 (0.79 – 1.19)	1.17 (0.95 – 1.43)
Location				
Commuter route	130/353	64/121	1.44 (1.21 – 1.71)	1.17 (0.95 – 1.43)
Campus	22/62	9/29	0.88 (0.47 – 1.64)	0.74 (0.49 – 1.11)
Residential	23/65	13/21	1.75 (1.35 – 2.26)	1.49 (1.14 – 1.96)
Cycling path	59/114	35/61	1.11 (0.66 – 1.85)	0.75 (0.51 – 1.10)
Park	66/105	23/39	0.94 (0.74 – 1.19)	0.78 (0.58 – 1.05)

*Poisson regression model with adjustment for clustering by site contained terms for age, date, sex, average annual income, location, and the interaction of date and location and date and age

Study details	Population and setting	Method of allocation to intervention/control	Notes
Authors: Bergman A.B, Rivara F.P, Richards D.D **Year (of publication):** 1990 **Aim of study:** To convince parents that riding bicycles without helmets is hazardous and to overcome the reluctance of children to wear helmets. **Study design:** Controlled before and after study. **Internal validity score** [+] **External validity score** [+]	**Source area/s:** Seattle pubic schools, USA **Nature of Law/standard/mass media:** broad- based community coalition, combining individual health education with mass-media health promotion, commercial advertising, and financial incentives. **Study year:** 1987-1989 **Eligible population:** Elementary school children **Settings:** Community based	**Data sources:** Discount coupon redemptions by distribution sites: physician offices, schools, youth groups and other sites (events, fairs, etc). Annual sales of the Pro-Tec Freestyle II youth helmet in the Seattle-King County area. A survey of helmet usage among elementary school children in the intervention community (Seattle, Wash) and the control community (Portland, Ore). **Statistical analysis:** Not reported **Method of allocation:** Not reported **Measures to minimise confounding:** Not reported **Intervention/s:** **Comparator/s:** **Sample sizes:** **Total n=** 9827 **Intervention n=** 4940 **Control n=** 4887 **Baseline comparisons:** **Study sufficiently powered?** Not reported	**Limitations identified by author:** **Limitations identified by review team:** **Evidence gaps and/or recommendations for future research:** **Source of funding:** Grant CCR002570 from the Centers for Disease Control and grant 6500-60281 from the Bureau of Parent-Child Health Services of the Washington State Department of Social and Health Services. **Observation from the Discussion section about barriers & facilitators:** The program was narrow in its focus as it aimed to only increase helmet use but not to change bicycling behaviour. It also targeted narrow age group that was thought to be amenable to behaviour change. Combination of mass media and other avenues of increasing awareness and altering behaviour.

Results:

Observed Use of Bicycle Helmets by Children Aged 5 to 12 years in two communities

	Seattle, Wash		Portland, Ore	
Month	**No of Observations**	**% Wearing Helmets**	**No of Observations**	**% Wearing Helmets**
May 1987	**905**	**5**	**1052**	**1**
September 1987	**1213**	**5**	**1331**	**2**
May 1988	**1259**	**11**	**1188**	**2**
September 1988	**1563**	**16**	**1316**	**3**

Study details	Population and setting	Method of allocation to intervention/control	Notes
Authors: Lee A, Mann N.P, Takriti R **Year (of publication):** 2000 **Aim of study:** To increase bicycle helmet wearing among young people, especially teenagers. **Study design:** controlled before and after study **Internal validity score**[§] [-] **External validity score**[†] [++]	**Source area/s:** Reading and Basingstoke, South East England. **Nature of Law/standard/mass media:** A hospital led community based bicycle helmet promotion campaign. It consisted of school based talks, age specific information, true case scenarios/videos of head injured children, a demonstration using egg and small helmet to illustrate the effect of a head injury with and without a helmet, information on how to wear a helmet properly, and a low cost helmet purchase scheme. **Study year:** 1992 - 1998 **Eligible population:** school age children , especially the high risk teenage group (11-15 years old) **Settings:** State schools and youth groups.	**Data sources:** Independent samples of 500 teenagers each from Reading (intervention) and Basingstoke (control) completed a self administered questionnaire at the end of each year for three years. The questionnaire consisted of five items relating to cycling behaviour and opinions held about helmets. Injury data (information on head injuries and total number of cycle injuries) were collected from the A&E department in Reading to monitor injury figures relating to pedal cycle crashes among the under 16 age group from June 1988 to May 1998. No A&E figures were available from Basingstoke. **Statistical analysis:** Not reported **Method of allocation:** Not reported **Measures to minimise confounding:** Not reported **Intervention/s:** Helmet campaign **Comparator/s:** No campaign **Sample sizes:** **Total n=** **Intervention n=** **Control n=** **Baseline comparisons:** similar in mean age, gender, as well as in the rates of helmet wearing. **Study sufficiently powered?** Not reported	**Limitations identified by author:** Casualty data did not give information on cycle helmet wearing rates in head injures patients attending the A&E department. **Limitations identified by review team:** **Evidence gaps and/or recommendations for future research:** Further studies should include rates of helmet wearing of those seen in A&E and closer examination of the reasons for the campaign success. **Source of funding:** Not reported. **Observation from the Discussion section about barriers & facilitators:**

Results:

Children under 16 years old who attended the A&E department, 1998-98 for treatment of a bicycle related injury, rates per 100,000 population (<16 years)

	Pre-programme				Post-programme					
	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98
Head injuries	124.2	117.5	107.5	112.5	62.5	70	74.1	48.3	51.7	60.8
All bicycle injuries	542.5	553.3	525	520.8	376.7	392.5	500	408	443.3	513.3
Head injuries as % of all bicycle injuries	22.89	22.38	20.48	21.6	16.6	17.83	14.83	11.84	11.65	11.85

Percentages of 11-15 year olds in the control and campaign (intervention) areas reporting that they always wear a helmet when cycling (1992-97)

	1992	1997
Intervention	11%	31%
Control	9%	15%

b. Playground Standards

Study details	Population and setting	Method of allocation to intervention/control	Notes
Authors: Howard AW **Year (of publication):** 2005 **Aim of study:** to determine whether applying new standards and replacing unsafe playground equipment reduced the number of school playground injuries **Study design:** Controlled before and after **Internal validity score**[§] [-] **External validity score**[†] [+]	**Source area/s:** The Toronto District School Board **Nature of Law/standard/mass media:** Canadian standards for playground equipment 1998 **Study year:** 2000 **Eligible population:** Playground equipment that represented a severe hazard **Settings:** School playgrounds	**Data sources:** database of incident reports from the Ontario School Board Insurance Exchange **Statistical analysis:** Random-effect meta-analytic methods **Method of allocation:** Not reported **Measures to minimise confounding:** **Intervention/s:** Replacement of playground equipment in the schools **Comparator/s:** No replacement of playground equipment in the schools **Sample sizes:** **Total n=** 311 schools **Intervention n=** 86 schools **Control n=** 225 schools **Baseline comparisons:** Not reported **Study sufficiently powered?** Not reported	**Limitations identified by author:** Amount of exposure to equipment or non-equipment play was not assessed in the study. The study did not measure supervision, which may have changed. Information on injuries was obtained from reports of teachers and other school employees, whose thresholds for recording and reporting injuries may have changed during the study. **Limitations identified by review team:** **Evidence gaps and/or recommendations for future research:** **Source of funding:** Not reported **Observation from the Discussion section about barriers & facilitators:** change in physical environment may explain fall in injury rates in the intervention schools

Results:

The injury rates and equipment-related injuries in the intervention schools decreased, while injury rates and equipment-related injuries in the non-intervention schools increased (see Table)

	Before intervention	**After intervention**	**Post-intervention effectiveness**	
	Rate (95% CI)	Rate (95% CI)	Relative risk (95% CI)	Injuries avoided
Intervention schools				
Injuries per 1000 students per month(overall)	2.61 (1.93 to 3.29)	1.68 (1.31 to 2.05)	0.70 (0.62 to 0.78)	550
Equipment-related injury per 1000 students per month	0.58 (0.45 to 0.72)	0.44 (0.31 to 0.57)	0.82 (0.66 to 1.03)	117
Non-intervention schools				
Injuries per 1000 students per month (overall)	1.44 (1.07 to 1.81)	1.81 (1.07 to 2.53)	1.40 (1.29 to 1.52)	
Equipment-related injury per 1000 per month students	0.25 (0.19 to 0.32)	0.32 (0.25 to 0.39)	1.15 (0.96 to 1.37)	

Study details	Population and setting	Method of allocation to intervention/control	Notes
Authors: Sibert JR **Year (of publication):** 1999 **Aim of study:** To examine effects of improving playground equipment **Study design:** Controlled before After **Internal validity score**[§] [-] **External validity score**[†] [-]	**Source area/s:** Public playgrounds in Cardiff **Nature of Law/standard/mass media:** replacement of playground equipment **Study year:** 1995 **Eligible population:** Not states **Settings:** Public playgrounds	**Data sources:** Accident and emergency department **Statistical analysis:** Cross-tabulation and Poisson regression models **Method of allocation:** not applicable **Measures to minimise confounding:** **Intervention/s:** Playgrounds where equipment were replaced **Comparator/s:** Playgrounds where equipment were not replaced **Sample sizes:** **Total n=** 19 playgrounds **Intervention n=** 5 playgrounds **Control n=** 14 playgrounds **Baseline comparisons:** No similar base line characteristics **Study sufficiently powered?** not reported	**Limitations identified by author:** No reported **Limitations identified by review team:** The duration for follow-up was short, there is uncertainty in long term effectiveness of the strategy. Assumption that usage was constant in playgrounds with limited data. Comparison between controls was not adequate because facilities were different. **Evidence gaps and/or recommendations for future research:** There is need for a longer follow-up after the changes were made **Source of funding:** Limited funding from Hag play- playground equipment manufacturer **Observation from the Discussion section about barriers & facilitators:** The changes made did not lessen the popularity of the playgrounds

Study details	Population and setting	Method of allocation to intervention/control	Notes

Results: Injury rate per observed child was significantly reduced in five playgrounds where changes had been made

	01/1994 – 06/ 1995	***07/1995 – 12/1996***	***P value***	
	Injury rate*	Injury rate*	Before and after changes	Compared with control
Playgrounds with changes (bark depth)	0.719	0.297	<0.001	<0.03
Playground with changes- Roath Par (Monkey bars and bark depth)	0.929	0.271	<0.001	<0.005
Playgrounds without changes	0.433	0.346	-	-

c. Fireworks Legislation

Study details	Population and setting	Method of allocation to intervention/control	Notes

Study details	Population and setting	Method of allocation to intervention/control	Notes
Authors: D' Argenio P, Cafaro L, Santonastasi F, Taggi F, Binkin N **Year (of publication):** 1996 **Aim of study:** to study the effects of a comprehensive, multifaceted intervention program to reduce fireworks-related injuries **Study design:** Before and after **Internal validity score**[§] [+] **External validity score**[†] [+]	**Source area/s:** Metropolitan Naples **Nature of Law/standard/mass media:** The regional Epidemiologic observatory of Campania initiated active surveillance of fireworks injury in 18 emergency rooms in metropolitan area of Naples in Italy. Following that, an interventional program called New Year without harm was developed to enforce laws prohibiting the sales of illegal fireworks, cleaning the streets in the morning of January 1, informing children and the public about the risks of fireworks related injuries **Study year:** 1992-1994 **Eligible population:** Not reported **Settings:**	**Data sources:** Emergency room records and from records of intentional and non-intentional injuries maintained by the police posts located on the grounds of each hospital **Statistical analysis:** Poisson and chi-square tests **Method of allocation:** Not applicable **Measures to minimise confounding:** Not reported **Intervention/s:** Forcing the laws prohibiting the sale of illegal fireworks, cleaning the streets early in the morning of January 1, and informing children and the public about the risks of firework-related injuries **Comparator/s:** Not applicable **Sample sizes:** **Total n=** **Intervention n=** **Control n=** **Baseline comparisons:** Not reported **Study sufficiently powered?** Not reported	**Limitations identified by author:** Not reported **Limitations identified by review team:** The study did not control for potential confounders. **Evidence gaps and/or recommendations for future research:** There is a need for studies with control population. **Source of funding:** Not reported **Observation from the Discussion section about barriers & facilitators:** Educational campaign with clear message may aid program effectiveness.

Results:

- There was 48% reduction in the number of persons injured by fireworks after intervention was implemented (before – 353 cases; after – 183 cases)
- The overall rates declined from 10.0 per 100,000 to 6.1 per 10,000

Study details	Population and setting	Method of allocation to intervention/control	Notes

Study details	Population and setting	Method of allocation to intervention/control	Notes
Authors: Edwin AFL, Cubison TCS, Pape SA **Year (of publication):** 2008 **Aim of study:** To assess the possible impact of the legislative changes on paediatric population **Study design:** Retrospective time series **Internal validity score**[§] [+] **External validity score**[†] [+]	**Source area/s:** United Kingdom **Nature of Law/standard/mass media:** Firework (Safety) Regulation 1996/1997The Firework Act 2003 and the Firework Regulations 2004 **Study year:** 1995 - 2005 **Eligible population:** Paediatric population **Settings:** Northern region	**Data sources:** The Northern Regional Paediatric Burns Centre registers, Newcastle Paediatric Hand Trauma Database, Her Majesty's Stationery Office website and the Newcastle University Law Library. **Statistical analysis:** Trend analysis **Method of allocation:** Not applicable **Measures to minimise confounding:** not reported **Intervention/s:** Firework (Safety) Regulation **Comparator/s:** not applicable **Sample sizes:** **Total n=** 2937 **Intervention n=** **Control n=** **Baseline comparisons:** not reported **Study sufficiently powered?** Not reported	**Limitations identified by author:** Not reported **Limitations identified by review team:** **Evidence gaps and/or recommendations for future research:** **Source of funding:** Not reported **Observation from the Discussion section about barriers & facilitators:**

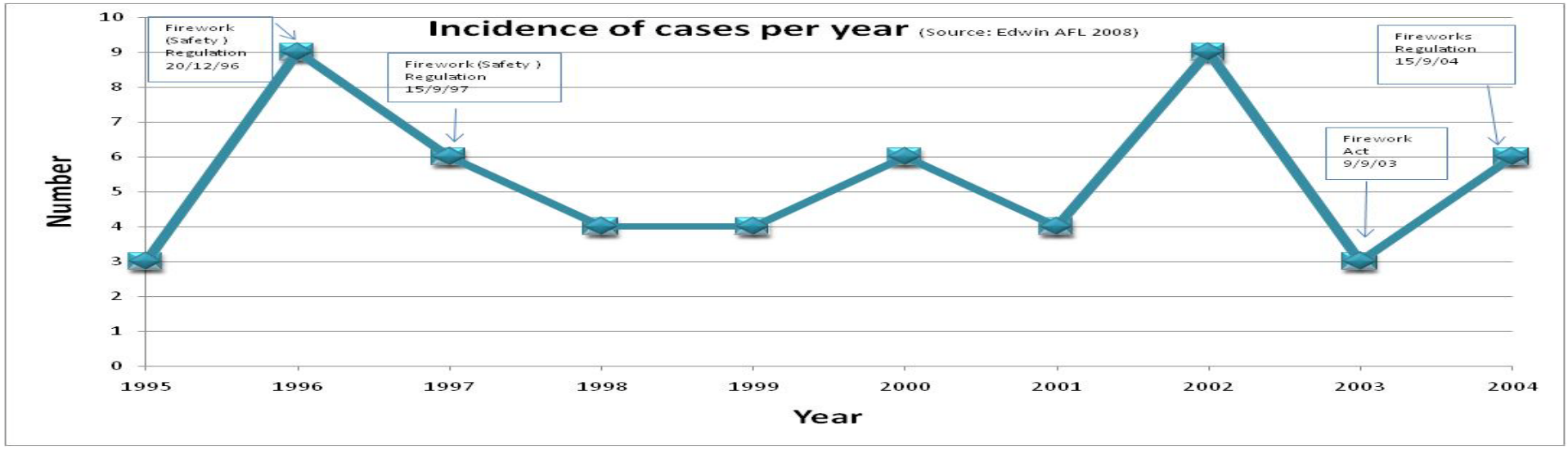
Study details	Population and setting	Method of allocation to intervention/control	Notes

Results: There was a drop in the numbers of firework injuries seen in all regions between 2001 and 2004. This fall in numbers did not reduce further in 2005. Between 2001 and 2005, the North and Yorkshire region reduced fireworks injuries seen by 39%—the greatest decrease in the UK (see Table).

Table: Firework injuries by super region (Source: Edwin AFL 2008)

Year	UK	North and Yorks	Scotland	Trent	Eastern	Greater London	South East	South and west	West Midlands	North West	wales
2001	707	134	57	71	31	50	52	45	65	170	32
2002	583										
2003	588										
2004	565	82	37	61	48	33	49	44	42	128	41
2005	494	82	54	64	28	27	47	20	37	102	33
Total	2937	298	148	196	107	110	148	109	144	400	106

Before 2003 Fireworks Act restricted the period of availability of fireworks, children with firework injuries were burned before 21st October or after 14th November (see Fig). While In 2004 only 1 (2%) child was injured outside this 3-week period, on 16 October 2004.



Study details	Population and setting	Method of allocation to intervention/control	Notes

Study details	Population and setting	Method of allocation to intervention/control	Notes

Study details	Population and setting	Method of allocation to intervention/control	Notes
Authors: Fogarty BJ **Year (of publication):** 1999 **Aim of study:** To examine effect of change in the pattern of firework-related injury following liberalisation of the law **Study design:** Before and after **Internal validity score**[§] [-] **External validity score**[†] [+]	**Source area/s:** Northern Ireland **Nature of Law/standard/mass media:** Legislation **Study year:** 1993-1997 **Eligible population:** not reported **Settings:** general population	**Data sources:** Hospital admission records **Statistical analysis:** descriptive statistics **Method of allocation:** not applicable **Measures to minimise confounding:** **Intervention/s:** Legislature governing firework sale in the Northern Ireland was relaxed, equalling that of the rest of the UK **Comparator/s:** not applicable **Sample sizes:** **Total n=** 30 patients **Intervention n=** **Control n=** **Baseline comparisons:** not reported **Study sufficiently powered?** Not reported	**Limitations identified by author:** The small numbers could not achieve statistical significance. **Limitations identified by review team:** The study did not control for potential confounders. **Evidence gaps and/or recommendations for future research:** There is a need for studies with control population. **Source of funding:** Not reported **Observation from the Discussion section about barriers & facilitators:**

Results:

There was increase in the firework admission after the legislation was relaxed (before -0.38 per 100,000 ; after - 0.43 per 100,000)

d. Drowning Prevention/Water Safety

Study details	Population and setting	Method of allocation to intervention/control	Notes
Authors: Bennett E **Year (of publication):** 1999 **Aim of study:** To increase life vest use among 1-14 year old children on boats, docks, at beaches, and swimming pools, and to increase general water safety awareness. **Study design:** Intermittent time series **Internal validity score**[§] [+] **External validity score**[†] [+]	**Source area/s:** King County, Washington **Nature of Law/standard/mass media:** social marketing and use of multimedia channel **Study year:** 1992-1994 **Eligible population:** **Settings:** King County, Washington	**Data sources:** Telephone surveys **Statistical analysis:** Chi-squared statistics and logistic regression **Method of allocation:** Not applicable **Measures to minimise confounding:** multivariable analysis was used to control for potential confounders simultaneously **Intervention/s:** Community-wide drowning prevention campaign **Comparator/s:** Not applicable **Sample sizes:** 2556 (pre-campaign – 697 and post-campaign - 1859) **Total n=** **Intervention n=** **Control n=** **Baseline comparisons:** Not reported **Study sufficiently powered?** Not reported	**Limitations identified by author:** Some of the increase in use may be attributable to other educational efforts. The use of non-random digit dialling method could have biased results. Similarly, the use of self-reported information may also bias the results, because people tend to exaggerate positive behaviours. It is possible that people aware of the prevention campaign were more likely to exaggerate use of life vests. The proportion of interviewed families with high incomes was greater than for all King County families, so our findings may not apply to low income families. The pre-campaign survey used a different sampling method than the tracking and post-campaign surveys. It is possible that the post-campaign survey population was more likely to use life vests than the pre-campaign population. **Limitations identified by review team:** There is no proper control group; it is not clear whether the effect found in the study is due to the intervention alone. **Evidence gaps and/or recommendations for future research:** There is a need for studies with control group to evaluate the program effectiveness. **Source of funding:** Children's Hospital and Regional Medical Center in Seattle, Washington.

Results:

Reported ownership of vests for all age groups increased from 69% in the pre-campaign survey to 75% in the post-campaign survey. Among those aware of the campaign, ownership increased to 80%.

The odds for reported use of a life vest by a child at beaches, pools, or docks were greater among those surveyed after the campaign compared with the baseline survey: odds ratio 1.6 (95% CI 1.1 to 2.5). The association remained significant after controlling for other potential confounders - child vest ownership, parent age, parent's confidence fitting a vest, child's swimming ability, parent use of vest, perceived susceptibility to drowning, parent's education and income, and perceived efficacy of vest.

Appendix 4 – Quality Assessment

		Bicycle Helmets								Playgrounds		Fireworks			Life vests
	Study identification	**Ji 2006**	**Lee 2005**	**Macpherson 2002**	**Cote 1992**	**Gilchrist 2000**	**Hagel 2006**	**Bergman 1990**	**Lee 2000**	**Howard 2005**	**Sibert 1999**	**Fogarty 1999**	**D'Argenio 1996**	**Edwin 2008**	**Bennet 1999**
	Study design	CBA	CBA	CBA	CBA	CBA	BA	CBA	CBA	CBA	CBA	BA	BA	RTS	ITS
	Section 1: Population														
1.1	Is the source population well described?	++	++	+	+	+	+	+	+	-	-	-	+	-	++
1.2	Eligible population representative of the source population?	+	+	+	+	+	+	+	+	+	+	+	+	+	+
1.3	Do the selected participants represent the eligible population?	++	++	+	+	+	+	+	+	+	+	+	+	+	-
	Section 2: Method of Allocation to intervention (or comparison)														
2.1	Allocation to intervention (or comparison) groups - how was confounding minimised?	+	+	NR	+	+	+	NR	NR	-	-	NA	NA	NA	NA
2.2	Interventions (and comparisons) well described and appropriate?	+	+	+	+	+	+	+	+	-	-	++	++	++	++
2.3	Allocation concealed?	-	-	-	-	-	-	-	-	-	-	NA	NA	NA	NA
2.4	Participants and/or investigators blind to exposure and comparison?	-	-	-	-	-	-	+	-	+	NR	NA	NA	NA	NA
2.5	Exposure to intervention and comparison adequate?	+	+	+	+	+	+	+	+	-	-	NA	NA	NA	NA
2.6	Contamination acceptably low?	+	+	+	+	+	+	+	+	+	+	NA	NA	NA	NA
2.7	Other interventions similar in both groups?	NR	NR	+	NR	+	+	-	-	-	NR	NA	NA	NA	NA
2.8	All participants accounted for at study conclusion?	+	+	+	+	+	+	+	+	NA	NA	NA	NA	NA	NA
2.9	Did the setting reflect usual practice?	++	++	++	++	++	+	+	+	++	++	NA	NA	NA	NA

		Bicycle Helmets								Playgrounds		Fireworks			Life vests
		Ji 2006	Lee 2005	Macpherson 2002	Cote 1992	Gilchrist 2000	Hagel 2006	Bergman 1990	Lee 2000	Howard 2005	Sibert 1999	Fogarty 1999	D'Argenio 1996	Edwin 2008	Bennet 1999
2.10	Did the intervention or control comparison reflect usual practice?	+	+	+	+	+	+	+	+	++	++	NR	NA	NA	NA
	Section 3: Outcomes														
3.1	Outcome measures reliable?	+	+	+	+	+	+	+	-	-	+	+	++	+	+
3.2	Outcome measurement complete?	+	+	+	+	+	+	+	+	+	+	+	+	++	+
3.3	Were all important outcomes assessed?	+	+	+	+	+	+	+	+	+	+	+	+	++	+
3.4	Were outcomes relevant?	+	+	+	+	+	+	+	+	++	+	+	+	+	++
3.5	Similar follow-up time in exposure and comparison groups?	++	++	++	++	++	++	+	++	++	++	-	+	NA	+
3.6	Was follow-up time meaningful?	+	++	+	+	+	+	+	+	+	+	+	+	++	+
	Section 4: Analyses														
4.1	Exposure and comparison groups similar at baseline? If not, were these adjusted?	-	-	++	-	-	+	-	++	NR	NR	NA	NA	NA	NR
4.2	Intention to treat analysis?	NR	NR	NR	NR	NR	NR	NR	NR	NA	NA	NA	NA	NA	NA
4.3	Estimates of effect size given or calculable?	++	++	++	++	++	++	++	++	++	++	++	++	+	++
4.4	Analytical methods appropriate?	++	++	++	+	+	++	+	+	++	++	NR	++	NR	++
4.5	Precision of intervention effects given or calculable? Were they meaningful?	++	++	++	-	++	+	-	++	++	++	-	+	-	++
4.6	Was the study sufficiently powered to detect an intervention effect (if one exists)?	++	++	++	-	+	-	++	++	NR	NR	NR	NR	NR	NR
	Section 5: Summary														
5.1	Are the study results internally valid (ie unbiased)?	+	+	+	+	+	+	+	-	-	-	-	+	+	+
5.2	Are the findings generalisable to the source population (ie externally valid)?	+	+	+	-	+	-	+	++	+	-	+	+	+	+

Appendix 5 – List of studies excluded at full text stage

Articles excluded based on design

(These articles did not evaluate using comparative design; for example, qualitative studies, systematic reviews, reviews)

Programs to prevent sports injury, *Medicine Today.6(5)()(pp 8-9), 2005.Date of Publication: May 2005.<974>* no. 5, pp. 8-9.

Abernethy, L. & Bleakley, C. 2007, "Strategies to prevent injury in adolescent sport: A systematic review", *British Journal of Sports Medicine.41(10)()(pp 627-638), 2007.Date of Publication: Oct 2007.* no. 10, pp. 627-638.

Abernethy, L. & Bleakley, C. 2007, "Strategies to prevent injury in adolescent sport: a systematic review. [Review] [50 refs]", *British Journal of Sports Medicine*, vol. 41, no. 10, pp. 627-638.

Blank, D. 2005, "Injury control from the perspective of contextual pediatrics", *Jornal de Pediatria.81(5 SUPPL.)()(pp S123-S136), 2005.Date of Publication: Nov 2005.* no. 5 SUPPL., p. S123-S136

Caine, D., Maffulli, N., & Caine, C. 2008, "Epidemiology of Injury in Child and Adolescent Sports: Injury Rates, Risk Factors, and Prevention", *Clinics in Sports Medicine.27(1)()(pp 19-50), 2008.Date of Publication: Jan 2008.* no. 1, pp. 19-50.

Curnow, W. J. 2008, "Bicycle helmets and public health in Australia.[see comment]", *Health Promotion Journal of Australia*, vol. 19, no. 1, pp. 10-15.

Emery, C. A. 2003, "Risk factors for injury in child and adolescent sport: A systematic review of the literature", *Clinical Journal of Sport Medicine.13(4)()(pp 256-268), 2003.Date of Publication: Jul 2003.* no. 4, pp. 256-268.

Goldberg, A. S., Moroz, L., Smith, A., & Ganley, T. 2007, "Injury surveillance in young athletes: A clinician's guide to sports injury literature", *Sports Medicine.37(3)()(pp 265-278), 2007.Date of Publication: 2007.* no. 3, pp. 265-278.

Hunter, W. M., Helou, S., Saluja, G., Runyan, C. W., & Coyne-Beasley, T. 2005, "Injury prevention advice in top-selling parenting books", *Pediatrics.116(5)()(pp 1080-1088), 2005.Date of Publication: Nov 2005.* no. 5, pp. 1080-1088.

Kendrick, D., Coupland, C., Mulvaney, C., Simpson, J., Smith, S. J., Sutton, A., Watson, M., & Woods, A. 2007, "Home safety education and provision of safety equipment for injury prevention", *Cochrane Database of Systematic Reviews.(1), 2007.Article Number: CD005014.Date of Publication: 2007.* no. 1.

Kendrick, D., Watson, M., Mulvaney, C., & Burton, P. 2005, "How useful are home safety behaviours for predicting childhood injury? A cohort study", *Health Education Research.20(6)()(pp 709-718), 2005.Date of Publication: Dec 2005.* no. 6, pp. 709-718.

Kendrick, D., Barlow, J., Hampshire, A., Polnay, L., & Stewart-Brown, S. 2007, "Parenting interventions for the prevention of unintentional injuries in childhood", *Cochrane Database of Systematic Reviews.(4), 2007.Article Number: CD006020.Date of Publication: 2007.* no. 4.

Licence, K. 2004, "Promoting and protecting the health of children and young people", *Child: Care, Health and Development.30(6)()(pp 623-635), 2004.Date of Publication: Nov 2004.* no. 6, pp. 623-635.

MacKay, M., Scanlan, A., Olsen, L., Reid, D., Clark, M., McKim, K., & Raina, P. 2004, "Looking for the evidence: a systematic review of prevention strategies addressing sport and recreational injury among children and youth", *Journal of Science and Medicine in Sport*, vol. 7, no. 1, pp. 58-73.

Macpherson, A. & Spinks, A. 2008, "Bicycle helmet legislation for the uptake of helmet use and prevention of head injuries. Cochrane Database of Systematic Reviews: Reviews," in *Cochrane Database of Systematic Reviews 2008 Issue 3*, John Wiley & Sons, Ltd, Chichester (UK).

McClure, R., Nixon, J., Spinks, A., & Turner, C. 2005, "Community-based programmes to prevent falls in children: A systematic review", *Journal of Paediatrics and Child Health.41(9-10)()(pp 465-470), 2005.Date of Publication: Sep 2005.* no. 9-10, pp. 465-470.

McGuine, T. 2006, "Sports injuries in high school athletes: A review of injury-risk and injury-prevention research", *Clinical Journal of Sport Medicine.16(6)()(pp 488-499), 2006.Date of Publication: Nov 2006.* no. 6, pp. 488-499.

Paes, C. E. N. & Gaspar, V. L. V. 2005, "Unintentional injuries in the home environment: Home safety", *Jornal de Pediatria.81(5 SUPPL.)()(pp S146-S154), 2005.Date of Publication: Nov 2005.* no. 5 SUPPL., p. S146-S154.

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Schieber, R. A., Gilchrist, J., & Sleet, D. A. 2000, "Legislative and regulatory strategies to reduce childhood unintentional injuries", *Future of Children.10(1)()(pp 111-136), 2000.Date of Publication: Mar 2000.* no. 1, pp. 111-136.

Shanmugam, C. & Maffulli, N. 2008, "Sports injuries in children", *British Medical Bulletin.86(1)()(pp 33-57), 2008.Date of Publication: Jun 2008.* no. 1, pp. 33-57.

Sleet, D. A., Schieber, R. A., & Gilchrist, J. 2003, "Health promotion policy and politics: lessons from childhood injury prevention.[erratum appears in Health Promot Pract. 2003 Jul;4(3):350]", *Health Promotion Practice*, vol. 4, no. 2, pp. 103-108.

Spitzer, M. 2005, "Influence of violent media on children and adolescents [5]", *Lancet.365(9468)()(pp 1387-1388), 2005.Date of Publication: 16 Apr 2005.<950>* no. 9468, pp. 1387-1388.

Towner, E. & Towner, J. 2001, "The prevention of childhood unintentional injury", *Current Paediatrics.11(6)()(pp 403-408), 2001.Date of Publication: 2001.* no. 6, pp. 403-408.

Tremblay, G. C. & Peterson, L. 1999, "Prevention of childhood injury: Clinical and public policy challenges", *Clinical Psychology Review.19(4)()(pp 415-434), 1999.Date of Publication: Jun 1999.* no. 4, pp. 415-434.

Woods, A. J. 2006, "The role of health professionals in childhood injury prevention: A systematic review of the literature", *Patient Education and Counseling.64(1-3)()(pp 35-42), 2006.Date of Publication: Dec 2006.* no. 1-3, pp. 35-42.

Articles excluded based on programme:

(These articles did not investigate a programme of interest to this review, for example strategies, policies, regulatory or legal frameworks and mass media campaign

Agran, P. F. & Hoffman, B. 2008, "Child passenger safety: Direction, selection, location, installation", *Pediatric Annals.37(9)()(pp 613-621), 2008.Date of Publication: September 2008.* no. 9, pp. 613-621.

Blake, G., Velikonja, D., Pepper, V., Jilderda, I., & Georgiou, G. 2008, "Evaluating an in-school injury prevention programme's effect on children's helmet wearing habits", *Brain Injury*, vol. 22, no. 6, pp. 501-507.

Bortolussi, R., Finlay, J., Moore, D. L., Robinson, J. L., Rousseau-Harsany, E., Samson, L. M., MacDonald, N. E., Allen, D., Hui, C. P. S., Saux, N. L., Pickering, L., & Salvadori, M. I. 2008, "A bite in the playroom: Managing human bites in child care settings", *Paediatrics and Child Health.13(6), 2008.Date of Publication: July/August 2008.* no. 6.

Browne, M. L., Lewis-Michl, E. L., & Stark, A. D. 2003, "Watercraft-related drownings among New York State residents, 1988-1994", *Public Health Reports.118(5)()(pp 459-463), 2003.Date of Publication: Sep 2003.* no. 5, pp. 459-463

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Cushman, R., James, W., & Waclawik, H. 1991, "Physicians promoting bicycle helmets for children: A randomized trial", *American Journal of Public Health.81(8)()(pp 1044-1046), 1991.Date of Publication: 1991.* no. 8, pp. 1044-1046.

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Emery, C. A., Cassidy, J. D., Klassen, T. P., Rosychuk, R. J., & Rowe, B. H. 2005, "Effectiveness of a home-based balance-training program in reducing sports-related injuries among healthy adolescents: A cluster randomized controlled trial", *Canadian Medical Association Journal.172(6)()(pp 749-754), 2005.Date of Publication: 15 Mar 2005.* no. 6, pp. 749-754.

Emery, C. A., Hagel, B., & Morrongiello, B. A. 2006, "Injury prevention in child and adolescent sport: Whose responsibility is it?", *Clinical Journal of Sport Medicine.16(6)()(pp 514-521), 2006.Date of Publication: Nov 2006.* no. 6, pp. 514-521.

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Gritz, E. R., Tripp, M. K., James, A. S., Carvajal, S. C., Harrist, R. B., Mueller, N. H., Chamberlain, R. M., & Parcel, G. S. 2005, "An intervention for parents to promote preschool children's sun protection: Effects of Sun Protection is Fun!", *Preventive Medicine.41(2)()(pp 357-366), 2005.Date of Publication: Aug 2005.* no. 2, pp. 357-366.

Karatzanis, A. D., Vardouniotis, A., Moschandreas, J., Prokopakis, E. P., Michailidou, E., Papadakis, C., Kyrmizakis, D. E., Bizakis, J., & Velegrakis, G. A. 2007, "The risk of foreign body aspiration in children can be reduced with proper education of the general population", *International Journal of Pediatric Otorhinolaryngology.71(2)()(pp 311-315), 2007.Date of Publication: Feb 2007.* no. 2, pp. 311-315.

Kirsch, S. E. & Pullen, N. 2003, "Evaluation of a school-based education program to promote bicycle safety", *Health Promotion Practice*, vol. 4, no. 2, pp. 138-145.

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Molnar, B. E., Gortmaker, S. L., Bull, F. C., & Buka, S. L. 2004, "Unsafe to play? Neighborhood disorder and lack of safety predict reduced physical activity among urban children and adolescents", *American Journal of Health Promotion*, vol. 18, no. 5, pp. 378-386.

Mulvaney, C. A., Kendrick, D., Watson, M. C., & Coupland, C. A. 2006, "Increasing child pedestrian and cyclist visibility: cluster randomised controlled trial", *Journal of Epidemiology & Community Health*, vol. 60, no. 4, pp. 311-315.

Nansel, T. R., Weaver, N. L., Jacobsen, H. A., Glasheen, C., & Kreuter, M. W. 2008, "Preventing unintentional pediatric injuries: A tailored intervention for parents and providers", *Health Education Research.23(4)()(pp 656-669), 2008.Date of Publication: August 2008.* no. 4, pp. 656-669.

Pendergrast, R. A., Ashworth, C. S., DuRant, R. H., & Litaker, M. 1992, "Correlates of children's bicycle helmet use and short-term failure of school-level interventions", *Pediatrics.90(3 I)()(pp 354-358), 1992.Date of Publication: 1992.* no. 3 I, pp. 354-358.

Pressley, J. C., Barlow, B., Durkin, M., Jacko, S. A., Dominguez, D. R., & Johnson, L. 2005, "A national program for injury prevention in children and adolescents: The injury free coalition for kids", *Journal of Urban Health.82(3)()(pp 389-402), 2005.Date of Publication: Sep 2005.* no. 3, pp. 389-402.

Rourke, L. L. 1994, "Bicycle helmet use among schoolchildren. Impact of a community education program and a cycling fatality.[see comment]", *Canadian Family Physician*, vol. 40, pp. 1116-1124.

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Schneider, M. L., Ituarte, P., & Stokols, D. 1993, "Evaluation of a community bicycle helmet promotion campaign: What works and why", *American Journal of Health Promotion.7(4)()(pp 281-287), 1993.Date of Publication: 1993.* no. 4, pp. 281-287.

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Schwebel, D. C. 2006, "Safety on the playground: Mechanisms through which adult supervision might prevent child playground injury", *Journal of Clinical Psychology in Medical Settings.13(2)()(pp 135-143), 2006.Date of Publication: Jun 2006.* no. 2, pp. 135-143.

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Van, H. R., Van, H. J., & Malenfant, J. E. 2007, "Impact of a comprehensive safety program on bicycle helmet use among middle-school children", *Journal of Applied Behavior Analysis*, vol. 40, no. 2, pp. 239-247

Waxweiler, R. J., Harel, Y., & O'Carroll, P. W. 1993, "Measuring adolescent behaviors related to unintentional injuries", *Public Health Reports.108(SUPPL.1)()(pp 11-14), 1993.Date of Publication: 1993.<556>* no. SUPPL. 1, pp. 11-14.

Articles excluded based on population:

(These studies did not aim at children and younger people under 18 years of age in play and leisure)

Coupland, C. A. C., Savelyich, B. S. P., Hippisley-Cox, J., Kendrick, D., Groom, L., & Cross, E. 2005, "A randomized controlled trial of the effect of providing information on accidental injury admissions and their costs to Primary Care Groups and Trusts", *Family Practice.22(3)()(pp 249-252), 2005.Date of Publication: Jun 2005.* no. 3, pp. 249-252.

Villamor, E., Hammer, S., & Martinez-olaizola, A. 2008, "Barriers to bicycle helmet use among Dutch paediatricians", *Child: Care, Health and Development.34(6)()(pp 743-747), 2008.Date of Publication: 2008.* no. 6, pp. 743-747.

Articles excluded based on location of study:

(Studies conducted in non-OECD countries)

Pan, S.-M., Hargarten, S., & Zhu, S.-K. 2007, "School bus and children's traffic safety", *Chinese Journal of Traumatology - English Edition.10(4)()(pp 250-256), 2007.Date of Publication: 01 Aug 2007.* no. 4, pp. 250-256.

Rodriguez Almada, H. D. 2005, "Non-accidental injuries in clhildren: Common pitfalls and how to avoid them", *Anil Aggrawal's Internet Journal of Forensic Medicine and Toxicology.6(2), 2005.Article Number: 20050701.Date of Publication: Jul 2005.<583>* no. 2

Pervin, A., Passmore, J., Sidik, M., McKinley, T., Tu, N. T. H., & Nguyen, P. N. 2009, "Viet Nam's mandatory motorcycle helmet law and its impact on children", *Bulletin of the World Health Organization.87(5)()(pp 369-373), 2009.Date of Publication: May 2009.* no. 5, pp. 369-373.

Articles excluded based on settings:

(These articles did not aim at external environment (play and leisure)

Diller, K. R. 2006, "Adapting adult scald safety standards to children", *Journal of Burn Care and Research.27(3)()(pp 314-322), 2006.Date of Publication: May 2006.* no. 3, pp. 314-322.

Hardy, M. S. 2006, "Keeping children safe around guns: Pitfalls and promises", *Aggression and Violent Behavior.11(4)()(pp 352-366), 2006.Date of Publication: Jul 2006.* no. 4, pp. 352-366.

Hong, J., Min, J., Kong, K. A., Park, B.-H., Lee, B., Shon, J. H., Sohn, J. H., & Park, H. 2008, "Comparison of the risk-taking behaviours of children and the practices adopted by their caregivers for improving home safety", *Public Health.122(10)()(pp 1079-1088), 2008.Date of Publication: October 2008.* no. 10, pp. 1079-1088.

Hurley, C., Kiragu, A. W., & Peltier, G. L. 2006, "The media and "copy-cat" burn injuries: 21st century impediments to burn prevention", *Journal of Trauma - Injury, Infection and Critical Care.60(6)()(pp 1382), 2006.Date of Publication: Jun 2006.* no. 6, p. 1382.

Hyder, A. A. 2009, "Newspapers: Neither necessary nor sufficient for injury surveillance", *Journal of Science and Medicine in Sport.12(3)()(pp 422), 2009.Date of Publication: May 2009.* no. 3, p. 422.

Kendrick, D., Watson, M. C., Mulvaney, C. A., Smith, S. J., Sutton, A. J., Coupland, C. A. C., & Mason-Jones, A. J. 2008, "Preventing Childhood Falls at Home. Meta-Analysis and Meta-Regression", *American Journal of Preventive Medicine.35(4)()(pp 370-379.e6), 2008.Date of Publication: October 2008.* no. 4, pp. 370-379

Liberal, E. F., Aires, R. T., Aires, M. T., & De Albuquerque Osorio, A. C. 2005, "Safe school", *Jornal de Pediatria.81(5 SUPPL.)()(pp S155-S163), 2005.Date of Publication: Nov 2005.* no. 5 SUPPL., p. S155-S163

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Morrongiello, B. A., Corbett, M., McCourt, M., & Johnston, N. 2006, "Understanding unintentional injury risk in young children II. The contribution of caregiver supervision, child attributes, and parent attributes", *Journal of Pediatric Psychology.31(6)()(pp 540-551), 2006.Date of Publication: Jul 2006.* no. 6, pp. 540-551

Runyan, C. W., Gray, D. E., Kotch, J. B., & Kreuter, M. W. 1991, "Analysis of United-States Child-Care Safety Regulations", *American Journal of Public Health*, vol. 81, no. 8, pp. 981-985.

Vickery, K., Edgecombe, D., Rimajova, M., & Stevenson, M. R. 2003, "Childhood drowning: barriers surrounding private swimming pools", *Pediatrics*, vol. 111, no. 2, p. E115-E119

Gielen, A. C., Joffe, A., Dannenberg, A. L., Wilson, M. E. H., Beilenson, P. L., & DeBoer, M. 1994, "Psychosocial factors associated with the use of bicycle helmets among children in counties with and without helmet use laws", *Journal of Pediatrics.124(2)()(pp 204-210), 1994.Date of Publication: 1994.* no. 2, pp. 204-210.

Knight-Bohnhoff, K., Smith, J., Deis, J., Chavez, Y., & Horne-Lucero, L. 1999, ""Troo, the Traumaroo" bicycle and playground safety program: a pilot study of kindergarten through second graders in the southwest", *Journal of Trauma Nursing*, vol. 6, no. 2, pp. 28-36.

Appendix 6 – List of studies of lower levels of evidence excluded from the review

a. Bicycle helmet related studies

1. Abularrage, J. J., Deluca, A. J., & Abularrage, C. J. 1997, "Effect of education and legislation on bicycle helmet use in a multiracial population", *Archives of Pediatrics and Adolescent Medicine.151(1)()(pp 41-44), 1997.Date of Publication: 1997.* no. 1, pp. 41-44.

   Abstract: Objective: To observe the effect of new legislation and a boroughwide bicycle helmet educational campaign on bicycle helmet use in a multiracial population. Design: A prospective observational study. Observations were made at randomly selected sites in Queens (study group) and Brooklyn (control group), NY, in May 1994, before a New York State law affecting both boroughs was enacted and before a bicycle helmet educational campaign was conducted in Queens. Variables observed included age, sex, race, and whether the child was wearing a bicycle helmet while riding. A bicycle helmet campaign was conducted in late May 19094. New York State bicycle helmet law was effected on June 1, 1994, requiring all children aged 1 to 14 years to wear helmets while riding their bicycles. Follow up observations were made at the same sites in July or August 1994. Setting: Queens County, New York, which is the most racially diverse county in the United States, according to 1990 census clam. Participants: Cross-sectional observations of children aged 1 to 14 years marie at randomly selected sites. Interventions: A boroughwide bicycle helmet educational campaign conducted in May 1994 in Queens. Results: The overall use of helmets increased from 4.7% (13/276) to 13.9% (44/316) (P<.001) in the study group. Helmet use decreased from 5.6% (19/342) to 4.2% (13/312) (P=.10) in the control group during the same period. Conclusions: In a multiracial population, a statistically significant (P<.001) increase of helmet use was demonstrated after a campaign and distribution of educational material. Legislation alone is inadequate for ensuring increased bicycle helmet use. <686>

2. Borglund, S. T., Hayes, J. S., & Eckes, J. M. 1999, "Florida's bicycle helmet law and a bicycle safety educational program: did they help?", *Journal of Emergency Nursing*, vol. 25, no. 6, pp. 496-500.

   Abstract: INTRODUCTION: This research studied the effectiveness of Florida's mandatory helmet law for children and a community bicycle safety campaign promoting helmet use. Children's use of helmets before and after the law's enactment and the type and extent of head injuries sustained in bicycle crashes were evaluated. METHODS: The trauma and medical records from Broward General Medical Center's Pediatric Referral Trauma Center provided demographic data, injury severity scores, and information on the type and extent of head injuries sustained. Data were compared using independent sample t tests and Pearson chi(2) statistics with.05 as the significance level. RESULTS: Each group consisted of 72 children, predominantly 7- to 12-year-old boys. Known helmet use rose from 5.6% to 20.8%, with children aged 10 to 12 years having the greatest increase in helmet use (27%). Helmet use rose in urban and suburban areas. Changes in the type and extent of head injuries were mixed. Injury severity scores were higher for nonhelmeted children in the after-law group. DISCUSSION: Although helmet use increased, especially among the 7- to 12-year-olds targeted during the bicycle safety campaigns, bicycle helmet use remains too low, and nonhelmeted children continue to have a higher risk for serious injuries. Community bicycle safety programs that promote helmet use remain an important adjunct to mandatory helmet use laws

3. Dannenberg, A. L., Gielen, A. C., Beilenson, P. L., Wilson, M. H., & Joffe, A. 1993, "Bicycle helmet laws and educational campaigns: An evaluation of strategies to increase children's helmet use", *American Journal of Public Health.83(5)()(pp 667-674), 1993.Date of Publication: 1993.* no. 5, pp. 667-674.

   Abstract: Objectives. The passage of a mandatory bicycle helmet law for children in Howard County, Maryland, provided an opportunity to compare legislation and education as strategies to increase helmet use. Methods. In 1991, a survey was mailed to fourth-, seventh-, and ninth-grade students attending a stratified sample of public schools in Howard County and in two similar suburban/rural counties without helmet laws. Results. Of 7217 students surveyed, 3494 responded (48.4%). Self-reported helmet use in Howard County rose from 11% to 37% after the law and accompanying educational campaign went into effect. Helmet use changed from 8% to 13% in Montgomery County, where educational efforts were undertaken, and from 7% to 11% in Baltimore County, where helmet promotion activities were minimal. Predictors of helmet use included having friends who wore helmets, believing helmet laws are good, being in fourth grade, living in Howard County, and using seatbelts regularly. Conclusions. Legislation combined with education appears to increase bicycle helmet use substantially more than does education alone. The Howard County law may be considered a successful model of a strategy to increase children's helmet use. <653>

4. Gielen, A. C., Joffe, A., Dannenberg, A. L., Wilson, M. E. H., Beilenson, P. L., & DeBoer, M. 1994, "Psychosocial factors associated with the use of bicycle helmets among children in counties with and without helmet use laws", *Journal of Pediatrics.124(2)()(pp 204-210), 1994.Date of Publication: 1994.* no. 2, pp. 204-210.

   Abstract: We examined the extent to which psychosocial factors, in addition to the presence of a law, are associated with the use of bicycle helmets. A mailed questionnaire was completed by 3,494 children in fourth, seventh, and ninth grades in three Maryland counties: Howard County, which had a law requiring child bicyclists to wear helmets and an educational campaign; Montgomery County, which had an educational campaign but no law; and Baltimore County, which had neither. Overall, 19% of the respondents reported having worn a bicycle helmet on their most recent ride. In a multiple logistic regression, children's use of helmets in all three counties was significantly associated with their beliefs about the social consequences of wearing helmets and the extent to which their friends wear helmets. Significant interactions were also found, suggesting that in the presence of a law, an educational campaign, or both, children's use of helmets was associated more with social concerns than with parental influences or cognitive factors, such as beliefs about the need for helmets or perceptions of risk. To increase helmet use, the issues of stylishness, comfort, and social acceptability of wearing helmets need to be addressed and more widespread adoption of bicycle helmet laws should be encouraged. <491>

5. LeBlanc, J. C., Beattie, T. L., & Culligan, C. 2002, "Effect of legislation on the use of bicycle helmets.[see comment]", *CMAJ Canadian Medical Association Journal*, vol. 166, no. 5, pp. 592-595.

   Abstract: BACKGROUND: About 50 Canadian children and adolescents die each year from bicycle-related injuries, and 75% of all bicycle-related deaths are due to head injuries. Although the use of helmets can reduce the risk of head injury by 85%, the rate of voluntary helmet use continues to be low in many North American jurisdictions. We measured compliance before, during and after 1997, when legislation making the use of helmets mandatory for cyclists was enacted in Nova Scotia. METHODS: In the summers and autumns of 1995 through

1999, trained observers who had a direct view of oncoming bicycle traffic recorded helmet use, sex and age group of cyclists in Halifax on arterial, residential and recreational roads. Sampling was done during peak traffic times of sunny days. We abstracted data from the Canadian Hospitals Injury Reporting and Prevention Program database on bicycle-related injuries treated during the same period at the Emergency Department of the IWK Health Centre, Halifax. RESULTS: The rate of helmet use rose dramatically after legislation was enacted, from 36% in 1995 and 38% in 1996, to 75% in 1997, 86% in 1998 and 84% in 1999. The proportion of injured cyclists with head injuries in 1998/99 was half that in 1995/96 (7/443 [1.6%] v. 15/416 [3.6%]) (p = 0.06). Police carried out regular education and enforcement. There were no helmet-promoting mass media education campaigns after 1997. INTERPRETATION: Rates of helmet use rose rapidly following the introduction of legislation mandating the use of helmets while bicycling. The increased rates were sustained for 2 years afterward, with regular education and enforcement by police

6. Liller, K. D., Nearns, J., Cabrera, M., Joly, B., Noland, V., & McDermott, R. 2003, "Children's bicycle helmet use and injuries in Hillsborough County, Florida before and after helmet legislation", *Injury Prevention*, vol. 9, no. 2, pp. 177-179.

   Abstract: The purpose of this research was to explore the changes in children's bicycle helmet use and motor vehicle bicycle related injuries in Hillsborough County, Florida before and after passage of the Florida's bicycle helmet law for children under the age of 16. The results show a significant increase in bicycle helmet use among children, ages 5-13, in the post-law years compared with the pre-law years. Also, there has been a significant decline in the rates of bicycle related motor vehicle injuries among children in the post-law years compared with the pre-law years. Although there have been complementary educational and outreach activities in the county to support helmet use, it appears that the greatest increase in use occurred after the passage of the helmet law. It is recommended that educational efforts continue to sustain helmet use rates and decreases in injuries

7. Macknin, M. L. & Medendorp, S. V. 1994, "Association between bicycle helmet legislation, bicycle safety education, and use of bicycle helmets in children", *Archives of Pediatrics and Adolescent Medicine.148(3)()(pp 255-259), 1994.Date of Publication: 1994.* no. 3, pp. 255-259.

   Abstract: Objective: To determine the association between bicycle helmet legislation and bicycle safety education and the use of bicycle helmets by children under age 16 years. Design: Anonymous questionnaire and direct observations of bicycle helmet use. Setting: Four predominantly white, upper-middle class suburbs of Cleveland, Ohio. Participants: All students in grades 1 through 7 attending public school on the day of the survey and children riding bicycles in a direct observational study. Interventions: Beachwood had bicycle helmet legislation and safety education. Orange had only bicycle helmet legislation. Pepper Pike and Moreland Hills did not have bicycle helmet legislation or safety education. Results: In Beachwood, 416 (67.6%) of 615 children who owned a bicycle reported always wearing their helmets, and 72 (85%) of 85 children directly observed were wearing bicycle helmets. In Orange, 103 (37.2%) of 277 children who owned bicycles reported always wearing helmets, whereas 41 (17.9%) of 229 children in Moreland Hills and 78 (21.5%) of 362 children in Pepper Pike reported always wearing helmets. Helmet use was significantly (P < .001) higher in Beachwood, with legislation and education, than in the other communities; helmet use was significantly (P < .001) higher in Orange, with legislation alone, than in Moreland Hills and Pepper Pike, with no programs. Conclusions: There was a dramatic association between reports of increased helmet use and bicycle helmet legislation plus education; the association was stronger than that found with legislation only. <586>

8. Macpherson, A. K., Macarthur, C., To, T. M., Chipman, M. L., Wright, J. G., & Parkin, P. C. 2006, "Economic disparity in bicycle helmet use by children six years after the introduction of legislation", *Injury Prevention*, vol. 12, no. 4, pp. 231-235.

Abstract: Background: Studies evaluating the effectiveness of bicycle helmet legislation often focus on short term outcomes. The long term effect of helmet legislation on bicycle helmet use is unknown. Objective: To examine bicycle helmet use by children six years after the introduction of the law, and the influence of area level family income on helmet use. Methods: The East York (Toronto) health district (population 107 822) was divided into income areas (designated as low, mid, and high) based on census tract data from Statistics Canada. Child cyclists were observed at 111 preselected sites (schools, parks, residential streets, and major intersections) from April to October in the years 1995 - 1997, 1999, and 2001. The frequency of helmet use was determined by year, income area, location, and sex. Stratified analysis was used to quantify the relation between income area and helmet use, after controlling for sex and bicycling location. Results: Bicycle helmet use in the study population increased from a pre-legislation level of 45% in 1995 to 68% in 1997, then decreased to 46% by 2001. Helmet use increased in all three income areas from 1995 to 1997, and remained above pre-legislation rates in high income areas (85% in 2001). In 2001, six years post-legislation, the proportion of helmeted cyclists in mid and low income areas had returned to prelegislation levels (50% and 33%, respectively). After adjusting for sex and location, children riding in high income areas were significantly more likely to ride helmeted than children in low income areas across all years (relative risk = 3.4 (95% confidence interval, 2.7 to 4.3)). Conclusion: Over the long term, the effectiveness of bicycle helmet legislation varies by income area. Alternative, concurrent, or ongoing strategies may be necessary to sustain bicycle helmet use among children in mid and low income areas following legislation

9. Mock, C. N., Maier, R. V., Boyle, E., Pilcher, S., & Rivara, F. P. 1995, "Injury prevention strategies to promote helmet use decrease severe head injuries at a level I trauma center", *Journal of Trauma-Injury Infection & Critical Care*, vol. 39, no. 1, pp. 29-33.

Abstract: Head injuries (HIs) remain a major contributor to trauma mortality, with many deaths occurring despite optimal use of available therapy. Injury prevention is vital to decrease the impact of HIs. Helmets can decrease the severity of HIs in both bicycle crashes (BCs) and motorcycle crashes (MCCs). A major challenge is to increase helmet use. A mandatory motorcycle helmet law in 1990 and information campaigns aimed at bicyclists have increased the percentage of riders wearing helmets in Washington State. We hypothesized that there would be an associated decrease in the proportion of severe HIs in BC and MCC admissions to the state's only level I trauma center. We analyzed injury region and outcomes for all 466 BC and 992 MCC instate admissions from 1986 to 1993. For BCs, the proportion of severe HIs (Abbreviated Injury Scale score of 4 or 5) declined from 29% in 1986 to 11% in 1993 ($p = 0.02$). BC trends paralleled helmet use in observations on 8,860 bicycle riders in the area, in which the percentage of helmeted riders rose from 5% in 1987 to 62% in 1993 ($p < 0.001$). For MCCs, severe HIs declined from 20% before passage of the helmet law to 9% afterward ($p < 0.001$). Mortality decreased for BCs and MCCs ($p < 0.05$), and length of hospital stay and ICU stay decreased for BCs ($p < 0.05$). The percentage of helmeted BC admissions rose from 0% to 32% ($p = 0.009$), and helmeted MCC admissions rose from 41% to 80% ($p < 0.001$).(ABSTRACT TRUNCATED AT 250 WORDS)

10. Moyes, S. A. 2007, "Changing pattern of child bicycle injury in the Bay of Plenty, New Zealand", *Journal of Paediatrics and Child Health.43(6)()(pp 486-488), 2007.Date of Publication: Jun 2007.* no. 6, pp. 486-488.

Abstract: Aim: To determine if helmet laws and safety campaigns have had an impact on bicycle injuries in children. Methods: A comparison of the number of bicycle injuries presented to Whakatane Hospital's Emergency Department in the period 1982-1986 to the period July 1998-December 2005. Results: In the first period there were 597 per 100 000 presentations per annum which increased to 890 per 100 000 per annum in the later period (P < 0.01). Fractures increased from 115 to 234 per 100 000 per annum respectively (P = 0.02). Injuries from a collision with a moving motor vehicle decreased from 72 to 30 per 100 000 per year and of those the proportion of serious head injuries dropped from 65% to 33%. There were four deaths in the earlier period but none in recent years. Conclusions: Injuries from bicycle use have increased but there has been a marked reduction in collisions with motor vehicles. This is a result of the changing use of bicycles by children. copyright 2007 The Author. <24>

11. Ni, H., Sacks, J. J., Curtis, L., Cieslak, P. R., & Hedberg, K. 1997, "Evaluation of a statewide bicycle helmet law via multiple measures of helmet", *Archives of Pediatric and Adolescent Medicine*, vol. 151, no. 1, pp. 59-65.

    Objectives: To evaluate an Oregon law requiring bicyclists younger than 16 years to wear a helmet and to compare methods of measuring helmet use. Design: Four prelaw and postlaw statewide helmet use surveys: (1) statewide observations, (2) middle school observations, (3) classroom self-report surveys, and (4) a statewide adult telephone survey. Setting: Oregon. Subjects: Statewide observations, 3313 child bicyclists at 13 sites; middle school observations, 995 child bicyclists at 33 randomly selected middle schools; classroom self-report surveys, fourth, sixth, and eighth graders in 448 classrooms (ie, 8955 students) before the law was effected and 456 classrooms (i.e., 9811 students) after the law was effected in 66 randomly selected schools; and statewide telephone survey, 1219 randomly called parents of 1437 children younger than 16 years. Main Outcome Measures: Prelaw and postlaw helmet use and ownership and knowledge and opinion about the law. Results: Observed helmet use among youth was 24.5% before the law was effected and 49.3% after the law was effected. School-observed use increased from 20.4% to 56.1%. Classroom survey self-reported "always" use of helmets increased from 14.7% to 39.4%; reported use on the day of the survey increased from 25.8% to 76.0%. Telephone survey–reported "always" helmet use increased from 36.8% to 65.7%. Younger children and girls were more likely to use helmets. Most students (ie, 87.8%) and parents (ie, 95.4%) knew about the law; however, only 42.6% of children thought the law was a good idea. Conclusions:We conclude that (1) the law increased helmet use; (2) although use estimates differ, all helmet surveys showed similar degrees of prelaw and postlaw change; and (3) half of child bicyclists are still not wearing helmets, indicating a need for additional promotion of helmet wearing. Laws seem to be an effective way to increase helmet use.

12. Rivara, F. P., Thompson, D. C., Thompson, R. S., Rogers, L. W., Alexander, B., Felix, D., & Bergman, A. B. 1994, "The Seattle children's bicycle helmet campaign: Changes in helmet use and head injury admissions", *Pediatrics.93(4)()(pp 567-569), 1994.Date of Publication: 1994.* no. 4, pp. 567-569.

    Abstract: Objective. To describe the impact of a community bicycle helmet campaign on helmet use and the incidence of bicycle-related head injuries. Setting. Metropolitan community and a large health maintenance organization. Interventions. Communitywide bicycle helmet campaign. Outcomes. Rate of observed bicycle helmet use in the community and incidence of bicycle- related injuries in an health maintenance organization population. Results. Helmet use among school-aged children increased from 5.5% in 1987 to 40.2% in 1992.

Bicycle-related head injuries decreased by 66.6% in 5- to 9-year-old and 67.6% in 10- to 14-year-old members of an health maintenance organization. Conclusions. Educational campaigns can increase helmet use and decrease the incidence of bicycle-related head injury. <467>

13. Rodgers, G. B. 2002, "Effects of state helmet laws on bicycle helmet use by children and adolescents", *Injury Prevention*, vol. 8, no. 1, pp. 42-46.

    Abstract: OBJECTIVE: To evaluate the effectiveness of state helmet laws in increasing the use of bicycle helmets by children and adolescents under age 16. SETTING: United States. METHODS: A cross sectional study of factors associated with the likelihood of helmet use by children and adolescents. Data were derived from a national random digit dial telephone survey of bicycle riders. A multiple logistic regression analysis was used to quantify the independent effect of the state helmet laws on helmet use. RESULTS: Helmet use was systematically related to the presence of state helmet laws (odds ratio 2.65; 95% confidence interval (CI) 1.29 to 5.44). The increase in the average probability of helmet use attributable to state helmet laws was 18.4% (95% CI 17.8% to 19.0%). CONCLUSIONS: State helmet laws significantly increase helmet use by children and play an important part in any comprehensive effort designed to achieve this goal

14. Schieber, R. A., Kresnow, M.-J., Sacks, J. J., Pledger, E. E., O'Neil, J. M., & Toomey, K. E. 1996, "Effect of a state law on reported bicycle helmet ownership and use", *Archives of Pediatrics and Adolescent Medicine.150(7)()(pp 707-712), 1996.Date of Publication: Jul 1996.* no. 7, pp. 707-712.

    Abstract: Objective: To evaluate the effect of a state law on reported bicycle helmet ownership and use. Design: Multistage cluster random-digit-dialing telephone survey. Setting: Georgia, June through November 1993. Participants: Adults who reported the behavior of bicyclists 4 through 15 years old. Intervention: State law mandating helmet use after July 1, 1993, for all bicyclists aged younger than 16 years. Main Outcome Measures: Bicycle helmet ownership and use. Results: Reported helmet ownership increased from 39% before the law took effect to 57% afterward (+46%, P=.06). Reported use increased from 33% before to 52% afterward (+58%, P<.05). About 7% of riders changed from 'never-wearing' to 'always-wearing' behavior. After the law took effect, in those households in which the law was known, 69% of riders owned and 64% used a helmet. By comparison, in those households in which the law was not known, only 30% owned and 25% used a helmet (P<.01). Reported ownership and use were 93% concordant, inversely related to rider age, and directly related to household income. Multivariable analysis indicated that race was an effect modifier of reported helmet ownership and use. In black riders, knowledge of the law appeared to be highly associated with both reported helmet ownership and use but was not significant in white riders. In white riders, though, age and income were significantly associated with reported helmet ownership and use. Conclusions: This law appeared important in increasing reported helmet ownership and use, particularly in black riders. Since knowledge of the law was associated with increased ownership and use, additional publicity about the law might further increase helmet use. Because most riders who owned helmets used them, giveaway programs targeting areas of low ownership may also increase use. <376>

15. Scuffham, P., Alsop, J., Cryer, C., & Langley, J. D. 2000, "Head injuries to bicyclists and the New Zealand bicycle helmet law", *Accident Analysis & Prevention*, vol. 32, no. 4, pp. 565-573.

Abstract: The purpose of this study was to examine the effect of helmet wearing and the New Zealand helmet wearing law on serious head injury for cyclists involved in on-road motor vehicle and non-motor vehicle crashes. The study population consisted of three age groups of cyclists (primary school children (ages 5-12 years), secondary school children (ages 13-18 years), and adults (19+ years)) admitted to public hospitals between 1988 and 1996. Data were disaggregated by diagnosis and analysed using negative binomial regression models. Results indicated that there was a positive effect of helmet wearing upon head injury and this effect was relatively consistent across age groups and head injury (diagnosis) types. We conclude that the helmet law has been an effective road safety intervention that has lead to a 19% (90% CI: 14, 23%) reduction in head injury to cyclists over its first 3 years

16. Shafi, S., Gilbert, J. C., Loghmanee, F., Allen, J. E., Caty, M. G., Glick, P. L., Carden, S., & Azizkhan, R. G. 1998, "Impact of bicycle helmet safety legislation on children admitted to a regional pediatric trauma center", *Journal of Pediatric Surgery*, vol. 33, no. 2, pp. 317-321.

Abstract: PURPOSE: The regional pediatric trauma center in Buffalo, NY, has been active in pediatric injury prevention programs, including community education and distribution of bicycle helmets, since 1990. Since June 1, 1994, the use of bicycle safety helmets for children under 14 years of age has been mandated by a state law in New York. The authors undertook this study to assess the impact of this legislation on the frequency of helmet use in children involved in bicycle crashes presenting to the regional pediatric trauma center, and to assess the impact of helmet use on the number and severity of head injuries. METHODS: Bicycle crash victims (n = 208) admitted to a regional pediatric trauma center from 1993 to 1995 were studied retrospectively. Head injuries were classified as concussion alone, skull fractures, intracranial hemorrhages (ie, epidural, subdural, and subarachnoid), cerebral contusions, or diffuse cerebral edema alone (without any other intracranial injury). Helmeted children (HC) were compared with nonhelmeted children (NHC) using chi2 and Fisher's Exact test. P value less than .05 was considered significant. RESULTS: Only 31 children (15%) wore helmets at the time of the crash. Helmet use increased from 2%, during the period of education alone, to 26% after the legislation went into effect (P < .00001). The proportion of children suffering head injuries was similar in both groups (HC, 68%; NHC, 61%; P = NS). However, the type of head injury was different. HC were more likely to sustain concussion alone (HC, 65%; NHC, 44%; P < .03). HC were less likely to have skull fractures (HC, 0%; NHC, 13%; P < .02), and exhibited a trend toward less intracranial hemorrhages (HC, 0%; NHC, 9%; P = NS), cerebral contusions (HC, 3%; NHC, 5%; P = NS), and cerebral edema (HC, 0%; NHC, 0.6%; P = NS). Excluding the isolated concussions, head injuries were noted in only one HC, compared with 30 NHC (P < .04). None of the three children who died wore helmets at the time of the crash, and all died of multiple head injuries. CONCLUSIONS: The bicycle helmet safety law resulted in a 13-fold increase in the use of bicycle helmets among the children admitted to a regional pediatric trauma center after bicycle crashes, but the helmet use remains inadequate. Helmet use reduced the severity of head injuries, and might have prevented deaths caused by head injuries

17. Vulcan, A. P., Cameron, M. H., & Watson, W. L. 1992, "Mandatory bicycle helmet use: experience in Victoria, Australia", *World Journal of Surgery*, vol. 16, no. 3, pp. 389-397.

Abstract: On July 1, 1990, the legislation requiring wearing of an approved bicycle (safety) helmet by all pedal cyclists, unless exempted, came into effect in Victoria, Australia. The paper describes the more important activities which paved the way for this initiative and presents some preliminary information about the effect of the legislation on wearing rates and head injuries. Since 1980 there has been promotion of

helmet use through bicycle education in schools, mass media publicity, support by professional organizations and community groups, bulk purchase schemes, and government rebates for helmet purchases. The Australian Standard for bicycle safety helmets has also been changed to meet community demands for lighter helmets with more provision for ventilation. There has been a steady increase in voluntary helmet use in Melbourne from 1983 to March 1990, as follows: 5% to 70% in primary school children; 2% to 20% in secondary students; and 27% to 40% in adults. In the period after the legislation, with relatively little enforcement, these three groups have shown substantial increases in helmet use rates, rising to 70-90% in most cases. Preliminary data show that the numbers of bicyclists with a head injury have dropped in the period since the legislation came into effect. The possible contributions to this reduction, of less bicycle use and lower risk of head injury in an accident, are discussed

18. Wesson, D., Spence, L., Hu, X., & Parkin, P. 2000, "Trends in bicycling-related head injuries in children after implementation of a community-based bike helmet campaign", *Journal of Pediatric Surgery*, vol. 35, no. 5, pp. 688-689.

    Abstract: BACKGROUND/PURPOSE: The aim of this study was to determine the effect of a community-based bike helmet promotion campaign on bike helmet use and related head injuries in children (0 to 14 years of age) in a large North American city. METHODS: The authors established a multifaceted, multidisciplined, community-based campaign to promote bike helmet use by children in 1989. The goals were to increase helmet use by 100% per year, to reduce fatal bike-related head injuries by 50% overall, and to explore the feasibility of legislation mandating helmet use. Helmet use was measured by standardized field observations repeated annually in a single borough within the metropolitan area. To estimate head injury incidence, the number of admissions to hospital for the treatment of bike-related head injuries in a regional trauma registry, which included all residents in the target population was used. The authors were unable to control for changes in exposure to bicycling or in the criteria for admissions to hospital for the treatment of head injuries during the study period. RESULTS: The bike helmet use rate rose from 4% in 1990 to 67% in 1996. The number of head injury admissions fell from 46 in 1990 to 24 in 1996. Legislation requiring helmet use by all children went into effect in October 1995. CONCLUSIONS: Bike helmet use increased significantly during the first 4 years of the campaign and again after the helmet law was implemented. The total number of bike-related head injury admissions declined by more than 50%. The campaign achieved all of its goals except for a 50% reduction in fatal head injuries, which were too infrequent for analysis

b. Playgrounds related studies

19. Addiss, D. G., Sacks, J. J., Kresnow, M., O'Neil, J., & Ryan, G. W. 1994, "The Compliance of Licensed US Child Care Centers with National Health and Safety Performance Standards", *American Journal of Public Health*, vol. 84, no. 7, pp. 1161-1164.

    The American Public Health Association and the American Academy of Pediatrics recently published health and safety guidelines for child care centers. A survey was conducted to determine the extent to which practices in US child care centers are reflective of these guidelines.

Compliance with 16 guidelines ranged from 19.5% to 98.6%, varied considerably by state, and was not consistently associated with selected center characteristics. Prevention efforts should focus on practices for which compliance is low and on those that have the greatest disease- and injury-reducing potential.

20. Browning, K. S., Runyan, C. W., & Kotch, J. B. 1996, "A statewide survey of hazards in child care centers", *Injury Prevention*, vol. 2, no. 3, pp. 202-207.

Abstract: OBJECTIVES: The purpose of this study was to determine adherence to selected recommended safety standards in North Carolina child care centers. METHODS: A self administered questionnaire eliciting information about safety practices in child care was mailed to a randomly selected sample of 409 North Carolina child care centers. RESULTS: One hundred and ninety five usable questionnaires were returned from child care centers in 75 counties. Results indicated that all of the standards included in the state's child regulations were being adhered to by at least 80% of the centers. However, adherence to recommended standards not included in the state's regulations was quite variable, with one standard implemented by less than 5% of the centers. The lowest rates of adherence were found for standards specifying that resilient surface material be used under playground equipment (4%) and that certain foods that may present a choking hazard to small children not be served (27%). CONCLUSIONS: Many hazards not addressed in North Carolina child care regulations are present in child care centers. Some safety standards are not adhered to due to lack of knowledge or limited resources. Inclusion of national standards in state child care regulations appears to reduce, but not eliminate, the likelihood of hazards being reported. Further research should include on-site inspections and attention to safety in family child care

21. Centers for Disease Control and Prevention (CDC) 1999, "Playground safety--United States, 1998-1999", *MMWR - Morbidity & Mortality Weekly Report*, vol. 48, no. 16, pp. 329-332.

Abstract: Each year approximately 211,000 U.S. children receive emergency department care for injuries sustained on playground equipment, making the use of this equipment the leading cause of injuries to children in school and child care environments. In response to the problem, the National Program for Playground Safety (NPPS) at the University of Northern Iowa (UNI) developed a national action plan that focuses on four areas of playground injury prevention: supervision, age-appropriateness of equipment, suitable fall surfaces, and equipment maintenance. During 1998-1999, NPPS surveyed a sample of the nation's child care, elementary school, and park playgrounds. This report summarizes the survey results, which indicate that playground injuries could be reduced by measures such as resilient surfacing below equipment, better equipment maintenance, improved supervision, and use of age-appropriate equipment

22. Chalmers, D. J., Parry, M. L., Crawford, A. I., & Wright, C. S. 2001, "Compliance of Dunedin school playground equipment with the New Zealand playground standard", *Australian and New Zealand Journal of Public Health*, vol. 25, no. 3, pp. 253-255.

Abstract: OBJECTIVE: Injuries resulting from falls from playground equipment are a public health concern in New Zealand. Like many other countries, New Zealand has a safety standard aimed at reducing the incidence and severity of these injuries by limiting the height from which children can fall from playground equipment and requiring the provision of impact-absorbing surfaces beneath equipment from which

falls are possible. The purpose of this study was to examine progress towards achieving compliance with these requirements in Dunedin school playgrounds. METHODS: Sixty-two schools were audited over the summer of 1997/98 and information recorded on equipment type, maximum fall height, surface type, and depth of loose-fill surface materials. Comparisons were made with audits conducted in 1989 and 1981. RESULTS: Substantial increases in the amount of playground equipment and in the provision of impact-absorbing surfaces were observed. A small increase in compliance with the requirement that the maximum fall height of equipment not exceed 2.5 metres was also observed. CONCLUSIONS: Any gains in safety achieved through increased compliance with the height and surface requirements of the New Zealand Standard have been counteracted by the substantial increase in the amount of equipment available in playgrounds. IMPLICATIONS: A more drastic measure is needed to achieve a meaningful reduction in the incidence of injury following falls from playground equipment. Language: Eng

23. Hudson, S. D., Olsen, H. M., & Thompson, D. 2008, "An investigation of school playground safety practices as reported by school nurses", *Journal of School Nursing*, vol. 24, no. 3, pp. 138-144.

    Abstract: The purpose of this study was to investigate school playground safety practices. The study used a purposeful sample of school nurses who attended a playground safety workshop at the 2006 National Association of School Nurses annual conference. Seventy-five questionnaires were distributed, and 64 useable questionnaires were returned. The responses indicated that little attention is being given to providing safe playground environments in schools as measured by best practices of supervision, age-appropriate design, fall surfacing, and equipment maintenance. Participants pointed to the need for better supervision and supervision training, careful selection of age-appropriate equipment, maintaining adequate fall surfaces under the equipment, and ensuring that equipment is properly maintained and repaired. The study also revealed that school nurses believe they could play a role in playground injury prevention through the collection and analysis of injury data, communication to administrators about the need for comprehensive planning of the play environment, and becoming active members of playground safety committees

24. Kotch, J. B., Hussey, J. M., & Carter, A. 2003, "Evaluation of North Carolina child care safety regulations", *Injury Prevention*, vol. 9, no. 3, pp. 220-225.

    Abstract: INTRODUCTION: The goal of this study was to track any changes in injuries and injury hazards during the first 3.5 years of implementation of the North Carolina Child Care Commission's 1996 playground safety regulations. METHODS: All reports (n=5402) of medically attended injuries in regulated child care settings in North Carolina during the period 1 January 1997 through 30 June 2000 were reviewed and analyzed. A total of 294 playground safety inspections were conducted in November and December 1998 in randomly selected North Carolina child care centers, and the playground safety inspections were repeated in 76 child care centers in August 2000. Finally, in 1999 a 1992 child care center director self assessment of safety features in classrooms was sent to the directors of 291 of the 294 centers. RESULTS: The annual rate of reported, medically attended injuries occurring in regulated child care facilities in North Carolina declined by 22% from 1997 to 1999. The playground safety inspections in the year 2000 revealed that, for nine of 10 playground concerns and 12 of 18 playground safety hazards, average ratings were equal to or better than those of 1998. Finally, the director surveys revealed no dramatic changes in classroom safety hazards since 1992. DISCUSSION: This study represents the first time that the authors are aware of that a significant decline in state-wide child care injury rates has been associated with improved regulation of playground safety in the US

25. Lesage, D., Robitaille, Y., Dorval, D., & Beaulne, G. 1995, "Does play equipment conform to the Canadian standard?", *Canadian Journal of Public Health.86(4)()(pp 279-283), 1995.Date of Publication: 1995.* no. 4, pp. 279-283.

Abstract: In the summer of 1991, play equipment in 254 playgrounds located on the island of Montreal were inspected, using a checklist made up of items drawn from the Canadian standard for the safety of children's play-spaces and equipment. The results of the study, covering 605 climbers, 522 swings and 181 slides, made it possible to identify the most and least respected aspect of safety. For example, one out of two pieces of play equipment was installed on a protective surface that did not conform to the Canadian standard; seven out of ten swings had seats made of non-impact-absorbing materials; and six our of ten pieces of equipment had bead entrapment openings. Knowing the physical shortcomings of play equipment is an important step in reducing injuries sustained on it. However, to be effective, the prevention of injuries related to play equipment requires a concerted effort on the part of several partners. <456>

26. Mitchell, R., Sherker, S., Cavanagh, M., & Eager, D. 2007, "Falls from playground equipment: will the new Australian playground safety standard make a difference and how will we tell?", *Health Promotion Journal of Australia*, vol. 18, no. 2, pp. 98-104.

Abstract: ISSUE ADDRESSED: This study describes the trend in incidence of hospitalised falls from playground equipment of children aged 14 years or less in New South Wales (NSW) and considers the potential effectiveness of playground safety standards in reducing the impact of playground-related injuries. METHOD: Hospitalisations of children aged 14 years or less following a fall from playground equipment were identified from the NSW hospitalisation data for the financial years 1992/93 to 2003/04 and described. RESULTS: During 1992/93 to 2003/04 there were 16,828 hospitalisations of children aged 0-14 years as a result of a fall from playground equipment, at a rate of 106.6 per 100,000 children. The incidence of hospitalisation increased from 83.3 to 130.3 per 100,000 children between 1992/93 to 2003/04. Males aged 5-9 years had the highest rate of hospitalisation at 198.4 per 100,000 children. Injury type varied by age group, but injuries to the elbow and forearm were common for all age groups. The rate of upper limb fractures that resulted in hospitalisation increased, while the rate of serious head injuries decreased. CONCLUSIONS: While severe head injuries have declined between 1992/93 to 2003/04, the increasing trend of upper limb fractures is of concern. Many factors need to be taken into account to assess the effectiveness of playground safety standards. The collection of exposure data is also crucial to be able to calculate the true risk associated with childhood falls from playground equipment

27. Norton, C., Rolfe, K., Morris, S., Evans, R., James, R., Jones, M. D., Cory, C., Dunstan, F., & Sibert, J. R. 2004, "Head injury and limb fracture in modern playgrounds", *Archives of Disease in Childhood*, vol. 89, no. 2, pp. 152-153.

Abstract: There were no serious head injuries in modern Cardiff municipal playgrounds with safety surfaces over five years injury surveillance. The literature suggests serious head injuries did occur before the introduction of safety surfaces

28. Sacks, J. J., Holt, K. W., Holmgreen, P., Colwell, L. S., Jr., & Brown, J. M., Jr. 1990, "Playground hazards in Atlanta child care centers", *American Journal of Public Health*, vol. 80, no. 8, pp. 986-988.

Abstract: We identified 684 playground hazards in 66 child care centers despite regulations mandating that the grounds be hazard-free. Of

21 centers with less than or equal to 5 hazards, 42.9 percent reported a playground-related injury in the previous year; of 25 centers with 6-11 hazards, 52.0 percent reported a playground-related injury; and of 20 centers with greater than or equal to 12 hazards, 60.0 percent reported a playground-related injury. Climbing equipment greater than or equal to 6 feet tall generally had inadequate impact-absorbing undersurfacing and had over twice the rate of fall injuries as climbing equipment less than 6 feet

29. Sherker, S. & Ozanne-Smith, J. 2004, "Are current playground safety standards adequate for preventing arm fractures?", *Medical Journal of Australia*, vol. 180, no. 11, pp. 562-565.

    Abstract: Objective: To assess compliance with current standards of playgrounds where children have sustained a fall-related arm fracture. Design, setting and participants: Between October 2000 and December 2002, a consecutive prospective series of 402 children aged under 13 years who fell from playground equipment and sustained an arm fracture was identified by emergency department staff in five Victorian hospitals. Trained field testers measured playground equipment height, surface type and depth, and surface impact attenuation factors to determine compliance with safety standards. Main outcome measures: Playground compliance with current Australian safety standards. Results: Ninety-eight percent of playgrounds had a recommended type of surface material. The mean surface depth was 11.1 cm (SD, 5.0 cm) and the mean equipment height was 2.04 m (SD, 0.43 m). Although over 85% of playgrounds complied with recommended maximum equipment height and surface impact attenuation characteristics, only 4.7% complied with recommended surface depth. Conclusion: Playgrounds where children have sustained an arm fracture generally comply with all important safety recommendations except surface depth. Playground fall-related arm fracture requires specific countermeasures for prevention, distinct from head injury prevention guidelines

30. Sherker, S., Ritchie, J., Eager, D., & Dennis, R. 2009, "Soft landings: encouraging compliance with safety standards in Local Government Authority playgrounds", *Health Promotion Journal of Australia*, vol. 20, no. 1, pp. 31-36.

    Abstract: ISSUES ADDRESSED: Consistent with health promotion principles of good practice, addressing playground injury necessitates the creation of a supportive environment for the enhancement of wellbeing and the prevention of injuries. This study aims to survey local governments to: determine compliance with playground safety standards; establish frequency of playground inspections and maintenance; and identify motivators and barriers to compliance with safety standards. METHODS: A survey of key informants for playground safety in all 152 local government councils in New South Wales (NSW) was undertaken. RESULTS: Of 152 local councils in NSW (43 metropolitan and 109 non-metropolitan), 71.7% (n=109) completed the survey, 12.5% (n=19) refused to participate and no response was received by 15.8% (n=24). Self-reported compliance with key aspects of the standard was generally high. However, only 55% of councils complied with surface impact attenuation <200 gmax and <1,000 HIC. Further, only 14.7% of councils reported impact testing the playground surface during inspections. The main motivators to compliance included: reducing risk of litigation or liability; enhancing community and child safety, and minimising the risk of injury. The main barriers included a lack of: time; personnel, and a lack of adequate and appropriate funding. CONCLUSIONS: Local Government Authorities have a duty of care to ensure the safety of playgrounds in their jurisdiction. They require time, personnel and adequate and appropriate funding in order to achieve this aim

31. Witheaneachi, D. & Meehan, T. 1997, "Council playgrounds in New South Wales: compliance with safety guidelines", *Australian & New Zealand Journal of Public Health*, vol. 21, no. 6, pp. 577-580.

Abstract: Despite initiatives to improve the safety of play environments, playground-related injuries continue to be a major public health problem. Efforts to address playground safety in New South Wales were consolidated during 1994 through the Kidsafe Playground Safety Project. In stage 1 of the project (described here), 240 council playgrounds were assessed to determine the extent to which playground equipment complied with safety guidelines. On-site inspection of the selected playgrounds provided data on 862 separate pieces of playground equipment. Of the 723 pieces requiring undersurfacing, less than half (45.4 per cent) had the recommended type of undersurfacing while only 42 of those pieces had undersurfacing to the recommended depth. However, when the fall height of equipment was considered in addition to the undersurfacing guidelines, only 13 (1.8 per cent) of the 723 pieces of equipment simultaneously satisfied all of the safety guidelines. Regrettably, none of the 240 council playgrounds assessed complied fully with the key safety guidelines. The results underscore the need for a collaborative effort on the part of local government, Kidsafe and health promotion and regional public health units to ensure that council playgrounds in New South Wales comply with recommended safety guidelines

32. Briss, P. A., Sacks, J. J., Addiss, D. G., Kresnow, M. J., & O'Neil, J. 1995, "Injuries from falls on playgrounds. Effects of day care center regulation and enforcement", *Archives of pediatrics & adolescent medicine*, vol. 149, no. 8, pp. 906-911.

Abstract: OBJECTIVES: To measure the incidence of playground fall injuries among children attending licensed US day care centers and to evaluate how injury incidence varies with center characteristics and with the regulatory and enforcement climate in which centers operate. DESIGN: Telephone surveys of directors of day care centers and enforcement agencies and review of written day care regulations. SETTING: Probability sample of licensed day care centers in 50 states and the District of Columbia. PARTICIPANTS: Children attending day care centers with playgrounds. MAIN OUTCOME MEASURES: Medically attended playground fall injuries. RESULTS: Among the 1740 day care centers studied, a weighted total of 89.2 injuries occurred during the 2-month study period (0.25/100,000 child-hours in day care). The most important risk factor for injury was height of the tallest piece of climbing equipment on the playground in both bivariate (P = .01) and multivariate (P = .02) analyses. Neither regulations addressing playground safety or playground surfaces nor enforcement patterns were associated with lower injury rates. CONCLUSIONS: Additional effort is needed to develop and evaluate regulations and enforcement that reduce injury risks for children while minimizing burden on day care centers. In the meantime, limiting climbing equipment heights may reduce playground injury rates