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Safekids New Zealand
Position Paper:

CHILD CYCLING INJURY PREVENTION

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Safekids New Zealand
Position Paper:

CHILD CYCLING INJURY PREVENTION

Summary

Bicycles are an important source of exercise, transportation and recreation for children in New Zealand, and for many New Zealand children, learning to ride a bicycle is an important part of their play and development. There are significant benefits for children and their communities associated with cycling, including health benefits such as higher daily levels of physical activity, and better cardiovascular fitness; improved liveability of communities and improved community accessibility and cohesion.

However, cycling related injuries are one of the top ten causes of unintentional injury related deaths for children in New Zealand.

- In the five year period 2003-2007 a total of 12 children died as a result of bicycle-related injuries.
- Boys were over-represented in cycling related fatalities: 11 boys died compared to one girl.
- European children accounted for half (6) of all bicycling related deaths.
- Boys aged 10-14 years were at greatest risk of fatal injury, accounting for seven deaths.
- A total of eight children died as a result of a crash involving a motor vehicle and a child cyclist.
- All child cyclist deaths involved boys aged between five to 14 years.
- Tamariki Māori were over represented in bicycling related deaths involving a motor vehicle and child cyclist, accounting for half of all these deaths.

Cycling related injuries are one of the top three causes of unintentional injury related hospitalisations for children in New Zealand (5.7 percent of all child injury hospitalisations). In the five year period 2005-2009 a total of 2,436 child cyclists aged 0-14 years were injured severely enough to be admitted to hospital, an average of 487 hospitalisations per year.

- Children aged between 10 – 14 years accounted for the highest number of all cyclist hospitalisations (57 percent).
- Approximately one third of all injuries occurred among children aged five to nine years.
- Hospital admissions for cycle injuries were significantly higher for males, for Māori and European children compared to Asian/Indian children, and for children from areas of higher socio-economic deprivation.

Safekids New Zealand recommends that the following interventions are supported to reduce the risk of injury and death to child cyclists.

1. Bicycle helmets

Bicycle helmets are effective in protecting child cyclists against head, brain and facial injuries. Children and parents need to be supported with ongoing education and awareness campaigns to ensure that bicycle helmets are appropriately fitted and correctly worn. Helmet wearing appears to decrease among older children, and community based interventions should be targeted to appropriately reach older children to ensure they continue to consistently wear appropriately fitted bicycle helmets.

2. Bicycle skills training

Cycling skills training has a positive effect in increasing knowledge and improving observed riding skills in children who receive training. The implementation of a nationwide cycle skills training programme is an important component of supporting the development of confident and capable cyclists, and has the potential to contribute to reductions in injury deaths and hospitalisations for child cyclists. Children and communities are encouraged to participate in the NZTA Cycle Skills training programme.

Children under 10 years of age should not cycle on the road unless accompanied by a competent adult cyclist, and careful consideration should be given to the skills of the child, the traffic environment, and their road rule knowledge. Children cycling on the pavement should be encouraged to cycle slowly (at an adult jogging or walking pace), and be alert to risks including pedestrians and cars moving across the pavement from driveways. Acknowledging the increased injury risk for children aged 11-14, especially boys, careful supervision alongside bicycle skills training is recommended to support children who transition to cycling on roads.

3. Enhancing the safer use of bicycles as part of children's active travel

Integrating safe and user-friendly cycle routes to schools is an important part of school travel plans. A national level policy is required to support school travel plans, and to identify opportunities to support children to cycle to school while not increasing the risk for cycling related injuries for child cyclists.

4. Increasing the visibility of child cyclists

Because of their smaller stature, children are at increased risk of not being seen by other road users, and lack of visibility or conspicuity is an important factor contributing to injury in child cyclist and motor vehicle collisions. Visibility aids such as bright coloured clothing, high visibility or reflective clothing, lights and reflectors aid the visibility of child cyclists, and child cyclists should be encouraged to wear visibility aids to make it easier for other road users to see them.

5. Engineering interventions and the impact of the built environment on encouraging safer cycling

There are a range of engineering features that support safety for child cyclists, including the development of safe crossing places (particularly on routes to schools), traffic calming measures, school speed zone restrictions, and cycle lanes and paths. When planning urban design, Local Authorities are encouraged to implement these features to reduce the risk of injury to child cyclists (as well as other vulnerable road users).

Reducing the speed limit on urban roads is an effective intervention to reduce the risk of child cyclist injuries, as well as the risk of injuries to child pedestrians and other vulnerable road users. Local authorities are encouraged to implement further initiatives to reduce speeds on roads which are used by child cyclists.

Local authorities are encouraged to develop safe crossing places for children as part of the connectivity of cycle routes for children's safe travel to school and other areas around their communities. Safe crossing places for children will require careful consideration to ensure that they meet the needs of children, which are different to the needs of adult cyclists.

Local authorities are also encouraged to develop cycle lanes and paths to separate child cyclists from motor vehicles. Separate cycle lanes and paths will provide protection for child cyclists (and other novice cyclists), and are likely to support increased participation in cycling by children and their families/whanau. In addition, communities are encouraged to support 'share the road' campaigns, to create a road user culture where there is increased awareness between drivers and cyclists of each other's needs.

Photo credit: NZTA

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'Cycling Mad' district promotes cycle safety

Central Hawke's Bay was once again crowned the Mayoral Challenge's 'Cycle Mad District' – for four years in a row – earning it the enviable reputation as a top cycling advocacy district. This year, event organizer and RoadSafe HB Co-ordinator Ethna Renner took the opportunity to promote safe cycling for kids. Cyclists in the Mayoral Cycle Challenge entered into a prize draw to win a $100 voucher, had to answer some important cycle safety questions. Answers can be found in Safekids' Got a bike? Be smart, be safe, be seen! child cycling resource that was distributed at the event.

-Safekids News June 2011, Page 11.

1. Introduction

Bicycles are an important source of exercise, transportation and recreation for children in New Zealand, and elsewhere in the world [1-2]. In common with other western countries, New Zealand data indicates that the popularity of cycling has increased in recent years, to the extent that more bicycles are imported per annum than cars [3]. More than one-third of New Zealanders own a bicycle [4]. However, analyses of the use of bicycles as a mode of transportation indicates that bicycles are rarely used, and represent a very small proportion (2 percent) of total travel time [5]. Use of bicycles by children in New Zealand appears to have been decreasing since the early 1980s [4, 6-7].

In spite of the apparent low levels of use of bicycles, bicycle injuries are a leading cause of injury to New Zealand children (0-14 years). In recent years child cyclist injuries have accounted for an average of two deaths per year (2003-2007) and more than 487 hospitalisations (2005-2009). In the five year period 2003-2007 child cyclist related injuries account for 5.7 percent of all child injury related hospitalisations and 2.7 percent of child injury related deaths for the period 2001-2005 [8]. Consequently, it is important to identify opportunities to reduce the burden of bicycle related injuries for children and their families/whanau.

As part of a national campaign to reduce bicycling injuries among New Zealand children, Safekids New Zealand has developed the current position paper to:

- Describe the epidemiology of child bicycle injuries in New Zealand among children 0-14 years
- Outline New Zealand road transport legislative requirements and expectations about child cycling
- Summarise key interventions to reduce bicycling injuries among children
- Identify opportunities to reduce the number of bicycling injuries among children in New Zealand.

In New Zealand and similar countries, learning to ride a bicycle is part of children's play as well as a significant developmental achievement, and it can become an important activity in their lives. Children need to be able to be adventurous, take risks and make mistakes and learn about the consequences of risk taking, as part of their development [9]. These experiences are important elements of growing up and increasing maturity, and are crucial to developing life skills and resiliency in adulthood. Learning to ride a bicycle can also be an important aspect of developing independence, as children first use a bicycle as a developmental toy, and then as they become more proficient, they are able to use it for recreation and for play with other children [10]. As children become older, cycling can also become an optional mode of transport to school and other activities.

Learning to ride a bicycle is a complex activity, and consists of several different components, including motor elements such as pedaling, balancing, steering and braking, as well as cognitive elements such as concentration, attention, judgement, planning and decision making [11]. Children's developmental maturity has an impact on their ability to cycle safely in specific situations. For example, younger children are more likely to have difficulty in paying attention to more than one aspect of a complex and potentially dangerous situation, such as when two cars approach the point where the child is about to cross the road. Cycling performance does not necessarily increase with age and improved cognitive and motor capacity. Older children may over-extend their capabilities by cycling faster, and under more dangerous conditions, than their skills are able to accommodate. Observations of eight to 13 year old children's cycling behaviours suggest that boys cycling speed increases with age, and both boys and girls make increased numbers of errors (such as failing to stop at signals or stopping too late) as they get older [11]. Acknowledging the risks for younger children, the New Zealand Police and the New Zealand Transport Agency recommends that children under 10 years old cycle on the road only when accompanied by a competent adult rider [12]. This is a recommendation only, and is dependent on the skills of the rider, the traffic environment, and the child and their supervisor's road rule knowledge.

There are significant benefits for children and their communities associated with cycling, including:

- Health benefits including higher daily levels of physical activity, and better cardiovascular fitness
- Improved liveability of communities
- Improved community accessibility and cohesion
- Economic benefits
- Improved safety and personal security
- Part of the climate change solution [4, 13-16].

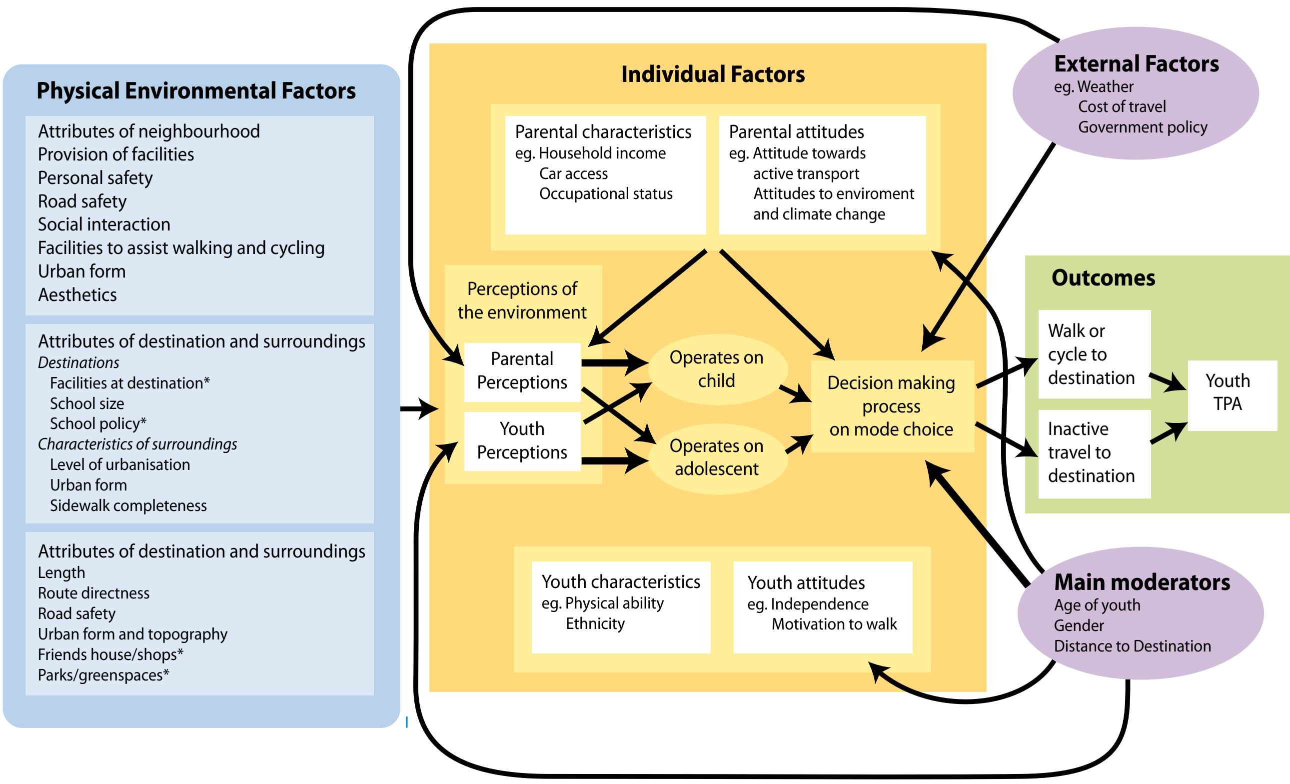
Despite the benefits of bicycling for children and their communities, there is substantial concern among parents and other adults that the risk of injury to children outweighs the benefits [13, 17-18]. However, perceptions of the risk associated with cycling may be higher than the actual risk. For example, although cycling to school is associated with increased risk of injury and death compared to other modes of transport, the risk per trip is small and children aged 10-14 years are more likely to drown than die as a result of a cycle-related injury [19].

In addition to perceptions of risk, a range of other individual and family factors appear to influence children's cycling behaviours, including gender (boys are more likely to cycle to school than girls); age (children make age-related gains in independent mobility); the overall fit of cycling within family work and lifestyle (e.g., time management); opportunities for adequate supervision when crossing roads; and parent's history of bicycling as a child [14, 20-22]. New Zealand research reports similar barriers to children's cycling behaviours [4].

Environmental factors have also been identified as influencing children's cycling behaviours including transport infrastructure, urban versus rural locations, intersection density and navigation of steep roads. Children are also more likely to engage in bicycling when their parents perceive that other children in the area also bicycle, particularly to school, where the neighbourhood is perceived as safe, and when there is family support for cycling.

Reflecting the complexity of factors that can influence children's cycling behaviours, Panter and colleagues have outlined a conceptual framework for the interplay of the range of physical environmental factors, individual factors and external factors that influence active travel, including cycling behaviours, in children (see Figure 1) [23]. The arrows in the diagram indicate a hypothesized direct relationship, and thicker arrows indicate a strongly hypothesized direct relationship.

Figure 1: A conceptual framework for the environmental determinants of active travel for children



Source: Panter 2008 [23]. Original image redrawn for clarity by Safekids NZ.

2. Child cyclist injuries in New Zealand

Child cyclist deaths 2003-2007

Cycling related injuries are one of the top 10 causes of unintentional injury related deaths for children in New Zealand. In the five year period 2003-2007 a total of 12 children died as a result of bicycle-related injuries [24]. Boys were over-represented in cycling related fatalities: 11 boys died compared to one girl. European children were over represented in all bicycling related deaths, accounting for six deaths. Boys aged 10-14 years were at greatest risk of fatal injury, accounting for 7 deaths.

A total of eight children died as a result of a crash involving a motor vehicle and a child cyclist. All of these deaths involved boys aged between five to 14 years. Tamariki Māori were over represented in bicycling related deaths involving a motor vehicle and child cyclist, accounting for half of all these deaths

There has been a decrease in the number of child bicycle related deaths over time. In the five year period up to 2003, an average of five children a year died as a result of a bicycle related injury [25]. However, in the period 2003-2007, the average number of deaths reduced to 2.4 per year [8]. Similar findings demonstrating reduced numbers of fatalities since the 1980s among child and adult cyclists have been reported by other agencies, who estimate that this data represents fewer children and young adults learning to ride bicycles [6, 26].

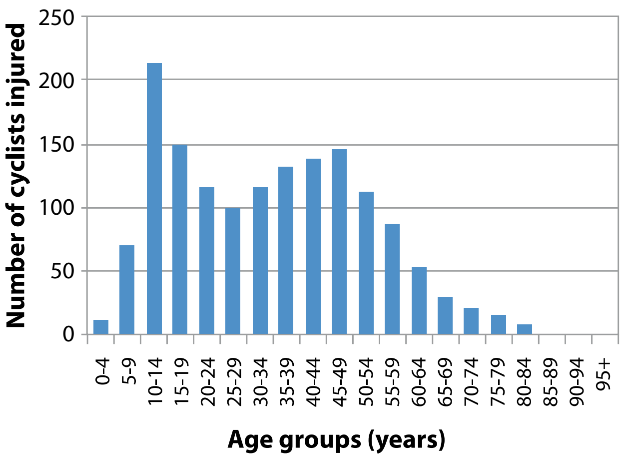
In the period to 2001-2005, cycle related injuries accounted for 2.7 percent of all child injury deaths.

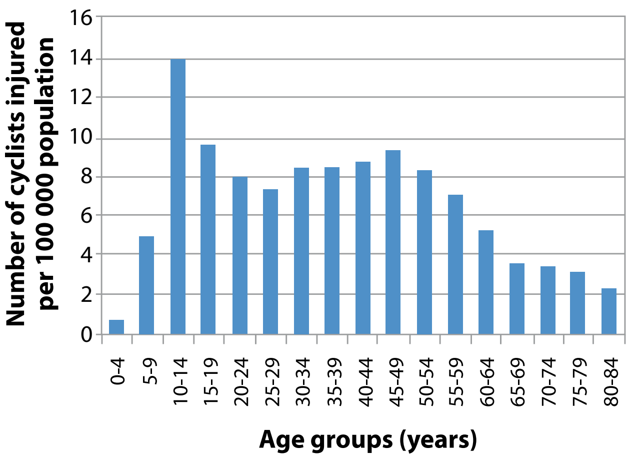
Child cyclist hospitalisations 2005-2009

Cycling related injuries are one of the top three causes of unintentional injury related hospitalisations for children in New Zealand. In the five year period to 2007, cycle related injuries accounted for 5.7 percent of all child injury hospitalisations.

In the period 2005-2009 a total of 2,436 child cyclists aged 0-14 years were injured severely enough to be admitted to hospital [24]. Children aged between 10 – 14 years accounted for the highest number of all cyclist hospitalisations (57 percent). Approximately one third of all injuries occurred among children aged five to nine years.

Figure 2: Hospitalisation of cyclists involved in motor vehicle crashes by age (2005-2009)





Source: Ministry of Transport 2010 [26].

In the period 2005-2009, child cyclists aged 10-14 years had the highest rate of hospitalisation, 14.1 per 100,000 population per year, compared to other age group hospitalisation rates between 5-9 per 100,000 per year [26]. Children in this age group had the highest risk of non-collision crashes (i.e., falling off a bicycle) [1].

A recent analysis of risk factors for hospital admissions for child cyclist injuries during 2006-2010 indicated that hospital admissions for cycle injuries were significantly higher for males, and for Māori and European children compared to Asian/Indian children [27]. Craig et al report that socioeconomic differences were not large, although once grouped by NZDep quintile, admission rates were significantly higher for children from areas of higher socio-economic deprivation (NZDep deciles 5–10, see Table 1). Similar findings have been reported from earlier years. For example, in the period 2003-2007, child cycling related injuries also demonstrated a socio-economic gradient. Injury rates in NZDep areas 9-10 were significantly higher than in NZ Dep areas 1-2 [8]. Other New Zealand research has identified increased risk of hospital admissions for child cyclist injuries for males and children living in urban areas [8].

Table 1. Hospital Admissions for Cyclist Injuries in Children Aged 0–14 Years by Gender, Ethnicity and NZ Deprivation Index Decile, New Zealand 2006–2010

Variable	Rate	Rate Ratio	95% CI	Variable	Rate	Rate Ratio	95% CI
New Zealand							
Cyclist Injuries 0–14 Years							
NZ Deprivation Index Decile				**NZ Deprivation Index Quintile**			
Decile 1	57.7	1.00		Decile 1–2	56.1	1.00	
Decile 2	54.5	0.94	0.79–1.13	Decile 3–4	61.0	1.09	0.96–1.23
Decile 3	65.1	1.13	0.95–1.34	Decile 5–6	64.7	1.15	1.02–1.30
Decile 4	57.2	0.99	0.83–1.18	Decile 7–8	68.5	1.22	1.08–1.37
Decile 5	63.6	1.10	0.93–1.32	Decile 9–10	73.9	1.32	1.18–1.48
Decile 6	65.5	1.14	0.96–1.34	**Prioritised Ethnicity**			
Decile 7	65.9	1.14	0.96–1.35	European	73.9	1.00	
Decile 8	70.7	1.23	1.04–1.44	Māori	68.1	0.92	0.85–1.00
Decile 9	81.9	1.42	1.21–1.66	Pacific	40.7	0.55	0.47–0.64
Decile 10	67.2	1.16	0.99–1.37	Asian/Indian	26.1	0.35	0.29–0.43
Gender							
Female	31.0	1.00					
Male	98.5	3.18	2.91–3.46				

Source: Numerator: National Minimum Dataset; Denominator: Statistics NZ Estimated Resident Population. Note: Rate is per 100,000; Ethnicity is Level 1 Prioritised; Decile is NZDep2001.

Overall, boys in New Zealand are over-represented in bicycling related injuries. In the period 2005-2009, more than three times as many boys as girls were admitted to hospital with bicycle related injuries, and the gender difference increased with age, i.e. Boys = 1,890 and Girls = 546 [24]. A total of 70 girls aged 0-four years were admitted to hospital compared to 143 boys of the same age. Among children aged five to nine years, 265 girls were admitted to hospital following bicycle related injuries compared to 565 boys. The difference was greatest among children aged 10 – 14 years: 211 girls were admitted to hospital compared to 1182 boys.

Children from all ethnic groups are affected by bicycle-related injuries, however, the burden of cycling related injuries is not equally distributed across ethnic groups. Rates of cycling related injuries are highest among European (73.9 per 100,000; third leading cause of injury) and Maori children (68.1 per 100,000; third leading cause of injury). Rates of hospital admissions for cycling related injuries were significantly lower for Pacific and Asian/Indian children compared to their European and Maori counterparts [8].

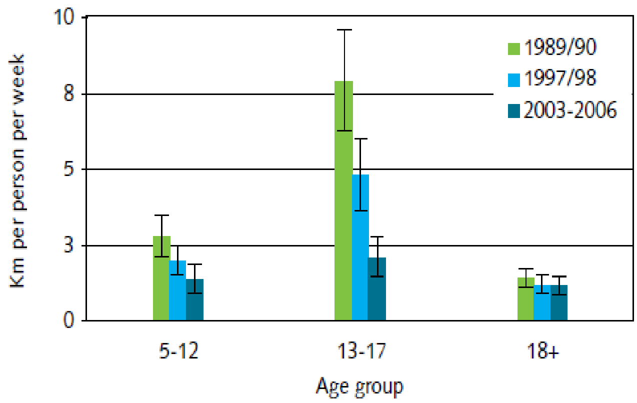
Most children are injured while cycling on the road or around the home, however for a large number of injuries the scene of the injury is unknown [25].

There is limited data available about high-risk times for child cyclist injuries, however data extrapolated from the New Zealand Household Travel survey suggests that children are at increased risk of injury between 4-6pm [26].

Approximately 14 percent of child cyclists aged 0-14 years (179) are injured in a crash with a motor vehicle (collision crashes). Children aged 10 – 14 years are at greatest risk, accounting for 69 percent (124) of this group. Boys are more likely to be injured in a bicycle crash with a motor vehicle (157 boys compared to 21 girls), and boys aged 10-14 years account for nearly two-thirds (62 percent) of this group. Most children injured in a crash with a motor vehicle are cycling on the road at the time of their injury.

The major risk to cyclists relates to exposure, or time spent cycling [28]. International data indicates that decreasing bicycle riding leads to increased risk of injury for cyclists, and increased risk of injury leads to decreasing bicycle use [29]. Similar patterns are evident in New Zealand. For example, Tin Tin et al comment that the increased risk of bicycle related injuries among children and adolescents are of particular concern, as this group has experienced the greatest increase in the risk of injury, despite a substantial decline in the amount of cycling over the last two decades [1]. The New Zealand Travel Surveys indicate that children are spending substantially less time cycling. Among 5-12 year olds, from 1989/90 to 2005/08 the average time spent cycling per week decreased from 28 minutes, to 8 minutes per week. A similar pattern was reported among 13-17 year olds, decreasing from 52 minutes to 12 minutes [30]. However, if fewer children use bicycles less frequently, they will have less opportunity to develop cycling and road safety skills, increasing their risk of injury as well as decreasing levels of physical activity.

Figure 3: Kilometers cycled per person per week by age group



Source: Ministry of Transport 2008 [4]

Christie and colleagues also suggest that any analysis of traffic fatalities also needs to take into account exposure data [31]. An analysis of the fatality rate per unit of exposure across a sample of OECD countries (New Zealand, the Netherlands, Germany, Switzerland, the UK, Norway and Sweden) for children aged 10 – 14 years demonstrated that New Zealand children are particularly vulnerable road users. New Zealand had the second worse fatality rate per 100,000 people divided by the average number of kilometers travelled. The authors state that the increased risk of injury for New Zealand children is associated with low levels of cycling among children.

Children aged 5-13 years at Papakura learning important bike safety skills (*Safekids News* September 2008)

International epidemiology of child cyclist injuries

Other countries also report child cyclist injury patterns which are similar to those found in New Zealand. Internationally, in high income countries, bicycle-related deaths are decreasing as they are in New Zealand [28].

Hutchinson and colleagues examined injuries and deaths among child cyclists aged 0-15 years in South Australia and reported that casualties among male child cyclists outnumber females by approximately six to one [32]. Older children (13-15 years) were at increased risk of injury. Child cyclist fatalities and serious injuries in South Australia appear to be reducing over time, from 1981 to 2008, and the authors suggest this is due in part to less use by children of bicycles for play and transport. Hutchinson et al suggest that policies which encourage cycling may result in a future rise in cyclist injuries and deaths.

In the UK, Sonkin and colleagues reported that in 2003, compared to 1985 there has been a 58 percent reduction in the average mileage that children cycled, with a subsequent reduction in cycling death rates per 10 million passenger miles travelled [33]. However, in spite of the overall decline in death rates for cycling, child cyclists (and child pedestrians) remained at greatest risk of death compared to other modes of transport.

Bicycle injuries are among the top five causes of non-fatal injuries for children aged 5- 14 years in the USA. Mehan and colleagues reported that the average age of a child injured with bicycle related injuries was 9.7 years, and children aged 5-14 years accounted for 78.6 percent of injuries [2]. Boys had higher injury rates than girls (7.24 per 1,000 boys compared to 3.23 per 1,000 girls). Boys aged 10- 14 accounted for 70.2 percent of all injuries, and boys aged 10-14 years had the highest injury rates (11.67 per 1,000 children). Most injuries occurred at home, or on the street. Over the 16 year period that data was collected, the number of injuries decreased slightly over time.

Internationally, evidence suggests there is a social gradient to cycling injuries. Higher rates of injury in lower income neighbourhoods may be explained by a number of factors, including environmental characteristics (increased hazards, fewer safe bicycle paths or crossings), risk, and safety behaviours (e.g., barriers to access for bicycle helmets). Overall, further research is required to examine the factors and pathways that contribute to higher rates of cyclist injuries in lower income neighbourhoods [14, 34].

3. New Zealand legislation requirements and expectations

Policy framework

Reducing barriers to increase the use of cycling as an active transport mode has been recognized in New Zealand central and local government transport and road safety policies for a number of years, however some authors argue that the priority given to cycling as a form of active transport has reduced over time [13]. In the most recent road safety policy framework, Safer Journeys New Zealand's Road Safety Strategy 2010-2020, the Government identified safe cycling as a priority area, and highlighted the need to reduce the number of cyclists killed or injured each year [35]. The Strategy highlights increasing cycle skills training in schools as an integral component of improving cycling safety. Other priority strategies to improve safety for cyclists are identified, including providing safe and convenient routes for cyclists to and from work and school, and increasing coverage of temporary lower speed limits around schools.

The Safer Journeys Action Plan 2011-12 also identifies a number of actions which are intended to support safer cycling [36]. Education and training actions include:

- Support of community-based cycle skills training that is provided to communities at risk in accordance with established national standards
- Promotion of the official Road Code for Cyclists
- Strengthening the motor vehicle learner licence test, by reviewing questions relating to cycling and walking.

The Action Plan also outlines commitment to support central, regional and non-government initiatives focused on improving safety for cyclists, including:

- investigation of the feasibility and potential effectiveness of a national 'share the road' campaign while assisting with local 'share the road' campaigns and 'model community' projects
- input as required into regional transport plans and road safety action plans [36].

International evidence demonstrates that the countries with the best road safety records in child road user (including child cyclist) injuries have national road safety implementation plans which include a wide range of measures such as:

- low speed limits, speed reduction levels, promotion of safety promotion messages for children, their parents and drivers
- area-wide engineering solutions to reduce pedestrian injury risk
- legislation and policy reducing vehicle speeds in residential areas and changing driver behavior
- traffic calming measures in residential areas, which changes driver behavior and which has been shown to reduce the risk of injuries to children by 60 percent in 30 km/hour zones [37].

Legislation

New Zealand cycle helmet regulation became effective from 1 January 1994, and required all cyclists to wear a Standards approved cycle helmet for all on-road cycling. Following the introduction of this legislation, helmet wearing rates increased to above 90 percent for all age groups, and for the three years following the introduction of the law, helmet wearing rates for all cyclists exceeded 92 percent [38]. A similar protective effect for children following cycle helmet regulation has also been observed in other countries [39].

The Land Transport Road User Rule (2004) establishes the rules under which all traffic, including child cyclists, must adhere to in order to use the road network and footpaths. Overall, the purpose of the traffic laws described in the Rule are to resolve conflict, prescribe behaviour, prohibit detrimental behaviour, and define the meaning of traffic control devices. Clauses 11.07 – 11.12 relate specifically to cyclists, and the clauses of particular relevance to children and young people include:

- Clause 11.08 which outlines the requirements for the use of safety helmets by cyclists. The clause prohibits a person riding, or being carried on a bicycle on a road unless they are wearing a safety helmet of an approved standard that is securely fastened.
- Clause 11.11 prohibits a person riding on the footpath or grass verge beside a road, unless they are delivering mail or newspapers.

Small wheeled recreational devices that have a wheel diameter of less than 355 millimetres (typically tricycles or small children's bicycles) are allowed to be ridden on the footpath.

Bicycle helmet legislation in New Zealand allows helmets complying with a range of international standards, and relates to on-road use only. The legislation requirements for bicycle helmets in New Zealand are described in Appendix 2.

4. Interventions to reduce injuries to child cyclists

Use of bicycle helmets to reduce injuries

Bicycle helmets are effective in protecting cyclists of all ages against head, brain and facial injuries. A recent Cochrane review examined "whether bicycle helmets reduce head, brain and facial injury for bicyclists of all ages involved in a bicycle crash or fall" p. 1 [40]. Thompson and colleagues reviewed eight papers which assessed the effects of bicycle helmets on head injuries and facial injuries, and identified that head injury is the greatest risk for cyclists: head injuries account for one-third of emergency department visits, two-thirds of hospital admissions and three quarters of deaths. Findings from the review concluded that bicycle helmets that meet national standards are protective against head, brain and facial injuries, and the protective effect is present for cyclists of all ages, and for a variety of crash causes. In summary, across cyclists of all ages, helmet wearing was associated with:

- A 69 percent reduction in the likelihood of head injury,
- A 69 percent reduction in the likelihood of brain injury and
- A 74 percent reduction in the likelihood of severe brain injury [40].

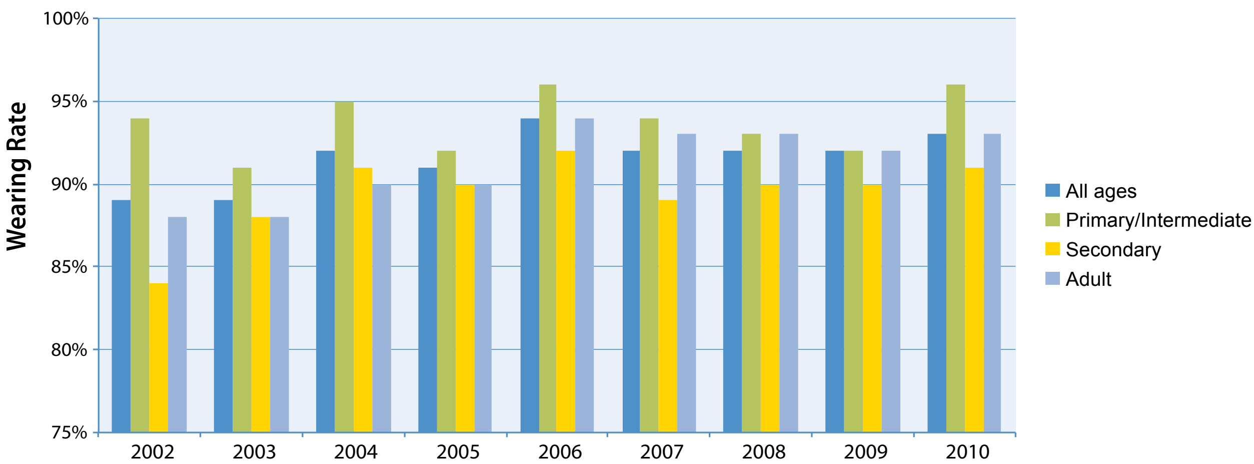
Helmet wearing also reduced the likelihood of head injury by 69 percent in cyclists involved in crashes involving motor vehicles, and 68 percent in all other types of crashes. In addition, helmet wearing reduced the likelihood of injury to the upper and mid-face by 65 percent [40].

Children's brains are particularly vulnerable to injury, and cycle helmets provide effective protection for cyclists and reduce the risk of injuries. Internationally, approximately two-thirds of hospital admissions among child cyclists are for head injuries, and three quarters of deaths among injured child cyclists are from head injuries [28, 41]. There is strong evidence that helmets provide children with effective protection from head and brain injuries in non-collision and collision injuries [28, 42]. For example, a case-control study of presentations to an emergency department demonstrated that the risk of injuries to the upper part of the head was 2.7 times higher among children who were not wearing helmets at the time of a bicycle crash [43]. Loss of consciousness was more than seven times higher for non-helmet wearing children, compared to those who were wearing a helmet at the time of a crash. Wearing a helmet reduced the risk of upper head injuries by 63 percent and loss of consciousness by 86 percent. Overall, the evidence suggests that wearing a helmet significantly reduces the risk to children of a range of injuries, while conversely the risk of death and serious injury appears increased among those who were not wearing a helmet at the time of their injury [44-45].

Research undertaken in New Zealand compared the protective effects of bicycle helmets for non-motor vehicle and motor vehicle bicycle crashes [46]. Head injuries among cyclists decreased with increasing helmet wearing among non-motor vehicle crashes, and this effect was evident across all age groups and was strongest among primary school aged children. A similar effect, although not as great, was reported among bicycle crashes involving a motor vehicle.

In New Zealand, rates of helmet use among cyclists appear high, particularly among children and increases in helmet wearing have resulted in significant decreases in head injuries among cyclists [38].

Figure 4: Cycle helmet use for all ages



Source: Ministry of Transport 2011 [47]

Internationally, New Zealand is among many jurisdictions that have introduced compulsory bicycle helmet legislation. Criticism of compulsory cycle helmet requirements has been voiced by various organisations and individuals, both in New Zealand and internationally. In summary, the criticism has acknowledged the injury reductions associated with helmet wearing, but has focused on the negative impacts of helmet requirements on cycling participation, and has suggested that helmets encourage risky riding, or that they distract attention from other safety measures such as improvements in infrastructure and reductions in motor vehicle speeds [48]. However, in a recent comprehensive review of bicycle helmet research, Haworth and colleagues comment that "the ability to assess the effects of bicycle helmet laws on cycling participation rates is constrained by the lack of long-term participation data that covers all types of riding. It is also difficult to predict what current cycling participation levels might have been under different scenarios" [48] (p. x). A New Zealand analysis of barriers to cycling among intermediate aged school children did not identify helmet use as a barrier to cycling to school [13].

A systematic review of 11 studies from Australia, Canada and the US demonstrated that mandatory requirement for the use of bicycle helmets resulted in an increase in helmet use following legislation [49]. A more recent systematic review of the impact of bicycle helmet legislation also provided evidence that bicycle helmet legislation increases helmet use and reduces bicycle related mortality and head injuries [41]. No evidence was found that legislation may lead to negative societal and health impacts such as a reduction in cycling participation, and similar findings are reported by other authors [50].

A review of nonlegislative community-based interventions for the promotion of bicycle helmet wearing by children demonstrated that community based interventions had a positive impact on encouraging children to wear helmets, particularly programmes that provided free helmets with an education component [51]. Interventions delivered in school settings, involving young (pre-school age) children, and incorporating discounted helmets also showed positive impacts on observed helmet wearing.

Research findings suggest that interventions from key community stakeholders can have a positive impact on helmet use. For example, advice from a general practitioner had a positive impact on helmet use by child cyclists [52-53]. Parents who received advice from a family physician either in the emergency department or family practice were more likely to report that their child always used a helmet compared to those without advice [53].

Similarly, letters from local emergency department clinical staff to primary school teachers to support students to correctly use cycle helmets resulted in a significant decrease in the number of severe head injuries requiring hospitalisation among school aged children [54].

International evidence suggests that helmet wearing among adolescents is highest among younger adolescents (11 years old), and decreases as children age [55]. However, nonlegislative community based interventions delivered in school settings also appear to encourage bicycle helmet wearing among young people aged 13-14 years. An Australian theory-based injury prevention programme, Skills for Preventing Injury in Youth (SKIP) showed a significant 20.2 percent decrease in cycling without a helmet among children who received an eight week classroom based injury prevention curriculum.

In order for child cyclists to receive the full benefit of a cycle helmet, it is imperative that the helmet is appropriately fitted. Poorly fitting helmets have a substantially decreased protective effect, and children whose helmets fit poorly have double the risk of head injury compared to those whose helmets fit properly [56]. Summarising the evidence about correctly fitting helmets, Hagel et al [57] state that "a correctly worn helmet sits straight and horizontal on the head, not too far forward to cover the eyebrow or too far back on the head so the forehead is exposed. The helmet should not be too loose and the wearer should have the buckle or helmet straps fastened. The helmet straps must be fastened with approximately one finger width between the chin and the straps. Furthermore the helmet should be stationary when movement is attempted. A helmet is considered to be in an incorrect wearing position when it is tilted either forward or backward, not securely strapped under the chin, has more than two finger breadths space between the head and the helmet and moves either front-to-front, side-to-side, or rotationally" (p. 178). Findings from observational studies and self-reported descriptions of helmet use among children suggest that many children may wear their helmets incorrectly, or have poorly fitting helmets, and strategies to increase the correct use and fitting of cycle helmets are likely to have a positive benefit on reducing the risk of head and brain injuries [56-57].

New Zealand researchers have examined the benefit-cost ratio of cycle helmet legislation. Costs associated with the purchase of helmets were compared to the value of injuries (but not deaths) prevented by helmets [58]. Injuries were valued according to willingness to pay estimates to avoid injuries requiring hospital stays of less than seven days, or seven days or more. The cost effectiveness of the helmet law was greatest for 5-12 year olds (2.61: 1 benefit cost ratio), and similar for 13-18 year olds (0.85:1 BCR) and adults (0.74:1 BCR). The authors noted that the estimates of the benefits were likely to be too low because they did not include the very high costs associated with permanently disabling head injuries, or the value of preventing minor (non-hospitalised) injuries. International evidence has identified cycle helmets as a cost-effective injury prevention intervention: $1 spent on bicycle helmets saves $29 [59].

Bicycle skills training programmes

As part of a focus on developing a consistent best practice approach for cyclist skills training in New Zealand, the NZ Transport Agency has developed a guide for cyclist skills training [60]. The Guide encourages Councils and other community organizations to consider community-based cyclist training to support the development of confident and capable cyclists, with the ultimate aims of contributing to a well functioning transport system, and to enable more people to cycle for transport and recreation. The Guide outlines skill sets (or outcomes) that need to be achieved at each grade of cyclist training, and includes a range of modules that can be delivered by a number of cycling related organizations, including for example Councils, the New Zealand Police, non-government and/or not for profit agencies, regional sports trusts or cycling advocacy organizations. Funding to support the delivery of programmes based on the Guide may be available through the NZTA Demand management community programmes activity class.

Delivery of the cycle skills training programme is currently being undertaken across the Auckland region by Auckland Transport, and the programme aims to train 9,000 children to Level 1, and a further 250 children to Level 2 (pers com, K. Cuthbert, Sept 2011).

Another example of a successful, high quality and cost-effective bicycle skills training programme is the 'Cycle Safe' cycle training programme that was developed in Christchurch [13, 35]. The programme is offered by most Christchurch schools as part of the school curriculum for Year 6 students. Skills training is delivered through five modules and incorporates a range of concepts including appropriate helmet use, safe navigation at intersections, learning the road code and bicycle maintenance [13].

Recent innovations in child cyclist skills training programmes have incorporated e-learning initiatives and virtual learning environments [61-63]. Findings indicate that the 'Bike Smart' eHealth software programme was successful in significantly increasing knowledge among young children (kindergarten to Year 3) about bicycling safety skills, correct helmet placement and how to identify hazards at intersections. However, the effect of the programme was not significant in increasing young children's ability to identify hazards on the street [61]. Babu, Plumert and colleagues evaluated the effectiveness of a virtual peer system to support safe versus risky road crossing behaviours among 10 and 12 year old children [62-63]. Findings demonstrated that the behaviour of a virtual peer influences children's behaviours, and depending on the behaviour of the peer, could result in increased or reduced risk taking behaviours.

An evaluation of a school based bicycle safety education programme targeting Year 4 students in Australia highlighted that some cycle skills education programmes can have unanticipated negative consequences. The Traffic Centre Road Safety Package (TCRSP) was operated by the Australian Federal Police (AFP) using the Belconnen Traffic Centre and involved Year 4 children riding bicycles and simulating being pedestrians in a mock road environment. The objectives of the program were to communicate the road rules and to improve bicycle riding skills. An assessment of the impact of the programme demonstrated that traffic centres have little to offer children in the development of bicycle and related road safety skills. Such centres may inadvertently encourage students to become over-confident about their ability to cope safely in traffic, and consequently it was recommended that the TCRSP was discontinued.

Summarising the evidence relating to cycling skills training, MacKay and colleagues comment that cycling skills training has a positive effect in increasing knowledge and improving observed riding skills in children who receive training [64]. In order for children to ride safely in traffic, they need to be knowledgeable about traffic rules, be able to read and understand traffic signage, and have sufficient cognitive and motor skills [10]. Comprehensive skills based programmes incorporate helmet education, traffic rules, safety guidelines and on-bicycle training into their design and delivery [64]. However, although the evidence for cycling skills training is positive, there appears to be no research evidence directly linking skills training and reduction in injuries for children [64].

Enhancing the safer use of bicycles as part of children's active travel

The New Zealand Transport Agency encourages a whole school approach to influence students to adopt road safety behaviours [65]. Young people are supported to make informed individual and collective decisions

The Consumer guide to

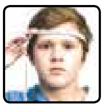
Bike helmets

consumer. Making decisions easy

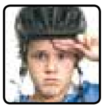
Wearing a good quality, well-fitted bike helmet can save you from serious injury or even death. By law, only helmets that meet the appropriate standards can be used on the road here. That means all helmets will pass a minimum safety test, and any helmet will do its job as long as it is undamaged and fits properly.

The most important thing is the FIT. Unless your helmet is fitted and worn properly, it won't give you good protection and may even do more harm than good in a crash.

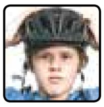
How to get the RIGHT fit



Most helmets have the size range they will fit (in centimetres) on the box or the label. Get someone to **measure your head** with a tape measure and then try on a few helmets in your size. Everyone has different-shaped heads, and you'll probably find one brand or model of helmet fits better than the others.



To see if a helmet fits properly, put it on and adjust the fitting at the back so that it is snug on your head. **It should sit flat and two finger widths above your eyebrows**, and shouldn't have any areas that dig into your head or are uncomfortable.



Before you do up the straps, try to tip it and rotate it on your head. **Your scalp should move as you move the helmet.** If the helmet tips sideways, backwards or forwards, it's not a good fit.

Sizing pads are for fine tuning and comfort, not to make a big helmet smaller.

Next make sure the straps fit properly. The straps should **run in straight lines from the rim**, with the rear strap and front strap meeting just below and to the front of the earlobe. Adjust the buckle so that the strap is **firm but not tight** under your chin, and not sitting over your jawbone.

6 Things you should NEVER DO!

1 Never wear a cap under your helmet. This ruins the proper fit. In an accident, the helmet may not stay on. If you want sun protection, buy a helmet with a visor.

2 Never buy a helmet to "grow into". The accident won't wait till the helmet fits.

3 Never wear a helmet with the straps loose. It won't stay in place, and it could catch and strangle you.

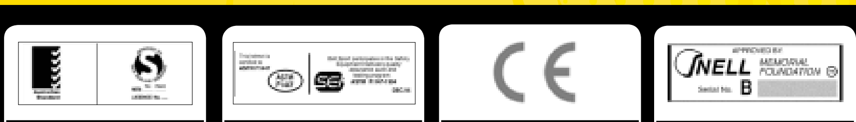
4 Never wear the helmet on the back of your head. A helmet worn like this exposes your forehead and face to the road, and also means you risk being strangled by the straps in a crash.

5 Never wear a helmet after it has been in an accident or has been bashed around. Cracks in the cover, cracked or crushed foam and frayed straps all indicate it's time for a new helmet. Even if you can't see any damage, a really good whack will ruin a helmet's protective qualities. That's why kids' helmets should be replaced every couple of years.

6 Never buy a second-hand helmet. It might look OK, but you have no idea if it has been damaged.

The *right* labelling

For a bike helmet to be legal to wear on the road it must comply with one of the following standards:



AS/NZS 2063:2008, NZS 5436 or AS 2063.2

ASTM F1447-2006

EN 1078

SNELL B90 OR B95

*A label stating that the helmet meets the **US Consumer Product Safety Commission's bicycle helmet safety standard** means the helmet is also approved.*

For more information visit: www.consumer.org.nz

DISPLAY THIS POSTER!** This poster may be displayed freely in schools, retail outlets, community centres and elsewhere. Copies can be downloaded at **www.consumer.org.nz/reports/childrens-bike-helmets

Courtesy of Consumer New Zealand

Safekids New Zealand's Got a bike? Be smart, be safe, be seen! card/ pamphlet and reflective stickers. This resource was developed for the Safekids Campaign as part of the cycle safety theme and is available in English and Māori. This can be ordered from infocentre@safekids.org.nz (Reference number 8857).

to contribute to a safe system, by engaging in school community partnerships, considering the school ethos and organisation and through learning in the school curriculum. A safe system involves the combination of safe roads, safe speeds, safe vehicles and safe road use. A range of curriculum resources have been developed for schools which focus on all elements of road safety, and which include cycle safety [66].

Integrating safe and user-friendly cycle routes to schools is an important part of school travel plans, and is likely to have a positive effect on the overall number of children who cycle to school as well as reducing safety concerns. Compared to other modes of travel to school, cycling is the most risky travel model for school aged children in New Zealand, as approximately three cycling trips undertaken by children per day will result in an injury [67]. Cycling accounts for 30.3 percent of the school-travel related injuries, and the risk of injury per million trips is highest for cycling (46.1 injuries per million trips) [67].

Internationally, initiatives such as Safe Routes to School, Walking School Buses, and Walk to school programmes have been implemented to increase children's walking and cycling to school, with some success [68]. In New Zealand, school travel coordinators are funded by local authorities and are responsible for supporting school travel plans in partnership with schools. However a review of school travel plans within the Auckland region reported minimal uptake of cycling since the start of school travel plan implementation [69]. The authors noted that this was due in part to local authorities being hesitant to promote cycling to school due to concerns about safety and increased risk of injury.

In contrast, Mackie [13] comments that in other parts of New Zealand, cycling initiatives have been established to encourage children to cycle safely to school. For example, informed by the development of Walking School Bus programmes, in 2006 a pilot 'cycle train' programme was developed, implemented and evaluated in Nelson [70]. In essence, a cycle train operates similarly to a walking school bus, where adult 'conductors' cycle along a set route to school, collecting children from designated 'bus stops.' Cycle trains are also known as 'bicycle pools' and have previously been established for children at schools in the UK, and for adults as part of workplace travel plans in the US. Findings from the evaluation of seven cycle trains involving 34 children across seven schools indicated that there was a high level of enthusiasm about participating in the cycle train, and that children developed friendships, enhanced their sense of community and increased exercise levels. Parents reported that children were learning good cycling habits and road safety rules in a safe context, while under adult supervision. Guidelines and resources to support the development and implementation of cycle trains in New Zealand have also been developed [70].

A key criticism of school travel plans in New Zealand is that there is no national-level policy or strategy that outlines the specific transport outcomes that schools are expected to achieve through their travel plans, or the system requirements that are need to achieve the outcomes [17]. Consequently, initiatives to support school travel plans are currently fragmented, and Mackie notes there is no requirement for schools or funding agencies to prioritise school travel initiatives, despite their potential benefits [17].

Indeed, some communities have discouraged younger children from cycling to school as road conditions were deemed too unsafe. From 1998 to 2002, the Eastern Bay of Plenty Child Injury Prevention Trust developed a campaign to work with primary schools to discourage children aged under nine years from commuting by bicycle to reduce the number of collisions with motor vehicles, and to promote the use of helmets at all times. As an alternative to cycling on roads, children were encouraged to cycle off-road. Researchers examined death and hospitalisation data before and following these initiatives, and found that when children changed their patterns of cycling from school commuting to engaging in off-road sports events, minor injuries and hospitalisations increased, but death and serious injury decreased [71].

Mackie comments that there are likely to be some cultural and socio-economic differences in the uptake of cycling initiatives, and cycling may be more common in less deprived areas [13]. More information is required about the barriers to cycling experienced by children from different ethnic groups.

Increasing the visibility of child cyclists

Conspicuity is the ability of a road user to be seen by other road users, and lack of visibility or conspicuity is an important factor contributing to injury in child cyclist and motor vehicle collisions [37]. Because of their small stature, children are at even greater risk of not being seen, compared with other vulnerable road users [28]. Visibility aids such as brightly coloured clothing, lights and reflectors enhance the conspicuity of cyclists, thereby attracting driver's attention to their presence [72]. However, although visibility aids have been found to improve driver's awareness of adult cyclists, little research has been undertaken investigating the use of visibility aids by child cyclists. Findings from a randomized controlled trial of seven to nine year old children demonstrated that children provided with free visibility aids (reflective or fluorescent slap wraps/wrist or ankle bands, and stickers) and an educational book on road safety significantly increased the use of aids for up to eight weeks after the intervention [73].

Research focusing on conspicuity among New Zealand adults shows promise for the value of reflective clothing and visibility aids to reduce cycling related injuries [74]. Adult cyclists who reported that they 'always' wore florescent clothing had an eightfold reduction in crash risk, compared to those who reported they never wore it.

Feedback from key stakeholders indicates that some cycle skills training programmes in New Zealand provide children with free wrist bands and high visibility jackets, to increase the conspicuity of children on bicycles (pers com, K. Cuthbert, September 2011). However, while conspicuity aids are seen as a valuable part of developing a broader safety culture, programme providers' ability to continue distributing these resources is limited by available programme resources.

Engineering interventions and the impact of the built environment on encouraging safer cycling

Cycling is an important component of active transport policies internationally, and the built environment can have an impact on cycling behaviours. Findings from a systematic review of experimental or observational studies which evaluated the effect of the built environment on cycling identified a range of factors positively associated with cycling, including:

- The presence of dedicated cycle lanes or paths
- Separation of cycling from other traffic
- High population density
- Short trip distance
- Proximity of a cycle path or green space
- Projects for children promoting 'safe routes to school' [75].

Environmental factors which negatively influenced cycling behaviours included perceived and actual traffic danger, long trip distance, steep inclines and distance from cycle paths.

The impact of built environment factors is evident on rates of cycling in New Zealand. Areas with flatter geography, including Nelson, Christchurch, and Palmerston North are experiencing growth in cycling rates [4].

The Ministry of Transport has identified a range of factors that will help New Zealand communities long term strategic planning to increase rates of walking and cycling, including designing for livable urban areas through integrating the following design characteristics:

- Connectivity – a well connected network of neighbourhood streets encouraging cycling, particularly if a range of destinations can be reached within comfortable cycling distance from any point within the neighbourhood. Combining visible connections with traffic-calming strategies that reduce traffic volumes and speeds create safer conditions for cycling. Safety considerations are important to encourage cycling, particularly among children.
- Density – higher density enables a greater number of public amenities to be located within cycling distance, reducing the need for motor vehicle trips. Density needs to be considered alongside connectivity and the quality of the transport network.
- Mixed use – this occurs when a variety of different activities exist in close proximity. When combined with connectivity and safety considerations, mixed use is related to increases in cycling, particularly to work.
- High quality public spaces – a high quality public space environment, combined with area-specific conditions, is related to increases in cycling participation [4].

The international and national literature identifies a number of engineering features that can be used to improve the safety of child cyclists, however a comparison of the effectiveness of engineering safety devices used in New Zealand and internationally concluded that there is no single engineering device that can solve transport safety issues among school aged children [7]. Overall, engineering devices need to be tailored for individual situations and user groups, and take account of the differences between rural and urban settings. Reflecting on what is required to support safer child cycling in the context of safer school travel planning in New Zealand, Wigmore recommended that a toolbox should be developed, which included a process for identifying the unique needs of specific environments, a fit with national standards, policies and guidelines, and which incorporated a matrix of 'best practice' devices to address real and perceived problems [7].

Engineering features that support safety among child cyclists include:

1) Safe crossing places

Crossing the road is an important feature of a child cyclist's journey, particularly to and from school. A number of different types of engineering features can be used to provide a safer crossing place, including Kea crossings, pedestrian crossings, pedestrian refuges, kerb extensions, platforms, and pedestrian fencing [7].

Mackie [13] identified safe crossing places as a very important part of connectivity of cycle routes for children's safe travel to school. He comments that formalized crossings should be bike friendly, and that careful consideration of crossing places is required to see that they are appropriate for children's use, as well as adult cyclists. Sufficient engineering should be incorporated such as wider 'share with care' footpaths to create safe links across residential roading networks, and incorporating signalized crossing on busy arterial roads.

2) Traffic calming measures

Traffic calming is the application of measures to reduce the speed of vehicles, and increase awareness of pedestrians and cyclists. Traffic calming improves safety for all road users, including child cyclists, and can be achieved through a number of measures such as vertical deflections of the road surface (e.g., speed humps, speed tables, rumble strips), horizontal deflections (e.g., chicanes, cycle tracks) or roadside cues (e.g., median islands, road narrowing) [4, 7].

The speed at which a cyclist is hit in a collision with a motor vehicle strongly determines how seriously they will be injured. For example, a cyclist hit at 32 km an hour has a 95 percent chance of survival [4]. However, if they are hit at 48 km per hour, their chance of survival decreases to 55 percent, and if they are hit at 70 km per hour, the survival chance is negligible. Reducing the speed of traffic increases a child's chances of survival if they are involved in a collision with a motor vehicle – the slower the speed the vehicle is travelling at the time of impact, the greater the chances of survival following a collision.

International evidence suggests that traffic calming measures have an impact on child injury risk, including a reduction of approximately 60 percent in the odds of a child being injured or killed when struck by a motor vehicle if a speed hump was located within a block of the child's home [76], as well as an overall reduction in child pedestrian injury rates [77]. Safety related aspects of the road environment also appear to contribute to increased physical activity among children and adolescents, including cycling [78-79].

Around New Zealand, there is increasing interest in developing and implementing initiatives to reduce speeds in suburban roads which contain high numbers of vulnerable road users. Hamilton City Council in partnership with the New Zealand Transport Agency and Waikato Regional Council has developed eight 'safer speed areas' in residential areas, where the speed limit will be reduced to 40 km per hour [80]. The areas have been identified as locations where the risk to vulnerable road users is too high if vehicles travel at the existing speed limit of 50 km per hour. Most of the areas are very close to schools, and other areas that serve a range of community functions as well as a transport function.

In Point England, Auckland, approximately 7 km of roads have been redesigned to become 'self explaining roads', to encourage the roads to be safer and more user-friendly for all road users, including drivers, cyclists, pedestrians and residents [81]. The road environment was changed to incorporate increased landscaping, community islands to limit forward visibility, and removal of road markings to create a visually distinct road environment, and the speed limit was reduced to 30 km per hour. Evaluation of the impact of the intervention demonstrated that three months after implementation, the project appeared to be successful as there was a significant reduction in vehicle speeds (average speed was at or below the anticipated 30km per hour design speed), and there was increased homogeneity of speeds on the intervention roads, as well as on other local roads.

3) School zone restrictions

Internationally, many countries reduce the speed limit around schools, particularly during the high-risk periods immediately before and after school, when the density of children is highest [82]. In New Zealand, active electronic 40km/hour warning signs around schools are becoming more common [17], and the Safer Journeys Strategy identifies them as an action to improve child cyclist safety [35]. The Ministry of Transport recommends that school zones should cover the school gate and the main routes to school used by children as it is the roads and intersections that children have to negotiate that present the greatest risk to their safety [4].

4) Cycle lanes and paths

Cycle lanes and paths separate cyclists from the other road users to various degrees. The greatest degree of separation is achieved through cycle paths, which may be either an exclusive cycle path, a shared path (shared with pedestrians and possibly others), or a separated path (separate sections for cyclists and pedestrians). Overall, cycle paths are more suitable than other facility options for children (see Figure 5).

Safety in numbers and share the road campaigns

The 'safety in numbers' theory suggests that cycling becomes relatively safer as the overall levels of cycling increase, and becomes less safe as participation levels decline. For example, if a community doubles the level of cycling, it is likely that the total number of injuries to cyclists

Figure 5: Suitability of cycle facility options for different cyclist categories

CYCLE FACILITY OPTION	CHILD/ NOVICE	BASIC COMPETENCE	EXPERIENCED
Kerbside cycle lane	🚲🚲	🚲🚲🚲🚲🚲	🚲🚲🚲🚲🚲
Cycle lane next to parking	🚲	🚲🚲🚲🚲	🚲🚲🚲🚲
Contra-flow cycle lane	🚲	🚲🚲🚲🚲	🚲🚲🚲🚲🚲
Wide kerb side lane	🚲🚲	🚲🚲🚲	🚲🚲🚲🚲
Sealed shoulder	🚲🚲	🚲🚲🚲🚲🚲	🚲🚲🚲🚲🚲🚲
Bus lane	🚲	🚲🚲	🚲🚲🚲🚲
Transit lane	🚲	🚲🚲	🚲🚲🚲🚲
Slow mixed traffic	🚲🚲🚲	🚲🚲🚲🚲	🚲🚲🚲🚲🚲
Paths	🚲🚲🚲🚲🚲	🚲🚲🚲🚲	🚲🚲🚲

LEGEND Benefit: 🚲 minimal benefit 🚲🚲🚲 moderate benefit 🚲🚲🚲🚲🚲🚲 most benefit

Source: LTSA 2004

Recipe for 'RIDE ON'

Delivery of a good road safety project is a bit like baking a cake. You have to have the appetite, the right ingredients and method – combined using the right tools, in a balanced and orderly way to get a good result.

This session will take you through how our cake looked in the past, and how poor results and a shortage of key ingredients forced a change of recipe.

Traditionally cycle education in school has been delivered by police education officers. Cycle safety and promotion has been happening in the Nelson and Tasman region - but it was all going on in a rather haphazard way.... This coupled with emergency department data showing that 10-19 year olds are over represented in local bicycle crash data, and a police restructure meaning even fewer PEOS available made it obvious we needed to do things differently.

The RIDE ON programme that has been developed is targeted at 10-14 year olds that includes various elements. These are:

1. Developing cycling skills according to the standards that NZTA and CAN advocate for.
2. Promoting children to think of their bikes as their first road vehicle and working towards a theory test.
3. An interactive safer route planning element which includes a feedback mechanism to councils for improving road engineering.

The goal of the programme is to reduce the risk of cycle crashes in the 10-19 age groups, while promoting better future 15-19 year old road users.

-- Abstract and photos from A *Recipe for Ride On: An Integrated Approach involving Councils, Health, Police and Sport & Recreation*, Nelson City Council.

caused by motor vehicle crashes will increase; however the number will not double since the risk per cyclist reduces [84]. While there appears to be no research directly focusing on the application of the 'safety in numbers' theory to children, New Zealand researchers have applied the estimate of a 34 percent reduction in fatal injury rate for a doubling of cycle usage, and propose substantial health and environmental co-benefits if the bicycle was to replace the car for short trips in urban settings in New Zealand. Lindsay and colleagues note the health gains from regular cycling would be greatest for Māori and Pacific peoples, reflecting the higher baseline mortality rates in these groups [84].

Informed by crash prediction models, Turner and colleagues also suggest that there is a strong safety in numbers effect evident on New Zealand roads [85]. Based on cycle versus motor vehicle injury crash data from Christchurch, Palmerston North and Hamilton, evidence suggests that cyclists are safer on routes that are well used by other cyclists. Cyclists are likely to be at less risk of injury in cities, towns and parts of urban areas that have a higher proportion of trips by cyclists, because drivers appear to be more regularly observing cyclists and more aware of their needs [85]. However, it is important to note that the environments in these cities are largely flat, which also influences cycling participation.

Overall, many road users appear to be unaware of the road rules relating to cyclists. 'Share the road' programmes have been initiated to support the development of a road user culture where a range of road users, including drivers, cyclists and pedestrians are aware of, and respect each other's needs [4]. Overall, road users seem to be unaware that cyclists are not allowed to ride on the footpath, are allowed to ride two abreast (subject to some restrictions), and are not required to use shared paths and cycle lanes. This general lack of awareness may also contribute to the risk of injury for child cyclists in some locations.

5. Safekids Recommendations

Safekids New Zealand recommends that the following interventions are supported to reduce the risk of injury and death to child cyclists.

1. Bicycle helmets

Bicycle helmets are effective in protecting child cyclists against head, brain and facial injuries. Children and parents need to be supported with ongoing education and awareness campaigns to ensure that bicycle helmets are appropriately fitted and correctly worn. Helmet wearing appears to decrease among older children, and community based interventions should be targeted to appropriately reach older children to ensure they continue to consistently wear bicycle helmets.

2. Bicycle skills training

Cycling skills training has a positive effect in increasing knowledge and improving observed riding skills in children who receive training. The implementation of a nationwide cycle skills training programme is an important component of supporting the development of confident and capable cyclists, and has the potential to contribute to reductions in injury deaths and hospitalisations for child cyclists. Children and communities are encouraged to participate in the NZTA Cycle Skills training programme.

Children under 10 years of age should not cycle on the road unless accompanied by a competent adult cyclist, and careful consideration should be given to the skills of the child, the traffic environment, and their road rule knowledge. Children cycling on the pavement should be encouraged to cycle slowly (at an adult jogging or walking pace), and be alert to risks including pedestrians and cars moving across the pavement from driveways. Acknowledging the increased injury risk for children aged 11-14, especially boys, careful supervision alongside bicycle skills training is recommended to support children who transition to cycling on roads.

3. Enhancing the safer use of bicycles as part of children's active travel

Integrating safe and user-friendly cycle routes to schools is an important part of school travel plans. A national level policy is required to support school travel plans, and to identify opportunities to support children to cycle to school while not increasing the risk for cycling related injuries for child cyclists.

4. Increasing the visibility of child cyclists

Because of their smaller stature, children are at increased risk of not being seen by other road users, and lack of visibility or conspicuity is an important factor contributing to injury in child cyclist and motor vehicle collisions. Visibility aids such as bright coloured clothing, high visibility or reflective clothing, lights and reflectors aid the visibility of child cyclists, and child cyclists should be encouraged to wear visibility aids to make it easier for other road users to see them.

5. Engineering interventions and the impact of the built environment on encouraging safer cycling

There are a range of engineering features that support safety for child cyclists, including the development of safe crossing places (particularly on routes to schools), traffic calming measures, school speed zone restrictions, and cycle lanes and paths. When planning urban design, Local Authorities are encouraged to implement these features to reduce the risk of injury to child cyclists (as well as other vulnerable road users).

Reducing the speed limit on urban roads is an effective intervention to reduce the risk of child cyclist injuries, as well as the risk of injuries to child pedestrians and other vulnerable road users. Local authorities are encouraged to implement further initiatives to reduce speeds on roads which are used by child cyclists.

Local authorities are encouraged to develop safe crossing places for children as part of the connectivity of cycle routes for children's safe travel to school and other areas around their communities. Safe crossing places for children will require careful consideration to ensure that they meet the needs of children, which are different to the needs of adult cyclists.

Local authorities are also encouraged to develop cycle lanes and paths to separate child cyclists from motor vehicles. Separate cycle lanes and paths will provide protection for child cyclists (and other novice cyclists), and are likely to support increased participation in cycling by children and their families/whanau. In addition, communities are encouraged to support 'share the road' campaigns, to create a road user culture where there is increased awareness between drivers and cyclists of each other's needs.

Appendix 1: Position Paper Literature Review Methods

A search of electronic databases was undertaken by the Safekids Information Specialist. Combinations of the following search terms were used to identify relevant materials:

Child; children; bike; bicycle; cyclist; cycling; injury; injuries.

The following data bases were included in the search: Medline; Cochrane; SafetyLit and the Safekids New Zealand in-house catalogue and database.

The criteria for inclusion in the position paper were documents published from 2005 onwards, as well as seminal references published earlier. The review was limited to information published in English.

The initial search generated over 500 documents which were assessed against the following concepts:

- Currency – how the document could build on and support existing information held by Safekids;
- Source – potential sources of information were identified and prioritised, including academic data bases and sources of unpublished literature (e.g., conference proceedings);
- Reliability and validity – all materials collected were critically reviewed, ensuring they were obtained from credible sources and were appropriate to the project's purpose; and
- Coverage and relevance – relevance was ensured by assessing that materials included in the review were appropriate to the project's purpose.

Documents were excluded if they did include children in the study population. Priority was given to including evidence from countries with similar cycling environments and policy contexts to New Zealand, such as Australia, Canada, UK and the USA.

Reference lists of relevant papers were also searched to identify additional documents which were assessed for suitability to be included in the position paper. This approach was particularly useful to identify reports and other documents which did not appear in initial searches of peer-reviewed data bases.

Information was sought from other libraries and non-government agencies which focus on cycling safety, including TransInfo (the Australian and New Zealand network of transport libraries) and CAN (Cycling Advocates Network).

Appendix 2: Bicycle Helmet Legislation

The Land Transport (Road User) Rule 2004, part 11 states:

11.8 Safety helmets for cyclists

(1) a person must not ride, or be carried on, a bicycle on a road unless the person is wearing a safety helmet of an approved standard that is securely fastened.

(2) The approved standards for safety helmets are –

a) AS/NZS 2063, Pedal Cycle Helmets or

b) NZS 5439, Pedal Cycle Helmets or

c) AS 2063.2 Pedal Cycle Helmets or

d) any safety helmet manufactured to the Snell standard for protective headgear for use with bicycles, or

e) any safety helmet manufactured to ASTM F1447 or

f) any safety helmet manufactured to the Consumer Product Safety Commission for Bicycle Helmets (reference 16CFR) Part 1203, complying with the SPSC certification process.

(3) A safety helmet must comply with the version of an approved standard for safety helmets that is –

a) applicable to the relevant standard-setting jurisdiction to the date of manufacture of the safety helmet or as specified in the standard, or

b) a more recent version of the standard if the safety performance of the safety helmet is not adversely affected.

(4) An approval of a safety helmet under the Traffic Regulations 1976 that was published in the Gazette before 27 February 2005 remains valid after this rule comes into force

(5) A person riding a cycle that is towing a trailer must ensure that every person carried on the trailer is wearing a safety helmet of an approved standard that is securely fastened.

(6) A person riding, or being carried on, a cycle on a road who is stopped by an enforcement officer must, if so requested by that or any other enforcement officer, produce for inspection by the officer the person's safety helmet or proof of the exemption granted under subclause (7).

(7) Subclauses (1) and (5) do not apply to a person if the Agency grants the person a written exemption from the requirement to wear a safety helmet on the grounds of religious belief or physical disability or other reasonable grounds

(8) The Agency may at anytime revoke in writing an exemption granted under subclause (7).

(9) The Agency may, by notice in the Gazette, approve types of safety helmets for use under this clause.

(10) In proceedings for an offence of breaching this clause, proof that a safety helmet worn by the defendant did not bear a standard specification mark or registered trademark is, until the contrary is proved, sufficient evidence that the helmet was not of an approved standard.

References

1. S. Tin Tin, A. Woodward and S. Ameratunga, "Injuries to pedal cyclists on New Zealand roads, 1988-2007." *BMC Public Health, 2010*. 10(655).

2. T. Mehan, R. Gardner, G. Smith and L. McKenzie, "Bicycle-related injuries among children and adolescents in the United States." *Clinical Pediatrics*, 2009. 48(166): p. 166-173.

3. New Zealand Bicycle Import Statistics. Available from: http:www.bianz/org/nz/default.asp?PageID=9326.

4. Ministry of Transport. *Raising the profile of walking and cycling in New Zealand: a guide for decision makers.* Wellington, Ministry of Transport, 2008.

5. Ministry of Transport. *Comparing travel modes. Household travel survey v2 revised November 2009.* Wellington, Ministry of Transport, 2010.

6. New Zealand Transport Agency. *Bicycle Crashes in the Auckland Region.* Wellington, New Zealand Transport Agency, 2010.

7. B. Wigmore, C. Baas, W. Wade and P. Baas. *School journey safety: a comparative study of engineering devices.* Wellington, Land Transport New Zealand, 2006.

8. Safekids New Zealand. *Analysis of Unintentional Child Injury Data in New Zealand.* Auckland, Safekids New Zealand, 2009.

9. VicHealth. *Children and Play: fact sheet.* Melbourne, Victorian Health Promotion Foundation, 2006.

10. P. Agran and D. Winn, "The Bicycle: a developmental toy versus a vehicle." *Pediatrics*, 1993. 91(4): p. 752-755.

11. V. Briem and K. Radeborg, "Developmental aspects of children's behaviour and safety while cycling." *Journal of Pediatric Psychology*, 2004. 29(5): p. 369-377.

12. New Zealand Transport Agency. *Cyclist skills training. A guide for the set-up and delivery of cyclist skills training in New Zealand.* Wellington, New Zealand Transport Agency, 2011.

13. H. Mackie. *I want to ride my bike: overcoming barries to cycling to intermediate schools. New Zealand Transport Agency Research Report* 380. Wellington NZTA, 2009.

14. K. Davison, J. Werder and C. Lawson, "Children's active commuting to school: current knowledge and future directions." *Public Health Research Practice and Policy*, 2008. 5(3): p. 1-11.

15. D. Lubans, C. Boreham, P. Kelly and C. Foster, "The relationship between active travel to school and health-related fitness in children and adolescents: a systematic review." *International Journal of Behavioural Nutrition and Physical Activity*, 2011. 8(5): p. 1-12.

16. L. Anderson, N. Wedderkopp, P. Kristensen, N. Moller, K. Froberg and A. Cooper, "Cycling to school and cardiovascular risk factors: A longitudinal study." *Journal of Physical Activity and Health*, 2011. 8: p. 1025-1033.

17. H. Mackie. *Improving school travel systems. New Zealand Transport Research Report 420.* Wellington NZTA, 2010.

18. F. Rivara and R. Sattin, "Preventing bicycle-related injuries: next steps." *Injury Prevention*, 2011. doi:10.116/injryprev-2011-040046.

19. Injury Prevention Research Unit. *Child injury: deaths and hospitalisations. Fact Sheet no. 40*. Dunedin, University of Otago, 2007.

20. T. Lorenc, G. Brunton, S. Oliver, K. Oliver and A. Oakley, "Attitudes to walking and cycling among children, young people and parents: a systematic review." *Journal of Epidemiology and Community Health*, 2008. 62: p. 852-857.

21. A. Timperio, D. Crawford, A. Telford and J. Salmon, "Perceptions about the local neighbourhood and walking and cycling among children." *Preventive Medicine*, 2004. 38: p. 39-47.

22. D. Soole, A. Lennon and N. Haworth, "Parental beliefs about supervising children when crossing roads and cycling." International *Journal of Injury Control and Safety Promotion*, 2011. 18(1): p. 29-36.

23. J. Panter, A. Jones and E. van Sluijs, "Environmental determinants of active travel in youth: a review and framework for future research." *International Journal of Behavioural Nutrition and Physical Activity*, 2008. 5: p. 34-48.

24. Unpublished child cyclist injury hospital admissions 2005-2009 and mortality data 2001-2005 from the Injury Prevention Research Unit, University of Otago, Dunedin, 2011.

25. Safekids New Zealand. *Factsheet: Child Cyclist Injury.* Auckland, Safekids New Zealand, 2007.

26. New Zealand Transport Agency. *Cyclists: Crash Fact Sheet 2010.* Wellington, New Zealand Transport Agency, 2010.

27. Unpublished child cyclist injury data 2006-2010 New Zealand Child and Youth Epidemiology Service, Otago School of Medicine, University of Otago, Dunedin, 2011.

28. M. Peden, K. Oyegbite, J. Ozanne-Smith, A. Hyder, C. Branche, K. Rahman, F. Rivara and K. Bartolomeos. *World Report on Child Injury Prevention*. Geneva, World Health Organisation, UNICEF, 2008.

29. P. Jacobson, "Safety in numbers: more walkers and bicyclists, safer walking and bicycling." *Injury Prevention*, 2003. 9: p. 205-209.

30. Ministry of Transport. *How New Zealanders travel: trends in New Zealand household travel 1989-2008*. Wellington, Ministry of Transport, 2009.

31. N. Christie, S. Cairns, E. Towner and H. Ward, "How exposure information can enhance our understanding of child traffic "death leagues"." *Injury Prevention*, 2007. 13: p. 125-129.

32. T. Hutchinson, C. Kloeden and A. Long, "Child cyclist traffic casualties: The situation in South Australia." *Journal of the Australasian College of Road Safety*, 2010. August 2010: p. 44-55.

33. B. Sonkin, P. Edwards, I. Roberts and J. Green, "Walking, cycling and transport safety: an analysis of child road deaths." *Journal of the Royal Society of Medicine*, 2006. 99(August): p. 402-405.

34. L. Oliver and D. Kohen, "Neighbourhood income gradients in hospitalisations due to motor vehicle traffic incidents among Canadian children." *Injury Prevention*, 2009. 15: p. 163-169.

35. Ministry of Transport. *Safer Journeys: New Zealand's Road Safety Strategy 2010-2020*. Wellington, Ministry of Transport, 2010.

36. Ministry of Transport. *Safer Journeys: Action Plan 2011-2012*. Wellington, Ministry of Transport, 2011.

37. S. Planitzer and C. Kormer. *Good and promising interventions for the prevention of injuries to pedestrians and two-wheelers: inventory and guide for the health sector*. Vienna, Austrian Road Safety Board, 2009.

38. P. Scuffham, J. Alsop, C. Cryer and J. Langley, "Head injuries to bicyclists and the New Zealand bicycle helmet law." *Accident Analysis & Prevention*, 2000. 32: p. 565-573.

39. B. Hagel, J. Rizkallah, A. Lamy, K. Belton, G. Jhangri, N. Cherry and B. Rowe, "Bicycle helmet prevalence two years after the introduction of mandatory use legislation for under 18 year olds in Alberta, Canada." *Injury Prevention*, 2011. 12: p. 262-265.

40. D. Thompson, F. Rivara and R. Thompson, "Helmets for preventing head and facial injuries in cyclists." *Cochrane Database of Systematic Reviews*, 2009. 4.

41. A. Macpherson and A. Spinks, "Bicycle helmet legislation for the uptake of helmet use and prevention of head injuries." *Cochrane Database of Systematic Reviews*, 2008. 3.

42. D. Thompson, F. Rivara and R. Thompson, "Helmets for preventing head and facial injuries in cyclists." *Cochrane Database of Systematic Reviews*, 1999. 4.

43. S. Thomas, C. Acton, J. Nixon, D. Baltislutta, W. Pitt and R. Clark, "Effectiveness of bicycle helmets in preventing injury in children: case control study." *British Medical Journal*, 1994. 308: p. 173.

44. S. Thomas, C. Acton, J. Nixon, D. Baltislutta, W. Pitt and R. Clark, "Effectiveness of bicycle helmets in preventing injury in children: case control study." *British Medical Journal*, 1994. 308: p. 173-176.

45. L. Buckley, M. Sheehan and R. Chapman, "Bicycle helmet wearing among adolescents." *Transportation Research Record: Journal of the Transportation Research Board*, 2009. 2140: p. 173-181.

46. L. Povey, W. Frith and P. Graham, "Cycle helmet effectiveness in New Zealand." *Accident Analysis & Prevention*, 1999. 31: p. 763-770.

47. Ministry of Transport. Transport Safety and Security: Road user behaviour. 2011 [cited 2011 December]; Available from: http://www.transport.govt.nz/ourwork/TMIF/SS020/.

48. N. Haworth, A. Schramm, M. King and D. Steinhardt. *Bicycle Helmet Research. CARRS-Q Monograph 5*. Brisbane, QUT, CARRS-Q, 2010.

49. M. Karkhaneh, J. Kalenga, B. Hagel and B. Rowe, "Effectiveness of bicycle helmet legislation to increase helmet use: a systematic review." *Injury Prevention*, 2006. 12: p. 76-82.

50. P. Parkin and A. Howard, "Advances in the prevention of children's injuries: an examination of four common outdoor activities." *Current Opinions in Pediatrics*, 2008. 20: p. 719-723.

51. S. Royal, D. Kendrick and T. Coleman, "Non-legislative interventions for the promotion of cycle helmet wearing by children." *Cochrane Database of Systematic Reviews*, 2005. 2.

52. T. Corden, N. Tripathy, S. Pierce and M. Katcher, "The role of the health care professional in bicycle safety." *Wisconsin Medical Journal*, 2005. 104(2): p. 35-38.

53. J. Chen, M. Kresnow, T. Simon and A. Dellinger, "Injury prevention counseling and behaviour among US school children: results from the second Injury Control and Risk Survey." *Pediatrics*, 2007. 119: p. e958-e965.

54. J. Vardy, E. Clinton and A. Graham, "Audit of an intervention to decrease cycle related head injuries in primary school children." *Injury Prevention*, 2006. 12: p. 271-272.

55. K. Klein, D. Thompson, P. Scheidt, M. Overpeck and L. Gross, "Factors associated with bicycle helmet use among young adolescents in a multinational sample." *Injury Prevention*, 2005. 11: p. 288-293.

56. F. Rivara, S. Astley, S. Clarren, D. Thompson and R. Thompson, "Fit of bicycle safety helmets and risk of head injuries in children." *Injury Prevention*, 1999. 5: p. 194-197.

57. B. Hagel, R. Lee, M. Karkhaneh, D. Voaklander and B. Rowe, "Factors associated with incorrect bicycle helmet use." *Injury Prevention*, 2010. 16: p. 178-184.

58. M. Taylor and P. Scuffham, "New Zealand bicycle helmet law - do the costs outweigh the benefits?" *Injury Prevention*, 2002. 8: p. 317-320.

59. P. Fuselli and A. Wanounou, "Canada and the World: A comparative approach to injury prevention." *Healthcare Quarterly*, 2011. 14(3): p. 84-89.

60. New Zealand Transport Agency. *Cyclist Skills Training: Summary of the Guide*. Wellington, NZTA, 2010.

61. K. McLaughlin and A. Glang, "The effectiveness of a bicycle safety program for improving safety-related knowledge and behaviour in young elementary students." *Journal of Pediatric Psychology*, 2010. 35(4): p. 343-353.

62. S. Babu, T. Grechkin, B. Chihak, C. Ziemer, J. Kearney, J. Cremer and J. Plumert, "An immersive virtual peer for studying social influences on child cyclists' road crossing behaviour." *IEEE Transactions on Visualisation and Computer Graphics*, 2011. 17(1): p. 14-25.

63. J. Plumert, J. Kearney, J. Cremer, K. Recker and J. Strutt, "Changes in children's perception-action tuning over short time scales: Bicycling across traffic-filled intersections in a virtual environment." *Journal of Experimental Child Psychology*, 2011. 108: p. 322-337.

64. M. MacKay, J. Vincenten, M. Brussoni, E. Towner and P. Fuselli. *Child Safety Good Practice Guide: Good investments in unintentional child injury prevention and safety promotion - Canadian Edition*. Toronto, The Hospital for Sick Children, 2011.

65. New Zealand Transport Agency. Curriculum. 2011 [cited 2011 September]; Available from: http://education.nzta.govt.nz/curriculum.

66. New Zealand Transport Agency. Cycle Safety. 2011 [cited 2011 September]; Available from: http://education.nzta.govt.nz/curriculum/cycle-safety.

67. G. Schofield, S. Gianotti, H. Baldland and E. Hinckson, "The incidence of injuries traveling to and from school by travel mode." *Preventive Medicine*, 2008. 46: p. 74-76.

68. P. Chillon, K. Evenson, A. Vaughn and D. Ward, "A systematic review of interventions for promoting active transportation to school." *International Journal of Behavioural Nutrition and Physical Activity*, 2011. 8(10): p. 1-17.

69. E. Hinckson, N. Snowling, P. Batts, H. Badland and G. Schofield. *Auckland Regional Transport Authority school travel plan evaluation*. Auckland, AUT University, 2007.

70. C. O'Fallon. *Developing school-based cycle trains in New Zealand*. Land Transport New Zealand Research Report 338. Wellington, Land Transport New Zealand, 2007.

71. S. Moyes, "Changing pattern of child bicycle injry in the Bay of Plenty, New Zealand." *Journal of Pediatrics and Child Health*, 2006. 43: p. 486-488.

72. I. Kwan and J. Mapstone, "Interventions for increasing pedestrian and cyclist visibility for the prevention of death and injuries." *Cochrane Database of Systematic Reviews*, 2006. 4.

73. C. Mulvaney, D. Kendrick, M. Watson and C. Coupland, "Increasing child pedestrian and cyclist visibility: cluster randomised controlled trial." *Journal of Epidemiology and Community Health*, 2006. 60: p. 311-315.

74. S. Thornley, A. Woodward, J. Langley, S. Ameratunga and A. Rodgers, "Conspicuity and bicycle crashes: preliminary findings of the Taupo Bicycle Study." *Injury Prevention*, 2008. 14: p. 11-18.

75. S. Fraser and K. Lock, "Cycling for transport and public health: a systematic review of the effect of the environment on cycling." *The European Journal of Public Health*, 2011. 21(6):738-743

76. J. Tester, G. Rutherford, Z. Wald and M. Rutherford, "A matched case-control study evaluating the effectiveness of speed humps in reducing child pedestrian injuries." *American Journal of Public Health*, 2004. 94: p. 646-650.

77. R. Petch and R. Henson. *Child traffic safety in urban areas*. Manchester, Telford Research Institute, University of Salford, 1999.

78. A. Carver, A. Timperio, K. Hesketh and D. Crawford, "Are safety-related features of the road environment associated with smaller declines in physical activity among youth?" *Journal of Urban Health*, 2010. 87(1): p. 29-43.

79. A. Carver, A. Timperio and D. Crawford, "Neighbourhood road environments and physical activity among youth: the CLAN study." *Journal of Urban Health*, 2008. 85(4): p. 532-544.

80. Hamilton City Council. Safer Speed Area. 2011 [cited 2011 September]; Available from: http://saferspeedarea.org.nz/.

81. Mackie research and consulting. Self Explaining Roads. 2011 [cited 2011 September]; Available from: http://www.mackieresearch.co.nz/self-explaining-roads/.

82. European Transport Safety Council. *Child Safety in the UK*. Brussels, European Transport Safety Council, 2005.

83. Land Transport Safety Authority. *Cycle Network and Route Planning Guide*. Wellington, LTSA, 2004.

84. G. Lindsay, A. Macmillan and A. Woodward, "Moving urban trips from cars to bicycles: impact on health and emissions." *Australian and New Zealand Journal of Public Health*, 2010. 35(1): p. 54-60.

85. S. Turner, G. Wood, Q. Luo, R. Singh and T. Allatt, "Crash prediction models and the factors that influence cycle safety." *Journal of the Australasian College of Road Safety*, 2010. 2010. 21(3): p. 26-36

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