Getting to School: Factors affecting choice of active travel modes in the trip to school

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Abstract

Active transport (walking and cycling) to school offers children an opportunity to become more active and enjoy regular exercise, while performing a functional journey. At a time when obesity is an increasing issue, active transport has the potential to provide exercise for children rather than travel in a car and provide a chance to develop independence and self-confidence. The environmental benefits of reduced pollution, noise and congestion around schools have been well documented. The literature reveals numerous individual, social and environmental factors that influence children’s active transport.

Rates of active transport have steadily declined in New Zealand and the aim of this dissertation was to examine the many influences on decision making for children’s active transport to school and to explore what factors are most important in determining their choice of mode of transport.

Using data from the Activating Communities to Improve Vitality and Equity (ACTIVE) study, the journeys to school of children between ten and eighteen years of age and their parents/caregivers, living in Hastings, New Plymouth, Masterton and Whanganui, were explored. Google Maps Street View was used to measure the children’s distance to school and the numbers of arterial roads children either travelled along or crossed on their journey to school. Observational analysis was presented in tabular form with descriptive text and regressions undertaken to determine whether potential relationships existed between active transport and factors that may have influenced behaviour.

In the current study, in concordance with other studies, a shorter distance between home and school was the strongest predictor of active travel mode choices. Approximately half the children in the study used active transport and of those 57% lived within two kilometres of their school. Those children who used active transport were more likely to attend the closest school to their home (78%) compared to those that travelled to school by car (43%). An increase in the number of arterial roads either traversed or crossed on the journey decreased the likelihood of active transport. Children that used active transport were more likely to have a parent who did
moderate or vigorous exercise and although adult access to a functioning bicycle was high among both children and adults, their utilisation was low.

Public health efforts to increase rates of active transport to school may need to focus on encouraging the attendance of children at the nearest school to their home if the barrier of distance (either perceived or real) is to be addressed.
Acknowledgements

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My supervisors, Michael Keall and Philippa Howden-Chapman, for their incredible depth of knowledge, insights and encouragement. They have given freely of their time, despite busy schedules and their own work commitments.

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Chapter one: Introduction

1. Overview of dissertation

Active transport (walking and cycling) to school by children has been promoted by governments and health agencies for a number of positive reasons, not least of which is, the health advantages of regular exercise, particularly at a time when obesity among children is increasing. The opportunity for children to develop independence can be added to the physical benefits for children. There are also environmental benefits in walking and cycling in terms of reduced air and noise pollution when car use is simultaneously decreased. Active transport has the potential to reduce traffic congestion around schools as well as lessen the impact of school traffic on overall transport flow. However, despite these evident benefits, the rates of active transport have decreased over the last 20-30 years and in its place the motor vehicle has been more widely used as a means of transporting children to school.

This dissertation was conducted to look at the multiple factors that influence the decisions that are made about a child’s mode of transport to school. Much of the literature on factors influencing active transport is in overseas literature and there are little data on the determinants of transport modes to school in New Zealand. Data collected in the ACTIVE study on households in Hastings, New Plymouth, Masterton and Whanganui from both children and adults provides an opportunity to examine the behaviours of children and adults, their views on cycling and the factors that most influence the decisions based around active transport.

The dissertation is divided into the following chapters. Chapter Two is the literature review. The literature has been investigated to understand the way in which a number of interconnected factors influence parental decision-making about whether to allow a child to cycle or walk to school. The parent, as gatekeeper, is required to weigh a number of associated factors: safety concerns (perceived or real) with the benefits of active transport; the availability of infrastructure to support the journey; and parental needs, such as work commitments. There are a number of demographic characteristics which may impact on the decision making process, such as socioeconomic status and
gender. Environmental factors also play a part, but there are a number of difficulties in assessing and measuring the “walkability” of a neighbourhood. The comprehensive approach required to increase rates of active transport presents a challenging agenda for New Zealand, especially as there are few proven interventions for increasing rates.

Chapter Three describes the methods used in this dissertation, which is a sub-analysis of the Activating Communities To Improve Vitality and Equality (ACTIVE) Study. The ACTIVE study was established to evaluate the success of the New Zealand Transport Authority’s (NZTA) funded model communities (urban environments where walking and cycling are offered to the community as the easiest transport choice) in Hastings and New Plymouth. Two control cities, Masterton and Whangai, have been used in the quasi-experimental study.

Data were collected from adults and children by the survey primarily to measure the impact of the initiative in the model communities. For the current study, data from all four cities were also used to explore children’s modes of transport to school and the distances travelled. Parental behaviour in terms of their travel mode to work and exercise behaviours, car and bicycle ownership and use were analysed to understand what factors might influence decision making.

This chapter describes the methods used to obtain and analyse data about the children and their parents in the ACTIVE study and the statistical methods used.

The results are presented in Chapter Four. Three case studies provided an understanding of the data in the context of households as opposed to individual children’s mode of transport to school. Descriptive analysis is provided of the factors influencing decisions about children’s active transport to school.

In Chapter Five, the discussion chapter, the main findings are discussed, the strengths and weaknesses of the methodology and data are explored and suggestions for further research are proposed.
2. Dissertation aims

The aim of this study was to explore the factors that influenced a child’s choice of mode of transport for their journey to and from school in two model communities, Hastings and New Plymouth, and two control cities, Masterton and Whanganui.

The objectives were to:

- explore children’s mode of transport (walking, cycling or by car) to school in relation to the distance from their home to the school;
- describe the nature of their travel routes along or through arterial roads;
- examine the relationship between active transport to school and demographic variables including, gender, age and socio-economic status;
- identify the choice of mode of transport to work for the parents/caregivers of the children and compare this to the children’s mode of transport to school;
- explore the amount of exercise taken (either walking or cycling) by the parents/caregivers and any relationship between their level of activity and their children’s mode of transport to school; a
- explore the degree of access to a functioning bike and access to a car in relationship to active transport mode choices to school and work.
Chapter 2: Literature Review

2.1 The benefits of active transport

At least 60 minutes of moderate to vigorous intensity physical activity daily has been recommended for children and young people between five and 17 years of age (World Health Organization, 2011). These recommended physical activity levels could be achieved through various combinations of play, recreation, and sport, as well as walking or cycling between destinations; the latter two activities are often referred to as active travel, and have the potential to make a substantial contribution to children’s daily physical activity (Garrard 2009).

Increasingly New Zealand school aged children are being driven to school. In 1989/90, children driven to school made up 31% of primary school students, but this increased to 45% in 1997/98, and 58% in 2007–11 (Ministry of Transport, 2012). Additionally the 2006/07 New Zealand Health Survey reported that one in twelve children aged between two and 14 were obese and one in five were overweight, rates that had remained constant since 2002 (Ministry of Health, 2008). In this context, active transport could have individual, social and environmental benefits.

2.1.1 Individual

Studies have consistently shown a positive relationship between cycling and health (Oja, 2011; Moller, 2011). Even for subjects with low initial fitness, frequently cycling short distances (minimal daily distance of six kilometres three times per week) is enough to improve physical performance (Hendriksen, 2000). Cycling and walking to school has been found to be associated with higher levels of physical activity and cardio-vascular fitness compared to passive means of transport to school (Cooper, 2006; Davison, 2008; Sirard, 2005).

Only a small number of studies have examined the association between active transport and BMI and cardiovascular fitness. The European Youth Heart Study reported that children who cycled to school were nearly five times more likely to be in the top quartile for fitness than those that walked or used motorised transport (Cooper, 2006).
Walking and cycling may reduce the incidence of seven conditions (diabetes, ischaemic heart disease, cerebrovascular disease, breast and colon cancers, Alzheimer’s disease and depression), all of which have been associated with minimal physical activity (Woodcock, 2009). The establishment of regular physical activity and exercise during childhood has been shown to continue on into adulthood and is therefore more likely to produce long-term health benefits (Kjonniksen, 2008).

Children who are constantly chauffeured in cars are therefore not only establishing habitual dependence on cars, but are also being denied the opportunity of freedom to move about unaccompanied by adult supervision (Hillman, 1993). Independent mobility for children has the potential to develop motor, spatial and practical coping skills, build local environmental knowledge and self-esteem, and assist in acquiring a sense of identity (Zubrick et al, 2010).

2.1.2 Social
Cycling appears to be a relatively uncommon activity in New Zealand, rather than a practical, cheap, convenient and possibly faster means of regular transport. However in countries with high rates of walking and cycling, active travel tends to be a part of daily life across the population. Cycling is a means of transport and exercise open to all age groups and economic circumstances as is evident in European countries such as the Netherlands, Denmark and Germany where all segments of society participate (Pucher, 2010).

It has been suggested that increased active travel, and consequent reduced motor vehicle use, confers additional benefits including community strengthening through increased social interactions on neighbourhood streets (Garrard, 2009). Unplanned interactions are more likely to occur and increase the opportunity of greater social ties (Lund, 2003).

In an evaluation of an Auckland walking school bus, one of the perceived main benefits of the programme was the social aspects of participation, which encouraged greater community cohesion (Kearns, 2004). The increased presence of people on streets has the potential to reduce social isolation and lack of accessibility to services, allowing children the opportunity of more independent mobility and exploration of their
neighbourhood. Restrictions on children’s spatial freedom have been linked to poor environmental knowledge, less competence and confidence and slower emotional development (Pain, 2001).

2.1.3 Environmental

Both walking and cycling are environmentally sustainable transport methods, which do not pollute the atmosphere and require much less space in terms of land use than any form of motorised transport. Transport is over 95% oil-dependent and accounts for 14% of global greenhouse gas emissions (Woodcock, 2007). The effect of air pollution on health in cities is substantial causing approximately 1.3 million deaths a year (WHO, 2011b). A transition to a low carbon transportation system could both reduce climate change and achieve health co-benefits for the population. Increased active transport in urban areas apart from having the potential to reduce carbon dioxide can also reduce ozone emissions and reduce fine particulate air pollution (Haines, 2012). Reducing vehicle emissions through improved vehicle technology has been marked and considerable effort has been directed at fuel content. However, this is now being offset by increased vehicle kilometres travelled despite rising oil prices (Longley, 2010).

Journeys that are relatively short in distance could feasibly be done by cycling or walking. The New Zealand Travel Survey for 2003-06 reported that: three quarters of vehicle trips in urban areas were seven kilometres or less; two thirds were five kilometres or less; and about 31% were two kilometres or less (Ministry of Transport, 2007). Moving just five per cent of vehicle trips of seven kilometres or less to bicycling would save about 22 million litres of fuel a year and cut 0.4% of all transport-related greenhouse gas emissions (Woodward and Lindsay, 2010).

2.2 Current rates of active transport

In New Zealand, cycling is an infrequently used mode of transport and represents only two per cent of total travel time for the population (Tin Tin, 2010), while walking makes up 13% of the total (Ministry of Transport, 2011). In terms of active transport, for those between five and 17 years of age, 31% of cycling time is spent travelling for education (Ministry of Transport, 2011).
The highest rates of cycling for children are in the Netherlands, Germany and Denmark, where the rates are more than ten times higher than in the UK and the USA (See Table 1). Unlike most countries, cycling in the Netherlands is evenly distributed across genders, age groups and socio-economic groups (Pucher, 2010).

Table 1. Recent rates of active transport (AT): a comparison of countries

<table>
<thead>
<tr>
<th>Location</th>
<th>Author/Year</th>
<th>Participants/age groups</th>
<th>Current rates of cycling and walking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dunedin, New Zealand</td>
<td>Yelavich, 2008</td>
<td>Primary school children</td>
<td>47.4% walked to or from school less than three times a week</td>
</tr>
<tr>
<td>Switzerland</td>
<td>Bringolf-Isler, 2007</td>
<td>9/10 6/7 13/14</td>
<td>AT significantly more common in 9/10 year olds (88.2%) than in 6/7 year olds (75.6%) and 13/14 year olds (68.9%)</td>
</tr>
<tr>
<td>U.S.A</td>
<td>Martin, 2005</td>
<td>5-11 12-18</td>
<td>Children aged 5-11 years old were more likely to walk to school than those aged 12-18 (18.7% versus 15.3%)</td>
</tr>
<tr>
<td>U.S.A</td>
<td>Fulton, 2005</td>
<td>7-9 9-11 12-14</td>
<td>14% reported AT to school. Rates were higher in 7-9 year olds (20.5%) and in 9-11 year olds (12.4%) versus only 8% in the older 12-14 year olds.</td>
</tr>
<tr>
<td>Alberta, Canada</td>
<td>Carson, 2010</td>
<td>9/10</td>
<td>39% of students used AT to school</td>
</tr>
<tr>
<td>Ontario, Canada</td>
<td>Larsen, 2009</td>
<td>11-13 (that lived within one mile of school)</td>
<td>62% used AT to school and 72% from school to home</td>
</tr>
<tr>
<td>Country</td>
<td>Source</td>
<td>Age Group</td>
<td>Findings</td>
</tr>
<tr>
<td>------------------</td>
<td>---------------------------------</td>
<td>-----------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>Ireland</td>
<td>Nelson, 2008</td>
<td>15-17</td>
<td>Approximately one third of adolescents aged 15-17 use AT to school: 32.2% walk and 5.3% cycle.</td>
</tr>
<tr>
<td>Netherlands</td>
<td>Ministry of Transport, Public Works and Water Management, 2009</td>
<td>School children</td>
<td>Of primary school children, 49% cycle, 37% walk and only 14% are brought and collected by car. In secondary school, the cycling share is even higher. However in the larger cities, there is more walking and a greater use of public transport.</td>
</tr>
<tr>
<td>Denmark</td>
<td>Pucher, 2010</td>
<td>School children</td>
<td>45% of all school children bike to school</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>Gill, 2005</td>
<td>School children</td>
<td>Only 1% of primary school children and 2% of secondary school children cycle to school.</td>
</tr>
</tbody>
</table>

### 2.2.1 Socio-economic status (SES)

Walking and cycling show varying trends among different socio-economic groups. In Melbourne, Australia there was an 80% decline in the proportion of children cycling to school between 1985 and 2001. The decline was greater among children attending schools in low SES areas (77%) compared with children in high SES areas (just under 50%) (Salmon, 2005). The high SES children were 1.7 times more likely in 1985 to walk to school compared to children from low SES areas, but by 2001 children from low SES areas were walking more often than those from high SES areas.

### 2.2.2 Culture

There also appear to be cultural differences in the prevalence of car use and cycling. For example, in Switzerland those living in the French and Italian regions were less likely to actively commute than those in the German-speaking part. (Bringolf-Isler, 2007). Similarly, in New Zealand, walking rates have been reported as lower among NZ European children compared to other ethnicities (Yelavich, 2008).
2.2.3 Urban form
Differences in rates of active transport appear to be influenced by urban form. A nationwide pattern of car passenger travel has replaced the time children aged zero to nine and 10-14 spend walking for transport. This trend, over the past 20 years, is more pronounced for children in main urban areas (cities of 30,000+) than those in smaller urban centres and rural settings (Keall et al, 2010).

Bicycle ownership in New Zealand households with one or more children is reported to be 70%. 69% of children aged five to 12 and 60% of 13-17 year olds reported having ridden a bike in the last year, but fewer reported having ridden in the last week (34% and 21% respectively) (Ministry of Transport, 2011). When approximately 31% of trips are two kilometres or less (Woodward and Lindsay, 2010) it might be expected, given the high rate of bicycle ownership, that a greater proportion of journeys would be undertaken by bicycle.

2.2.4 Increased reliance on the car and decline in active transport
Despite the number of benefits derived from cycling, reliance on motorised transport has increased in westernised countries. The motor car is the dominant mode of transport in New Zealand, which has one of the highest rates of car ownership in the world. Driver or passenger trips account for 80% of the share of total travel (Tin Tin, 2010). Both walking and cycling have declined significantly alongside the growth and increasing affordability of the motor car.

Ideas of what is healthy have changed over time. While the car is now an accepted part of commuting, at the turn of the Twentieth Century in Melbourne, it was ironically through public health messages that car usage was encouraged: cars were promoted as more hygienic than horses for transportation (Hinde, 2010).

The most dramatic decline in active transport modes occurred during the 1970s in a number of countries (See Table 2). In the United Kingdom, children’s independent mobility began to decline from 1971; between 1971 and 1990 child bicycle ownership increased from two thirds to nine out of ten children, but the proportion of children who reported they were allowed to use them on the road declined from two thirds to a quarter (Hillman, 1993). In New Zealand between 1989 and 2003, there was an
increase of 30% in the millions of hours spent in travel, which was due in part to population increase, but largely due to the time spent driving which increased by 50%. There was a simultaneous decrease in the time spent cycling (43%) although there was no change in the time spent walking (Ministry of Transport, 2007). The biggest decline in cycling among school age children occurred during the 1990s, when cycling dropped from 21% among five to 12 year olds in 1989/90 to 9% by 1997/98 (Ministry of Transport, 2011). Walking for those aged five to 14 years decreased from 1.5 hours per person per week in 1989/90 to around one hour per person per week in 2007–10 (Ministry of Transport, 2011).

Table 2. Changes in rates of active commuting among children: a comparison of countries

<table>
<thead>
<tr>
<th>Location</th>
<th>Author</th>
<th>Participants/age groups</th>
<th>Time period and changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. A.</td>
<td>Davison, 2008</td>
<td>5-15</td>
<td>Less than 16% of students aged 5-15 years used AT to school in 2001 compared to 48% in 1969</td>
</tr>
<tr>
<td>U.S.A</td>
<td>Sirard, 2008</td>
<td>5-15</td>
<td>AT dropped approximately 37% between 1977 and 1995 from 15.5% to 9.9%. Over the</td>
</tr>
<tr>
<td>Location</td>
<td>Author</td>
<td>Age</td>
<td>Findings</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-----------------</td>
<td>-------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Melbourne, Australia</td>
<td>Garrard, 2009</td>
<td>Age not specified</td>
<td>In 1970 55.3% of young people walked to school, falling to 22.2% in 1994. In the same period cycling declined from 7.5% to 3.9% at the same time as car travel increased from 14.3% to 55.3%.</td>
</tr>
<tr>
<td>Sydney, Australia</td>
<td>Garrard, 2009</td>
<td>5-9, 10-14</td>
<td>5-9 year olds that walked to school declined from 57.7% in 1971 to 25.5% in 1999-2003. For children aged 10-14 years walking declined from 44% to 21.1% in the same period.</td>
</tr>
<tr>
<td>Netherland, Germany and Denmark</td>
<td>Pucher, 2010</td>
<td></td>
<td>Cycling levels plummeted from about 1950 to 1975 like the rest of Europe before a reversal and growth.</td>
</tr>
<tr>
<td>UK</td>
<td>Hillman, 1993</td>
<td></td>
<td>Between 1971 and 1990 the proportion of children who reported they were allowed to use bicycles on the road declined from two thirds to a quarter.</td>
</tr>
</tbody>
</table>
Similar declines occurred in the Netherlands, Denmark and Germany (Pucher, 2010). Cycling levels fell dramatically in these countries from about 1950 to 1975. In 1950, cycling levels in the UK were higher than they are now in Germany - 15% of all trips.

2.2.5 Land usage
In Western countries the dominance of the car as a means of transport was accompanied by an opening up of land on urban limits and a gradual move to, and spread of, low density housing, as people sought to be removed from the pollution of industrial centres. It has only been in the latter part of the Twentieth Century that car reliance has been recognised as a major contributor to environmental unsustainability, obesity and a decline in active transport (Hinde, 2010). More densely populated areas such as Europe have developed public transport systems so that cities with higher population densities can have low levels of vehicle dependency. In contrast, countries where there is a trend to separate urban functions by taking advantage of cheaper land on the outskirts of urban areas, have increased dependence on the car, as people have to travel further. The growth and affordability of the car has enabled people to escape the congestion and pollution of the city, but the problem has been widened to the suburbs as people are prepared to live further from work and other facilities in exchange for a better lifestyle (Chapman, 2007).

2.2.6 Less injury when cycling rates are high
The risks of injury for cyclists are lower in countries with a higher bicycle use (Transport, Public Works and Water Management, 2009). In the Netherlands, the annual number of road accident victims has halved since 1980, both among cyclists and car users, even in a time when both bicycle and car use increased (both cars and bicycles covered 32% more distance in 2001 compared to 1980). In municipalities with high bicycle use, the risk of cyclist injury is approximately 35% lower than in municipalities with fewer cyclists.

3. Potential barriers and enablers of active transport
There are a number of factors, individual, social and environmental that act independently or together to influence whether or not children use active transport to
school. These factors have the potential to promote or restrict cycling and walking, but are mediated through the perceptions of parents or caregivers and thus are unique to each child’s physical and social circumstances. Factors that limit or enable adults to use active transport may not be the same for children.

3.1 Age
Most studies report that active commuting to school is more common among younger children aged between eight and 11 years of age (Yelavich, 2008; Bringolf-Isler, 2008; Fulton, 2005), although the reported percentages vary between studies. In a Swiss study, high rates of active transport were found across all age groups, 75.6% among six to seven year olds, 88.2% among nine to 10 year olds and 68.9% among 13-14 year olds (Bringolf-Isler, 2008). A similar pattern, but with lower numbers overall, was reported in an American study, where 20.5% of children aged nine to 11 used active transport, but only eight per cent of those aged 15-17 years (Fulton, 2005). Primary or elementary schools are more numerous than colleges or secondary schools and it is likely therefore that younger children live closer to their primary school and are thus more likely to use active transport. A greater percentage of primary school children (18.5%) aged five to 11 have been found to use active transport than secondary school age children aged 12-18 (15.3%) (Martin, 2005). For older adolescents aged 15-19 in New Zealand, there is also a move away from active transport to increased time as car passengers, particularly in secondary urban areas with populations between 10,000 and 30,000 (Keall, 2010).

3.2 Gender
Boys are more likely than girls to use active transport (Davison, 2008; Yelavich, 2008). Although the rates vary, the trend is similar across countries: in America 16.6% of boys versus 11.1% of girls used active transport (Fulton, 2005); in Ireland the reported rates were 41% versus 33.8% (Nelson, 2008); in Australia, 9.2% versus 3.7% of children aged 10-12 years (Timperio, 2006); and in Canada boys aged 11-13 were 1.5 times more likely to use active transport than girls (Larsen, 2009).

Older girls at high school in the United States were more likely to walk to school than younger girls aged five to 14 (McDonald, 2008). The distance from school was also
associated with rates of physical activity in adolescent girls. The rates of physical activity among girls declined with distance from school, those with lowest rates living more than five miles from school. It may be that girls living further away had less time to be physically active and, if they depended on cars and buses, were less likely to stay late for after-school activities (Cohen, 2006).

3.3 Socio-economic status and ethnicity

Increasing household income and increased car ownership per capita of the population have been associated with lower rates of active transport among children (Pont, 2009) and those students from higher SES households were more likely to travel to school by car than to walk (Ewing, 2004; McMillan, 2007). In New Zealand, children from lower SES backgrounds and those that attended low decile schools (deciles 2-4) were more likely to walk to school than those from higher decile schools (Yelavich, 2008; Davison, 2008).

New Zealand children living in lower socio-economic areas are more likely to have better access to community resources in terms of distance to amenities. However, there are a number of other barriers that operate to limit active transport in these areas such as the perceived safety of the neighbourhood through which children pass to reach a school (Pearce, 2007; Field, 2004). Also, air pollution and the presence of hazardous substance sites are more prevalent in more deprived neighbourhoods, which may discourage active transport (Stevenson, 2009; Salmond, 1999). Initiatives designed to promote active transport may not always reach lower socioeconomic areas, for example, in a study of walking school buses in Auckland, New Zealand, an unequal distribution of available initiatives was observed. Half of the walking school buses were clustered in decile ten (least deprived) educational areas and were all but absent in the most deprived areas, despite the evidence that children from lower socio-economic areas are more likely to be injured as pedestrians (Kearns, 2005).

Māori and Pacific children were more likely to walk to school than NZ European children (Yelavich, 2008; Davison, 2008). And therefore were predictably also at greater risk of pedestrian injuries. However, one study found that traffic calming modifications were more frequently present in higher socio-economic areas where the
risk of pedestrian injury is usually lower and less common in lower socio-economic areas (Hopgood, 2013). This difference in traffic calming measures could be contributing to socio-economic inequities in the distribution of pedestrian injuries among children.

There is evidence that more equal societies are characterised by increased levels of trust, social cohesion and involvement in community. Not only are crime and child traffic injuries higher in less equal societies (Christie, 2004), but more economically just societies support more equitable transportation systems that cater for the requirements of all citizens (Wilkinson and Pickett, 2009). The counties that have the best pedestrian safety (The Netherlands, Sweden, Finland, Germany and Denmark) have a strong commitment to supporting high levels of safe walking and cycling and have implemented programmes to facilitate this.

3.4 Social factors

Perceived neighbourhood safety affects children’s choices of travelling to school (McMillan, 2007). Social interaction, neighbourhood cohesion and informal social control are mechanisms that influence children’s opportunities for active transport. Willingness to intervene on behalf of the common good is a measure of the degree of interaction and trust among neighbours and this social cohesion has been found to influence the decision to walk, particularly when children face trips of less than 1.6 kilometres (McDonald, 2007). Adolescents, particularly girls, were more likely to report walking and cycling in the neighbourhood when their experience included: friends living nearby; young people the same age to socialise with; and they knew and waved or talked to their neighbours (Carver, 2005). However, children were less likely to cycle to school if they had few other children in their neighbourhood (Timperio, 2006).

Children are deeply embedded in their family context and therefore their behaviours with relation to active transport are influenced by their parents’ values and beliefs. The normalisation of car travel appears to be well established by early adolescence. The car is perceived by young people as more convenient than either walking or cycling and as a pleasant and safe means of transport (Lorenc, 2008).
Parents of children with two or more cars were more likely to drive children to school, as were parents who had children at day care (Bringolf-Isler, 2008). Children were more likely to walk or cycle to school where their active transport did not interfere with parents’ work schedules, after school commitments or when parents actively valued physical activity (Davison 2008). In an American study, the children of mothers who commuted to work were less likely to walk or bike to school: children of mothers in the paid workforce made 0.5% of their school trips by walking with their mothers, compared to children whose mothers were at home, who made 5.2% of trips to school with their mothers (McDonald, 2008). A Canadian study found that children were more likely to walk or cycle home from school (72%) rather than to school (62%), which could indicate that children’s opportunities for active travel were closely linked to parental scheduling and travel (Larsen, 2009).

3.5 Environment and Urban Design

3.5.1 Distance

Shorter distances between home and school are associated with active transport to school (Davison, 2006; Ewing, 2004; Larsen, 2009; Martin, 2005; Panter, 2008; Pont, 2009). Two Australian studies reported that children are more likely to walk or cycle to school at least once a week, if they lived within 800 metres of their school (Davison, 2008; Temperio, 2006).

As the distance from home to school increases, the proportion of children using active transport drops sharply. Those who lived within one mile of school were more likely to walk compared to those that live one to 1.5 miles or further away (Schlossberg, 2006; Yelavich, 2008; McDonald, 2008). In one study, after controlling for gender and population density, a one mile increase in distance decreased the odds of active commuting by 71%. The majority of walkers in the study lived within 1.5 miles and cyclists within 2.5 miles (Nelson, 2008). In another study of 812 parents of children aged five to 12, as distance increased from more than 0.75 – 1.5km, the proportion of those children taking no active commuting trips doubled (from 22.8% to 43.1%), while the proportion of those taking five or more trips to school per week dropped by one third (69.5% to 44.8%) (Merom, 2006) The feasibility of walking or cycling distances is influenced by the perceptions of both children and parents.
3.5.2 Size of school
More children tend to walk to small schools, but this effect possibly occurs through the effect of distance to the school, as children tend to live closer to small neighbourhood schools (Braza, 2004).

3.5.3 Population density
Student rates of active travel to school appear to be influenced by population density. Adolescents living in more densely populated areas were more likely to actively commute than those in more sparsely populated areas (Nelson, 2008), which may be related to shorter distances between school and homes.

Older high density urban neighbourhoods tend to have grid networks of streets with consequent greater connectivity, while newer suburban low density neighbourhoods often have curvilinear street networks with more cul-de-sacs (Braza, 2004). Children are more likely to use active transport when the immediate areas around a school are densely populated (Davison, 2008; Kerr, 2006; McDonald, 2008). Similarly, when a greater percentage of houses within 0.25 miles of the school had windows facing the street, more children used active transport to school. This may be as a result of a perception of a child being more visible in such areas.

3.5.4 Street network connectivity
The network of roads and paths in New Zealand predominantly accommodates car travel. With increased urban sprawl, the distances to places of study have increased. The road environment influences physical activity in different ways according to age group, gender and type of physical activity. There are factors that are uniquely relevant to the decisions adults make about active transport that may not be relevant to children (Pont, 2009). One study reported that children whose routes to school had higher intersection densities and lower dead-end densities were more likely to walk to and from school (Schlossberg, 2006).

However, there is mixed evidence on the effect of street connectivity. Higher connectivity effects are only observed in studies when objective measures are used, but when self-report measures are utilised, people report being more influenced by traffic safety or do not recall street networks (Davison, 2006). Street networks may
appear to be important but children also take short cuts and are not necessarily bound by the street networks (Braza, 2004). Children’s travel may be more influenced by traffic speed or the presence of sidewalks, which is consistent with findings that children are less likely to commute if they have to cross busy roads. The shortest route between home and school, or seemingly best connected, may not be the safest and hence chosen route (Tiomperio, 2006). The type of terrain covered may also influence the choice of route; steep inclines were associated with reduced active transport to school among five to six year olds (Davison, 2006; Temperio, 2006).

The Netherlands, Denmark and Germany have created integrated and extensive systems of separate cycling facilities, intersection modifications and priority traffic signals and traffic calming. The network has expanded over time and has been maintained to ensure safety, increase convenience and make cycling more attractive. By addressing the many fold factors that enable or discourage cycling, this multi-focused approach has contributed to greater cycling levels (Pucher, 2010).

### 3.5.5 Mixture of land use

Environments that support walking tend to provide shorter distances to frequently travelled destinations such as bus stops and recreation areas (Panter, 2008). Increased land mix increases the variety of destinations available within short distances and increased likelihood of active transport to school (Larsen, 2009).

### 3.5.6 Built environment

There is a positive association between the proportion of street miles with sidewalks and children’s rates of active transport to school (Davison, 2006; Ewing, 2004; Fulton, 2005). The presence of a busy road was associated with lower rates of active commuting to school, particularly among five to six and 10-12 year olds (Davison, 2006).

There is a positive association between the presence of controlled crossings, (Davison, 2006), improved routes to the school, traffic speed limits and bike paths (Eyler, 2007) and increased active transport to school. However, in Australia, school crossings and reduced speed limits only apply in close proximity to the school, for example, a 250 metre radius. This may account for the increased likelihood of walking or cycling to
school among children who live nearer to the school. In contrast in Berlin, 3,800 kilometres of city streets (72% in total) are traffic calmed with speed limits of 30km/hour or less providing an extensive network of streets amenable to active transport (Jacobsen, 2006).

Evidence supports higher rates of cycling among adults in communities with greater density of population, greater connectivity and greater land-mix use (Saelens, 2003). However, some evidence shows that its effect is modest on children’s mode choice and it is not the most important factor (McMillan, 2007).

**Section 4. Safety**

Children’s active transport incurs both the risk of physical injury from accidents and also from crime, particularly by strangers.

**4.1 Collection and reporting of injury statistics**

Comparing cycling and walking injury statistics between countries can be challenging due to variations in definitions and methods of data collection. Injuries may be under-reported, depending on the sources of data used. In New Zealand any injury resulting from a motor vehicle crash is required to be reported to the police, but although fatalities are universally reported, other injuries may not be and this reporting bias may undercount the actual number of injuries (Keall, 1995).

Fatality rates can vary within countries depending on the denominators used: absolute level of risk (fatalities per population) or exposure (relative fatality rates per trip or per kilometre travelled). In turn, exposure is influenced by numerous factors such as the number of trips, the number of roads crossed, the number of zebra crossings, or even the time of day (Christie, 2004). The difference in susceptibility to injury between adults and children can determine the severity of the injury. Male and female children between ages five and 15 are susceptible to the same degree of injury, but after age 15, the same physical injury is 25% more likely to kill a female than a male (Evans 1991).

In addition to exposure, the characteristics of the pedestrians and the characteristics of the road environment in which the travel takes place are important. British studies
have identified greater risk for children on road networks associated with housing estates built before 1914, busy main roads and on roads where there is a mix of residential homes, shops or businesses (Christie, 2007).

As an alternative means of transport, walking and cycling are often compared to car passenger injury risk. Exposure-based relative risk is generally higher for pedestrians and cyclists than for car passengers, but this varies between countries. The countries with the lowest risk of pedestrian injury include the Netherlands, Denmark and Germany.

Time series data shows that decreased bicycle riding trends are associated with increased risk of injury and increased risk in turn is associated with decreasing bicycle use. In the Netherlands between 1950 and 1978 the average kilometres cycled per inhabitant fell by 65% while the cyclist fatality rose by 174% (Pucher, 2010). This was during a time of enormous growth in car usage. Similarly in the United Kingdom, up to 1973 a similar pattern of decreased cycling alongside increased cycling fatalities occurred. From 1973-83 in the United Kingdom a very small increase in the distance cycled was accompanied by a decrease in fatalities. Over the period 1984-99, a decrease in the distance cycled was matched by a decrease in bicyclist fatalities by 60%, but an indication of increased risk of cycling fatalities (Jacobsen, 2003). In contrast, in the Netherlands, Germany and Denmark cycling safety greatly improved (by approximately 70% since the 1970s) while the rates of cycling simultaneously increased in all three countries (Pucher, 2010).

Although the actual number of road traffic accidents has decreased over time, a study examining trends in road traffic accidents from 1980 to 2004 in Christchurch found that the magnitude in the reduction of the total number of accidents between 1980-1984 and 2000-2004 was markedly less pronounced around the school opening and closing times compared to other times. There was a 20% increase in the total number of accidents occurring at approximately 3.00pm (Kingham, 2011). The study also noted that there was no clustering of accidents around the school vicinity, but rather in the north and north-east sectors of the city, following two of the major arterial routes. This could indicate that safety measures of calming and controlling traffic in areas close to
the school may work, but further away from such protective measures, children remain at risk.

4.2 Safety in numbers
Both historic trends and current figures appear to show that low levels of cycling are unsafe for cyclists and those countries with higher participation perform better in terms of risk of fatality. A motorist is less likely to collide with a person walking or cycling when greater numbers are visible, as motorists are reported to drive more slowly when they see a larger number of pedestrians (Todd, 1992).

The concept of ‘safety in numbers’ suggests that greater numbers of cyclists on the road facilitate safer cycling, although increased safety cannot be claimed to be causal in increasing rates of cycling. Substantial increases in the distances cycled in cities are associated with a decrease in the number of cyclists killed or seriously injured and although a significant transfer in the number of trips from motor vehicles to walking or cycling would be required, the total number of accidents could be reduced (Elvik, 2009).

In New Zealand active transport and cycling in particular remains an unusual mode of transport. Tin Tin (2010) looked at regional variations in cyclist injuries in New Zealand and found that the injury rate increased with decreasing per capita time spent cycling. The rate also increased with increasing per capita time spent travelling in a car. They noted a “risk in scarcity” effect for cyclists, such that the risks will increase if fewer people cycle. They found that if cycle usage was to remain constant and car use was reduced by 10%, 56 fewer cycling injuries per year would occur in New Zealand.

Behaviour change by motorists is considered the most likely mechanism which underlies the “safety in numbers” effect (Jacobsen, 2003). Also if more people cycle, drivers are more likely to cycle themselves and therefore potentially be more considerate of other road users (Jacobsen, 2003).

4.3 Risk – car, pedestrian and cyclist
Car travel is often perceived to be safer than active transport. Yet, the car occupant fatality rates per 100,000 population aged 10-14 years, divided by the average kilometres travelled (that is, the exposure), revealed that New Zealand had the highest
car fatality rate, 0.00045, in the OECD. Germany had the second highest fatality rate, 0.00025 (Christie, 2007), which was considerable lower than the New Zealand rate.

For the period 2003-08, cycling had a much higher risk when measured by distance travelled (10 times the risk of driving) than by time spent on the road (only three times higher than the risk by driving). Pedestrians also have a greater risk when measured by distance travelled rather than by time spent on the road, as they will travel a smaller distance in the same time as a car (Ministry of Transport, 2009).

Males in the five to nine age group are at the highest risk for pedestrian fatality. There were 9.8 deaths or injuries per million hours walked in 2006-10, compared to 5.5 for those aged 10-14 and 5.4 for those aged 15-19. Unlike adult pedestrian deaths and injuries which occur at times evenly spread through the day, child deaths and injuries occur between 8-9am, 3-4pm and 4-6pm, the times when they are more likely to be travelling to and from school (Ministry of Transport, 2011).

Young cyclists aged from five to 17, years have a higher risk than adults per distance travelled. Among cyclists, the five to 12 year old group have the greatest risk per distance travelled than other age groups (Ministry of Transport, 2011). Children between 10 and 14 years old account for the highest number of cyclist hospitalisations. There may be a number of reasons for this; inexperience and the speed of cars but also the fact that children are physically more fragile and likely to be injured. Most casualties occur on urban roads and over half occur on major urban roads, typically busy arterials.

4.4 Socio-economic status and risk
Although the overall fatalities from injury have fallen in the UK, inequalities in pedestrian and cyclist injury fatalities remain. According to the National Statistics Socio-Economic Classification (NS-SEC) in the United Kingdom, fatalities for pedestrians aged 0-15 years of age were 20.6 times higher for those in NS-SEC 8 (never worked/long term unemployed) than in NS-SEC 1 (higher managerial/professional occupations). For cyclists, it was 27.5 times higher (Edwards, 2006). A New Zealand study found that children aged between five and nine years of age in the lowest household income bracket crossed approximately 50% more roads than those in the
middle and upper income brackets, although increased exposure may partly explain the risk of pedestrian injury in lower SES groups (Roberts, 1994).

There are lower car ownership rates among lower socio-economic groups. Māori and Pacific children are two to three times more likely to have pedestrian injuries than children of other ethnic backgrounds (Kearns, 2005). This could be from a number of factors: proximity to busier roads, fewer safe crossings, shortage of safe outdoor play areas, and being less likely to own a vehicle so that chauffeuring children to school is not an option. Therefore, child pedestrian injury could be viewed as a direct consequence of an unequal societal distribution of wealth (Collins, 2001). Similarly, both crime and traffic injury rates are higher in less equal societies. More equitable societies are characterised by increased levels of trust, social cohesion and involvement in the community life and less violence (Wilkinson, 2009). Also economically equal societies support more equitable transportation systems that cater for the needs of all road users.

4.5 Risk of fatality outweighed by health benefits
While active transport carries a risk of injury, it contributes to health benefits. Estimated inhalation of air pollution doses have been measured as higher in cyclists than in car drivers. This is countered by the health benefits attributed to physical activity in terms of cardiovascular fitness and reduced mortality. One study (de Hartog, 2010) has estimated that for those who shift from car to bicycle the beneficial effect of increased physical exercise due to cycling resulted in approximately nine times more gains in life years than the losses in life years due to increased inhaled air pollution doses and traffic accidents.

4.6 Cognitive ability of children and developmental factors
Although adults act automatically to cross the street safely, this is a complex cognitive, perceptual and motor task that requires a number of skills. These require strong attentional processes, information processing, decision making and deductive reasoning skills, which may be a challenge for younger children. Although peripheral vision may be developed by the age of seven years, the ability to judge traffic speed in terms of acceleration and deceleration does not mature until about the age of 12.
years. Visual search skills mature at approximately eight years of age and the ability to negotiate safely around barriers such as cars at between six and 10 years of age (Schwebel, 2012; Chakravarthy, 2007)). Alongside these factors, a child’s individual temperament and personality together with social influences on behaviour may affect children’s abilities to successfully negotiate traffic.

Learning to ride a bicycle is a complex activity and consists of motor skills in addition to cognitive components. The New Zealand Police and the New Zealand Transport Agency recommend that children under 10 years old cycle on the road only when accompanied by a competent adult rider (New Zealand Transport Agency, 2011).

4.7 Injury severity
Patterns of injury to pedestrians and cyclists are dependent on vehicle speed, the angle of impact, the centre of gravity, which part of the body first comes in to contact with the vehicle and vehicle design. In children, the most common injuries aside from superficial injuries involve the head and neck (34.6%) with musculoskeletal injuries being the second most common (22.2%) and chest and abdominal injuries third. In contrast, among adults head and neck injuries were less common (26.7%) (Chakravarthy, 2007).

4.8 Child protection or traffic control
In many westernised countries both the policy and the regulatory environment have largely focused on removing children from the source of danger, rather than making the environment safer for children’s active transport (Garrard, 2009). Children have been excluded from what is perceived to be a dangerous environment while an increasingly car-based culture has flourished. Safety for child pedestrians and cyclists is frequently framed so as to place responsibility on children to be brightly dressed and avoid danger, wear protective helmets and further their skills in road safety, rather than a focus on withdrawing the danger away from children through traffic restrictions (Hillman, 2006). Collins (2001) sees the continual emphasis on modifying children’s behaviour to accommodate the car-centric environment as problematic: children’s needs are excluded from planning and transport decisions; blame is implicitly placed on children when injuries occur; the potential for altering the environment is ignored;
and there is a heavy reliance on pedestrian education programmes, which do not show great success rates in decreasing the rate of injuries.

An example of measures to protect New Zealand cyclists is the compulsory use of cycle helmets. In the Netherlands, which has the best cycling safety record, only 1% of adult cyclists wear a helmet and 3-5% of children (Dutch Bicycling Council, 2006). It is difficult to unravel whether the wearing of helmets gives motorists an increased perception of cyclists as vulnerable or if helmets reduce the consideration of motorists since they may appear less vulnerable while wearing head protection. Similarly it is difficult to know whether cyclists are discouraged from cycling, because helmets increase their perception of cycling as a dangerous pursuit, or that helmets may provide a false sense of security and encourage riskier behaviour (Pucher, 2010).

While many activities carry an element of risk, there is a strong focus on the risk of injury particularly associated with cycling, possibly due to the visibility and the attention given to it in the media. The silent cost, in terms of health, of being sedentary and sitting in a car for an hour compared to the positive health benefits of cycling, are known to be a greater risk in terms of health. However the risk of injury or death while cycling is often the most persuasive image, possibly because cyclist injuries tend to be very severe. Daniel Kahneman (Kahneman, 2011) has described an “availability heuristic” whereby when estimating the size or frequency of an event, a person will recall instances according to the ease with which the instances come to mind. For example, a dramatic event such as a plane crash or a cycling death, particularly of a child, will receive a great deal of attention in the media and the image is more readily retained than reports of obesity among teenagers. Therefore, it is possible that parents when considering whether their child should walk or ride a bicycle to school, recall cycle accidents and injuries more readily and make a decision based on what most readily came to mind, that is, the risk of injury or death.

4.9 Crime
Although local crime has been negatively associated with children’s physical activity (Davison, 2006) the public perception of crime based on media representation can outweigh the effects of reality itself. Harm from strangers, or “stranger danger” is
often cited as a reason for restricting children’s independent transport to school. Such concerns as sexual assault on a child are often cited as a reason to restrict children’s activity.

In relation to parental concerns about neighbourhood safety, Tranter (2001) describes parents’ vulnerability to ‘social traps’. For example, by chauffeuring their children to school, parents aim to protect their children from the traffic danger to which they are contributing. Furthermore, road safety concerns may heighten anxiety about strangers, since road safety concerns may lead to less outdoor play, cycling or walking. This in turn may result in fewer people being out and about in the neighbourhood, less familiarity with people living locally and increased fear of ‘stranger danger’. Parents, in turn, sense a need to chauffeur their children, but the subsequent increase in traffic volume accentuates road safety fears thus creating a ‘downward spiral of fear’ (Mullan, 2003).

Section 5. Attitudes and perceptions

5.1 Parents as gatekeepers

For parents who believe that active transport to school is unsafe, the most commonly expressed reason is road traffic, closely followed by the risk of harassment or violence from other children and the threat of other adults (Bringolf-Isler, 2008; Brunton, 2003; Salmon, 2007). These two fears are the most prevalent in the literature and differences in school setting had little relationship with the level of parental concern about safety in terms of traffic and strangers (Eyler, 2007).

Unlike rational choice theories that suggest decision making is about weighing the pros and cons of each alternative, it has been suggested that the choices regarding children’s transport to school are made in response to the circumstances of a given situation. Two layers of decision making have been suggested: the first decision, to escort a child to school or not, is influenced primarily by safety concerns both traffic and strangers, and also, to a lesser extent, a child’s maturity and cognitive ability (Faulkner, 2010). Following the decision to escort the child, the second choice between active transport and use of a car is primarily influenced by convenience which includes
work schedules and obligations, distance from the school, number of children that go to different schools and time constraints. Safety is less of a concern in this second layer of decision making. Therefore parents who are more concerned about child safety are more likely to escort their child to school either by accompanying them or, more often, transporting them by car (Mammen, 2012). However both these decisions take place within a broad physical and social environment influenced by ethnicity, family structure, gender, socio-economic status and the neighbourhood in which parents live (Faulkner, 2010).

Parental opposition to active travel to school is one of the main barriers to children walking or cycling to school and studies have reported a variety of different reasons put forward by parents to disallow active transport. In surveys and interviews one of the most common reasons, is perceived distance to the school (Martin, 2005; Yeung, 2008; Timperio, 2004). The distance believed by Australian parents to be acceptable for five to six year olds was 1.5 kilometres and for 10-12 year olds, 1.6 kilometres, but with differences between socio-economic groups; the higher socio-economic groups thought 1.8 kilometres appropriate but only 1.1 kilometres among those in lower socio-economic groups (Timperio, 2004). Perceptions of ‘too far to walk or cycle’ varies both between countries and over time.

5.2 Risk perception
Parents perceive a trade-off between, on one hand, their responsibility to ensure their child’s safety and on the other hand, to foster their child's independence. There are social pressures to adopt cultural norms defining safety, which often are often not aligned with the actual risks associated with different transport modes (Brunton, 2003). In high cycling countries, such as the Netherlands, the blame for injury to pedestrians or cyclists is seen to lie with the motorist, but in low cycling countries, such as New Zealand, the responsibility is considered to sit with the parents to protect their children (Garrard, 2011).

Risk perceptions are often based on emotional responses to a situation, rather than rational analysis. In turn, emotional responses are shaped by a range of psychological and social processes. Risk perception research has identified a number of biases that
contribute to misjudging of risk in general that may foster parental fear of independent mobility for their children. Familiarity bias can arise in low-cycling countries because driving is a familiar activity, but cycling for transport is relatively unusual. Therefore parents adjust to the everyday risks of driving, with which they are familiar, but are relatively more fearful of the unknowns of cycling for transport. Control bias arises when motorists and cyclists share road space forcing parents to surrender their control for the safety of their children to the children themselves and to unknown car drivers (Slovic, 2004). In addition initiatives put in place to address community and personal safety fears can have had the unintended consequence of heightening parental caution and increasing vigilance by raising their awareness of the dangers. It has been suggested that trust in others may be an important determinant of children’s independent mobility (Garrard, 2009; Zubrick, 2010).

Good quality empirical evidence showing changes in the level of parental fear for the security of their children over time is lacking (Zubrick, 2010). What has increased is public and media fixation with the relatively rare incidents in which children are victims at the hands of strangers, along with a rise in risk aversion and protectiveness.

5.3 Parents’ reasons for driving and the car culture
A systematic review of studies of children and parents’ views on walking and cycling in the United Kingdom identified a culture of car use, due to a perception of cars as more convenient, as status symbols and part of a normal adult lifestyle (Lorenc, 2008). A longitudinal study confirmed the importance of convenience in influencing decisions about whether to use active transport or a car; children whose parents reported it was inconvenient to use the car for school travel were more likely to take up and maintain their active commuting (Panter, 2013). Thus, reducing the convenience of the car, along with increasing the convenience of active transport has the potential to increase rates of active transport.

The use of cars for transport has become a normalised behaviour which is established in early adolescence (Brunton, 2003; Lorenc, 2008), and to some extent in younger children (Lorenc, 2008). The car is perceived as convenient, particularly for journeys linked to parental employment when schools are on a route to work; pleasant in that
carrying heavy backpacks and bad weather can be avoided; and safe in terms of avoiding dangerous traffic conditions, high speed vehicles and a lack of complete sidewalks (Schlossberg, 2006; Bringolf-Esler, 2008; Brunton, 2003). Children are influenced by the family and social circumstances in which they are situated and influenced by their caregivers’ attitudes, values and beliefs. Parental perceptions about safety, work demands and financial priorities will determine what children will be permitted to do (Pont, 2009). Changes in family functioning over time have influenced travel mode choices and the need for provision of care for children from a younger age outside the home has changed the shape of daily activities and routine (Zubrick, 2010).

5.4 Neighbourhood
Perception as distinct from objective reality drives the behaviour of parents; if a neighbourhood is perceived as unsafe, due to traffic or strangers, children’s opportunities for active transport are reduced regardless of the real accident or crime rates (Stevenson, 2009). Parental concerns about the local neighbourhood have tended to be higher for younger children aged five to six (Timperio, 2004) and there is evidence that social anxiety and generalised fear, including a fear of crime or victimisation, can be transmitted from parent to child (Murray, 2009).

When parents believe that other adults in the neighbourhood will watch out for and monitor children, they are more likely to allow their children to walk or cycle to school. When parents felt negatively about their social environment, children were less likely to be allowed to actively travel to school (McDonald, 2010). Women expressed more fears about strangers than traffic and even more women from lower socio-economic groups expressed fear of strangers (58.3% in low socio- economic groups compared to 45.1% in higher socio-economic groups) than road safety (34.7% versus 20.4%). It has been suggested that higher socio-economic areas are more conducive to cycling and walking and that those from lower socio-economic groups may live in “worse” neighbourhoods (Timperio, 2004).

The role of friends suggests that neighbourhood characteristics which encourage the formation of social networks may have a significant role to play in encouraging independence. One of these characteristics is the distance which children live from
their schools – children who lived nearer to their school have more friends than those who did not. Schools that have a local catchment area are more likely to facilitate the development of local social networks and the independence which goes with this (Brown, 2008). However, perceptions of groups of young people in public spaces often have negative connotations and many public programmes are often aimed at getting young kids off the streets or restricting their congregation and socialising in public spaces. These policy and planning decisions that are not child-friendly, or that discourage the presence of adolescents, contribute to a societal norm about children and their movement and place in the public realm (Zubrick, 2010).

Children whose parents have greater networks and social integration within their neighbourhood have been found to have greater independent mobility. Moreover lower levels of perceived social danger among parents have been associated with a stronger sense of community (Prezza, 2005). In the Netherlands, perceived social safety and social cohesion is positively related to walking and cycling (Aarts, 2012).

5.5 Parental exercise and travel behaviour
An Australian study (Ziviani, 2004) surveyed parents to identify their attitudes and experiences that determined the extent to which their children walked to school. Two psychosocial factors were found to significantly impact on whether their children walked to school: firstly, whether both parents had themselves walked to school (Ziviani, 2004). Secondly, whether both parents considered the health benefits of physical activity important in their lives and the lives of their children has been found to be associated with children’s active transport (Merom, 2006; Ziviani, 2004). When parents restrict a child’s physical activity in a neighbourhood, there is a subsequent decrease in active transport to school and lower levels of general moderate to vigorous physical activity outside school hours. This has been found to be true particularly for adolescent girls, but not so much for adolescent boys (Carver, 2010; Cooper, 2003; Davison, 2008). Conversely when parents actively value physical activity and support it, children are more likely to use active transport (Davison, 2008).

In a study of 812 Australian parents of five to 12 year old children, it was found that if the parent responsible for taking the household’s children to school was male, then
the child was twice as likely to use regular active transport to school, compared to a female parent. When parents did not work, a child was more likely to use active transport to work while conversely the children of parents who commuted to work were half as likely to use active transport to work (Merom, 2006).

5.6 Child perceptions

Children’s desire to cycle to school is often thwarted by parental concerns about safety (Collins, 2001). In one survey, almost half (45%) of those children being driven to school expressed a desire for a more active travel mode (Mitchell, 2007). The barriers to active transport most commonly cited by children were parental restriction, most commonly explained as safety concerns. Younger children in particular are more positive about active transport than adults (Brunton, 2003). It has been argued that the education system, rather than focusing on learning as behaviour change (for example, encouraging children to recycle and reduce energy consumption), might assist children to think critically and politically about their situation and develop a greater sense of belonging in their environment. Children’s voices and needs are not currently being acknowledged in planning and environmental management (Schusler, 2009; Hayward, 2012).

Most children expressed different views to parents in terms of heavy traffic or safety issues and saw their parents’ views as more negative than their own (Timperio, 2004). However, like adults, children’s perceptions of distance to school over and above actual distance may influence the choice of mode of transport. A survey of 15-17 year old adolescents in Ireland found that distance was perceived as a barrier; four out of ten car users and one in ten bus users lived within 2.5 miles of their school (Nelson, 2008). A third of parents, who perceived distance as a barrier to their children’s active transport to school actually lived within 0.8 kilometres of the child’s school (Nelson, 2008).

The difficulty of attempting to fulfil the role of a ‘good parent’ needs to be balanced with the need for the independent development of the child (Lorenc, 2008). Although parents recognise the need to allow their child’s development of skills and autonomy to enable their transition to responsible members of society, these ideas are
countered by parental responsibility to keep children safe, the structured lives of adults, car based culture and a distrust of strangers (Hillman, 2006).

Section 6. Interventions to promote walking and cycling
Attempts to influence rates of active transport can be delivered at the level of government in the form of policy, through local government initiatives and planning, traffic engineering and through local programmes, for example in schools. These efforts can be aimed at the whole population (such as traffic engineering), targeted groups (school programmes) or individuals.

6.1 Individual behaviour change
Two systematic reviews found that interventions that engage people in a participative process, address factors of personal relevance, target those most motivated to change, and are delivered either at the level of the individual or household, may be more effective than those that simply aim to raise awareness or impose changes in the physical and economic environments (Ogilvie, 2004; Ogilvie, 2007). Therefore different types of people may respond to different approaches tailored to their psychological characteristics or life circumstances, so that one size may not fit all (Ogilvie, 2007). Behaviour change interventions also need to take into account people’s perceptions about barriers to active transport and challenge normalised expectations of behaviour, particularly the norms and expectations of parenting and the tension between children’s protection and developing their independence (Brunton, 2003; Lorenc, 2008).

The timing of the intervention is important. Because the preference for car travel appears to be established in early adolescence, younger children’s ideas about car travel as more convenient and cycling and walking as a low status mode of transport, should be challenged early in their development (Lorenc, 2008). As children appear receptive to messages about the environment and health and hold more positive views of the benefits of active transport, incorporating children’s perspectives into interventions could be useful. Little research has been done on interventions to effect
young people’s perceptions of active transport or on promoting the capacity of children and young people to make their own transport choices (Lorenc, 2008).

Studies of individualised marketing and intensive interventions with individuals report the consistent positive effects of interventions on cycling behaviour (Yang, 2010). Research has indicated that life events (such as getting a new job, having children, moving house, having a health event) lead to a reconsideration of travel modes and possible turning points in travel behaviour. Transport policy makers could take advantage of life events as opportunities to market travel alternatives to adults and parents (Christensen, 2012). For example, a life health event, such as a heart attack in an individual, could be used to influence a change in behaviour. Individual behaviour is also mediated by personal history, intrinsic motivations and facilitating conditions. Habit can also be an important determinant of travel behaviour. Interventions which are tailored to times when car-orientated behaviour is interrupted, for example, a home move or other life course event, can offer an opportunity to break the habit of using the car (Verplanken, 2008).

Behaviour change interventions can take time to manifest change and the benefits generated by the investment may continue over a number of years. Therefore, monitoring changes in attitudes towards cycling as well as travel behaviours is important to indicate whether people are more likely to contemplate changing their behaviour in the future (Garrard, 2011). In countries such as Denmark and the Netherlands, achieving the benefits of active travel at the population level required implementing behaviour change programmes with demonstrated efficacy, with commitment and wide programme reach, which are supported by environmental and policy changes aimed to make active travel choices easy choices (Garrard, 2011).

6.2 School programmes

Systematic reviews and narrative reviews that include school programmes aimed at increasing active travel to school or reducing car travel have revealed inconsistent programme impacts, both between programmes and for individual schools within multi-site programmes (Ogilvie, 2007; Pucher, 2010; Yang, 2010; Chillon, 2011). When a reduction in injury rates is the measured outcome, there is mixed evidence for the
impact and success of specific programmes targeted at schools. The evidence base for active school travel programmes is limited and few pedestrian education programmes have been found to be effective in reducing injury rates (Collins, 2001).

However, there is some evidence, from a systematic review, that targeted behaviour change programmes can change the behaviour of motivated subgroups in a population resulting in a shift of around five per cent of all trips at a population level (Ogilvie, 2004). Active travel programmes often lead to increased levels of active travel to school in participating programme schools, but there is little evidence of an overall mode shift to active travel in countries like New Zealand, Australia and the United Kingdom, where other measures (such as traffic calming, traffic engineering, etc) are not used in conjunction with behaviour change programmes. Interventions can also have unintended effects and have an impact on some communities more than others, for example, 54 Walking School Buses (WSB) were established in 29 schools in Auckland in 2002 and evaluated. An analysis of the locations and socio-economic characteristics of the schools that adopted the initiative found WSB were clustered within less deprived areas and were almost absent in the most deprived. The way that interventions are promoted may also influence understanding and motivate uptake by populations, for example, the WSB may have been more successful had it been promoted as reducing the risk of injury rather than congestion at the school gate (Kearns, 2005).

In a systematic review which included fourteen interventions that focused on active transportation to school for primary school children in the US, Australia and the United Kingdom, most of the interventions reported a small effect size on active transportation (Chillon, 2011). However, the interventions that were most successful had two common elements: a strong involvement of schools through principals and teachers working actively in the intervention, and parents receiving specific materials and being encouraged to walk (Chillon, 2011). Similarly in a U.S. study to identify factors that influence active transport initiatives, the collaboration of many organisations and individuals, requiring leadership and cooperation, were important (Eyler, 2007).
The Safe Routes to School (SRTS) programme in the United States is administered by each State including planning, development and implementation of projects and activities to improve safety and reduce traffic, fuel consumption and air pollution within a two mile radius of schools. Pedestrian injury rates have decreased in areas with an SRTS programme but remained unchanged in areas without SRTS interventions (DiMaggio and Li, 2013).

Community wide promotional activities have the potential to increase cycling by modest amounts (Yang, 2010), but programmes targeted at children are particularly important in increasing cycle use, and these are often linked to simultaneous infrastructure measures. Evidence from Bike It Schools in England demonstrates that cycle use can increase by over 400%, although from low baselines of 2-3%, and reflect the high level of suppressed demand for cycling among this age group. The programme had expert cycling officers in schools helping children with cycle training, storage, travel plans as well as parental involvement (Sustrans, 2008).

6.3 Infrastructure/Environment
A number of environmental interventions have been identified to increase cycling or walking: traffic calming, multi-use trails, closing or restricting the use of roads, cycle infrastructure, high population density, safe routes to schools and green space (NICE, 2008; Fraser, 2010). However there is evidence that access to open spaces alone does not appear to be associated with increased physical activity (Witten, 2008). Interception studies focused mainly on roundabouts found that multi-lane roundabouts can significantly increase risk to cyclists unless a separated cycle track is included in the design (Reynolds, 2009). Changing perceptions of road safety may also be as important as improving the infrastructure in increasing children’s rates of active transport (Timperio, 2004), particularly as perceptions of safety are not always correlated with actual measured rates of injury or crime (Lorenc, 2008).

6.4 Government and Public Policy
Government policies have the potential to have a powerful impact on travel behaviour and include transport, land-use, urban development, housing, environmental, taxation and parking policies. Historical policy decisions have had an impact on the present day
landscape and infrastructure and once urban form is established, it is very expensive and slow to effect change, which emphasises the importance of urban planning.

At a time when the car was becoming the predominant mode of transport, the Netherlands, Germany and Denmark led a reversal of transport and urban planning policies in the mid-1970s in response to the First Oil Crisis that allowed a cycling revival to make active transport safe, convenient and attractive. Policies and programmes improved the bicycling infrastructure, while simultaneously imposing restrictions on car use and making it more expensive. In the Netherlands cyclists and pedestrians were prioritised over motor vehicle mobility (Pucher, 2010; Garrard, 2011). In contrast in the UK there has been no over-arching government policy to promote and finance cycling infrastructure and even less action at local level to provide safe facilities for cyclists. The resultant infrastructure has led to cycling mostly being framed as a consideration within injury reduction studies. The result has been a lack of designated space for cycling as the volume and space for motor traffic has increased. This has acted as a significant barrier to cycling which may have created a generation of people who have never ridden a bike (Pucher, 2010).

Government policies can influence an individual’s choice of mode of transport, either through pull or push policies; pulling by making cycling more attractive as a mode of transport by reducing costs, improving infrastructure and safety; or pushing by making competing modes more expensive, for example, increasing car parking costs, speed limitations and taxation on car ownership (Pucher 2010).

Behaviour change programmes with local impact are necessary, but alone they are inadequate to bring about population change. On a smaller scale, area-wide policies such as those in the USA cities of Davis, California and Portland, Oregon have achieved high levels of active transport in contrast to the USA as a whole. Therefore many levels of government have a role to play in promoting active transport choices. Strategic planning and a systems approach appear to work best (Ogilvie, 2004; Garrard, 2011).

It is difficult to isolate the separate impacts of individual policy interventions designed to promote walking and cycling. Substantial increases in bicycling require an integrated package of many different, complementary interventions, including infrastructure
provision and pro-bicycle programmes, as well as supportive land use planning and restrictions on car use (Pucher, 2010). For example, the impacts of improved bicycle parking, bike training and individualised marketing are probably influenced by the extent and quality of the cycle network. Similarly bike to school programmes are more likely to be successful in traffic-calmed residential neighbourhoods. Therefore measures to promote cycling and walking are expected to be interactive and synergistic (Pucher, 2010).

Between 2008 and 2011 in the UK, the Department for Transport, Cycling England and the Department of Health invested £43 million to create twelve Cycling City and Towns (CCT). The aim of the programme was to explore whether and how increased investment in cycling as part of a whole-town strategy could lead to a significant and sustained increase in the number of cyclists and frequency of cycling. Interventions were tailored to each town or city. Although quantitative results are yet to be published qualitative research has involved people, including children, who had changed their cycling behaviour since the start of the programme. The research found that whether or not a person cycles at all, or cycles for particular kinds of journeys is determined by a mix of contextual factors, which suggests that interventions which tackle only one of the potential barriers in this mix may be less likely to succeed than interventions which address barriers across several different levels (Christensen, 2012).

6.5 Research design

Most studies fall short of the ideal research design for demonstrating causation (an experimental approach with treatment and control groups) or for evaluating interventions to increase active transport and therefore do not adequately address the direction of causality, such as whether cycling infrastructure led to increased levels of cycling or whether cycling demand led to investments in bicycle infrastructure (Pucher, 2010; Chillon, 2011). Many studies only measure the impacts of incremental expansions and do not capture the full impact of a completed system. This may account for the poor estimated impacts of some specific infrastructure improvements. A complete system of bicycling infrastructure (e.g. lanes, paths, cycle tracks, traffic signals and parking) may have far more impact than the sum of its individual parts.
Also a coordinated package of complementary infrastructure measures, programmes and policies may enhance the impact of any intervention that is a component of that package. A comprehensive approach produces a much greater impact on bicycling than individual measures that are not coordinated (Pucher, 2010).

In many studies a cross sectional approach is used and this design reveals that interventions need to address many varied factors that influence children’s active transport to school. One of the most influential factors is distance, as longer distances from school have been associated with lower rates of active transport. Very few studies have accounted for distance in their study designs or analyses, when distance should be used as an inclusion criterion for intervention studies targeting children living within walkable or cycle-able distance from school (Chillon, 2011).

**Section 7. Measuring Walkability and bikeablity**

Because people move relatively slowly through an environment on foot or on a bicycle, their experience is more intimate, detailed and finely experienced than that of a motorist. They also cover a relatively smaller area or distance (Moudon, 2003). The finer detail at which pedestrians, and to lesser extent cyclists, experience the environment, added to the generally small spatial area covered by walking and cycling trips, means that analysis of affective factors influencing active transport will necessarily be different to the factors influencing car trips.

**7.1 Macro- and micro-level environmental determinants**

Both macro-level and micro-level elements of the environment have been associated with adult travel and physical activity. Macro-level factors include the characteristics of the area in which the trip takes place and combines four built environment variables that have been found to predict whether people walk or not for transport: higher density communities, diversity of land use types, street connectivity and retail floor ratio (a low ratio indicates a retail development likely to have substantial parking, while a high ratio indicates smaller set-backs and less surface parking, two factors believed to facilitate pedestrian access) (Frank, 2010; Leslie, 2007).
A number of micro-level physical factors or objective variables may be utilised to capture the characteristics of a neighbourhood or route. These are numerous and include:

- Streets and traffic – road width, traffic volumes, presence of traffic calming, crossings (controlled or uncontrolled)
- Pavements - presence and continuity of pavements and type of surface
- Cycling facilities – presence of bike lanes beside or separated from traffic
- Public space/amenities – presence of street furniture or benches
- Architecture or building characteristics – building height
- Aesthetics – cleanliness, trees, parks
- Parking/driveways – presence of parking garages
- Maintenance – presence of litter, cleanliness
- Indicators related to safety – presence of graffiti (Brownson et al, 2009; Pikora, 2002)

Studies have examined macro-scale elements of the built environment (measured on an area-wide basis), while others have focused on micro-scale elements that influence the safety and attributes of specific routes. Clusters of characteristics have emerged as contributing to increased levels of walking and cycling.

7.2 Walkability
“Walkability” has been defined in many different ways. The walkability of a neighbourhood is a measure of whether community design (including the quality of the environment, safety, comfort and pleasure) encourages or inhibits walking (Frank, 2003; Frank, 2004; Gordon-Larsen, 2005; Handy, 2002). For example, lack of a sidewalk can make walking unsafe, and a disconnected street network can discourage walking. Conversely, having retail stores close to where people live and providing connected streets increases the likelihood that a person will incorporate walking into their daily routine (Moudon, 2003). A higher average number of minutes per week are spent walking for transportation in high walkability neighbourhoods compared to low walkability neighbourhoods and this situation exists for both high and low income neighbourhoods (Sallis, 2009; Frank, 2010).
In order to discover whether neighbourhood characteristics support active transport, information needs to be collected and recorded about those characteristics which are believed to, or there is evidence to support, influence active transport. Such information may be obtained from:

- interview or self-report to examine the extent to which individuals perceive access and barriers to various elements of recreation, land use and transportation environments;

- systematic observations or audits to objectively and unobtrusively quantify attributes of the built environment;

- data from archival (existing) datasets that are often layered and analysed with Geographical Information Systems (GIS).

### 7.3 Walkability tools

A walkability tool is an audit instrument used to inventory and assess physical environmental conditions associated with walking (Moudon, 2003). ‘Bikeability’ is often included under walkability and there were no separate bikeability tools identified. Community audits, instruments and protocols have been used to measure the actual physical environment as it is directly observed. For assessing neighbourhood or community features, street segments are the typical unit of observation. Segments are typically sampled, because it is not feasible to audit entire neighbourhoods (Brownson, 2009).

Characteristics of an environment that are relevant to cycling or walking vary according to landscape, built form and cultural traditions (Millington, 2009). Different tools have been developed in a variety of countries, for example, the Scottish Walkability Assessment Tool (SWAT) developed in Scotland may have greater applicability across northern Europe characterised by high density housing and well-connected streets. In contrast the Systematic Pedestrian and Cycling Environmental Scan (SPACES) tool developed in Australia is characterised by a mix of high and low density housing (Millington, 2009). Like many walkability tools the SPACES tool was developed to
measure the walkability of a neighbourhood in terms of physical activity, but not specifically for the walkability of a neighbourhood for active transport or specifically for children, who may have different requirements than adults.

Remote methods of gathering data on the walkability of an area may be less labour intensive and therefore less time consuming than physical streetscape audits.

A virtual audit can be conducted remotely by examining computer generated streetscape images derived from Google Street View. A study in Auckland compared the efficiencies of physically and virtually conducting a streetscape audit within the neighbourhood context and assessed the level of agreement between each audit method. This study found Google Street View to be an efficient and reliable tool which provided an alternative to physically auditing the streetscapes associated with walking and cycling (Badland, 2010). A limitation of Google Street View as a research tool is the time lapse between the recording of the street imagery and the physical audit date.

7.3.1 Problems with walkability tools

In comparing a number of different walkability measures, research reveals that walkability measures are not a “one size fits all”. Existing walkability indices which look at the current built environment may not explain how walking behaviour varies across trip purpose and socio-demographic factors. A Canadian study of 17,394 households in Montreal looked at trip purpose, taking into account that not all individuals evaluate choice in the same way. The utility of either walking or cycling varies not only by time, distance and convenience, but also by the characteristics of the decision maker and the type of trip. Their study showed that factors influencing school trips differ from shopping trips revealing that walkability indices do not necessarily apply to all types of walking trips, for example, of school trips made in locations with the highest walk score or connectivity measures, only 33% are made by foot (Manaugh, 2011).

Most tools consider walkability; however walkability does not predict bikeability – different criteria may be important to the different modes of transport.

Walkability tools do not differentiate between adults and children, whose experience of the transport system and needs may be different, for example, a Belgian study of
12-18 year olds living in a less ‘walkable’ suburb in a suburban area of town was associated with more active travel to school (mainly cycling) than living in a more walkable inner city area (van Dyck, 2009).

Most indices look at walkability for recreation or shopping, and hence focus on facilities in an area, but not many indices look at walkability for active transport to school, where different factors are at play, for example, the distance to public transport (Ewing, 2009; Handy, 2002). Walkability tools do not look at a specific journey across possibly two audit areas and one feature of an otherwise walkable neighbourhood may be sufficient to discourage children from waking or cycling.

Active transport to school is unique and distance is the strongest indicator. In examining environmental factors that influence rates of children’s active transport to school, distance is one of the most limiting factors in the choice to use non-motorised transport (Panter, 2008).

Tools which included retail space or mixed land use may not be relevant to children cycling on specific routes to school. However dwelling density may be more significant if houses facing on to the street increase the perception of visibility and safety.

Studies of pedestrian accessibility generally use the street network or sometimes a more limited network of streets that can be safely used by pedestrians. But unlike vehicles, pedestrians are not confined to the street network and their actual travel network around the city may include formal pedestrian facilities, such as pedestrian over and under passes, walkways, and greenbelt paths, together with informal routes, such as those through parks, parking lots, shopping centres, and other public facilities. In general, focusing on the street network ignores pedestrian travel outside the network, including the sometimes substantial travel involved in getting to and from the street (Tal, 2011).

The number and type of variables collected by the many environmental audit tools, illustrates the lack of empirical evidence for single variables to affect the walkability or cycle-ability of a neighbourhood (Moudon, 2003).
The nature of the urban form is only one part of a complex decision about the choice of active transport to school, which is influenced by many contextual factors. The urban form, either real or perceived by parents, may determine whether a child is permitted to walk or cycle to school. It has been suggested that the motivation to use active transport is the precursor to attitudes to the urban form (Mc Millan, 2005).

In summary, there are a number of factors, mediated through parents, which influence whether a child uses active transport to school or another means of transport. These multiple factors are illustrated in Figure 1. The parent acts as a gatekeeper and must evaluate health, safety, infrastructural and environmental information to assist decision making. The demographic characteristics of the parent and child may also affect behaviour.

Evidence supports the effectiveness of an integrated package of many different, complementary interventions, including infrastructure provision and pro-bicycle programmes, as well as supportive land use planning and restrictions on car use (Pucher, 2010).

Most studies do not address all the factors that influence children’s active transport to school. One of the most influential factors is distance and greater distances from school have been associated with lower levels of active transport. Very few studies have accounted for distance in study designs or analyses when it is a key factor in whether intervention studies targeting children, within walking or cycling distance from school, are successful. Distance can be viewed as either the most direct route (i.e. shortest) or the safest route (i.e. less potential traffic or crime hazards).
Child characteristics
Age
Gender
Ethnicity
SES
Social context/family
Location – rural/urban

Environmental
Distance
Urban form
Land use
Population density
Street connectivity
Congestion
Cycle paths
Pavements

Social/cultural
Neighbourhood
Car culture
"Good parent"

Benefits of cycling
Individual health (physical & mental)
Social
Environmental

Parental perceptions and attitudes
Actual vs perceived
Assessment of Risk

GATEKEEPER
Children's perceptions
Independence
Development
Self-efficacy
Peer behaviour

Safety
Traffic
Crime/stranger danger
Physical & mental
ability

Children's Active Transport
Walking
Cycling

Parental characteristics
Car ownership
Work commitments
Income
Mother in employment
Social support
Modelling behaviour

Weather
Terrain

Government
Economy
Legislation
Policy
Local Government initiatives

Promotion of cycling
Programmes in schools

Figure 1. Influence diagram for children's active transport to school.
Section 8. Context of Current Study

Programmes which attempt to increase rates of cycling and walking work best through an integrated package of interventions which address the many factors which inhibit or promote active transport. While programmes led from government and through national policy would be most influential, whole town strategies are potentially effective in changing attitudes and behaviour.

Between 2008 and 2011, the Department for Transport in the UK established Cycling England (CE) and with the Department for Health invested £140 million (plus local matched funding) to create the Cycling Cities and Towns (CCTs).

The strategies for promoting cycling varied between each CCT but targeted investment programmes focused on specific groups, places and journey purposes, including schools, workplaces and rail interchanges. Capital investment included on and off road cycle lanes and routes, improved signage, a range of cycle parking facilities and enhanced cycle crossing facilities at key junctions. Programmes have included road shows and promotional activities, cycle training for adults and children, marketing and information campaigns, events sponsorship and bike maintenance and recycling (Christensen, 2012).

The initial report on the six Cycling Demonstration Towns reported that the proportion of pupils who cycled to school on a regular basis – either ‘every day’ or ‘once or twice a week’ increased by 126% (from 11.6% to 26.2%) between the baseline survey at each school (in either September 2006 or September 2007) and the ex-post survey ten months later. At 22 schools a further follow-up survey 12 months after the end of intensive support, reported that the prevalence of cycling amongst children for the journey to school was maintained: the proportion of pupils cycling to school either ‘every day’ or ‘once or twice a week’ was 8.7% at baseline (September 2006); 26.0% in the survey ten months later (July 2007) and 25.1% after a further 12 months (July 2008) (Sloman, 2009). Findings revealed a significant potential for more children who live within two kilometres of school to cycle to school.
8.1 Model communities

Using a similar concept to the Cycling Cities and Towns, the New Zealand Transport Agency (NZTA) has funded two model communities, Hastings and New Plymouth through their District Councils with the sums of $3.71 and $3.57 million respectively over the 2010/11 and 2011/12 financial years, and further funding to 2015. Funding supports a multi-faceted approach including infrastructural changes (cycle lanes and separate walkways) and an informational-educational aspect (including campaigns to encourage increased cycling and walking). The NZTA explains model communities as urban environments where walking and cycling are offered to the community as the easiest transport choice. This is being done without any corresponding restrictions on car use, but it does attempt to address a number of barriers in a packaged approach.

Hastings and New Plymouth have different intervention programmes personalised to the character of the cities, but they share a number of key aspects in their multi-pronged approach:

- Investment in the infrastructure, for example, new tracks and cycle paths, lighting, bike stands, footpath renewal and shared-space projects;
- Publicity and awareness campaigns aimed at changing attitudes and beliefs about cycling and walking;
- An emphasis on safety both through infrastructure design but also education programmes, including safety education in schools;
- A focus on connectivity in key areas, for example, the CBD and around schools
- Travel planning support through the provision of maps; and
- Community involvement of other government agencies, schools and community groups.

The package of activity in the New Plymouth District Council proposal includes:

- Shared pathway projects prioritised for maximum impact;
- Complementary local and state highway on-road cycle improvements;
- Ongoing opportunities for expanding the network – Waitara and beyond;
- An active transport hub;
The New Plymouth “Dream street” concept and shared space within the city centre; and

A complementary education programme including cyclist skills training, children involved in driving down speed, ‘Share the road’, ‘Pathways’ and ‘Captain Car Door’ campaigns, Wild West Bike Fest, car free days, school gateway projects, travel planning, surveys, modal mapping and a new movement web site.

The package of activity in the Hastings District Council proposal includes:

- A focus on four key arterial routes into the city centre, completing routes and linking communities and modes;
- Complementary on-road cycle improvements on key collector routes;
- Shared pathway projects;
- Footpath renewal, connectivity and lighting;
- A network of information signs, bike stands and seats; and
- A complementary education programme including cyclist skills training, Share the road, campaigns, promotional campaigns for ‘Walk and cycle to school’, ‘Walk and cycle to work’, ‘Walk and cycle to the shop’ and ‘Walk and cycle for fun’, and safety programmes (New Zealand Transport Agency, 2010)

To understand and measure the effects of these infrastructural and educational initiatives the Activating Communities To Improve Vitality and Equality (ACTIVE) Study is being conducted by the NZ Centre for Sustainable Cities in collaboration with the Hastings and New Plymouth councils. The two matched control cities, Whanganui and Masterton, were chosen for their similarities to the two experimental cities in terms of size, climate and population (see Appendix C). Baseline data have been collected in all four cities and changes have been observed between 2011, 2012 and 2013 to understand if the interventions in Hastings and New Plymouth have increased active transport and improved attitudes to active transport for the populations of these cities.
8.2 The current study
The current study aims to look at the rates of active transport for children aged ten or over included in the ACTIVE study and the multiple factors that influence the decision to use active transport to school.
Chapter 3: Methods

Aim of the study: to investigate the key factors behind a child’s choice of mode of transport for their journey to and from school.

Objectives

- To explore children’s mode of transport (walking, cycling or by car) to school in relation to distance from their home to the school and travel along or through arterial roads;
- To examine the relationship between active transport to school and demographic variables including, gender, age and socio-economic status;
- To identify the choice of mode of transport to work for the parents/caregivers of the children and compare this to the children’s mode of transport to school;
- To explore the amount of exercise taken (either walking or cycling) by the parents/caregivers and any relationship between their level of activity and their children’s mode of transport to school; and
- To explore access to a functioning bike and access to a car and active transport to school and work.

3.1 Methods for the ACTIVE study

The Activating Communities to Improve Vitality and Equity (ACTIVE) study is a quasi-experimental investigation of the model communities programme in Hastings and New Plymouth.

Individual household data collected in face-to-face surveys from these two cities and two control cities, Masterton and Whanganui, were collected from the same randomly selected households at baseline, one year and two years later. The evaluation is intended to assess whether the model communities’ interventions resulted in increased active travel with a move away from, particularly, car use.

The monitoring and evaluation of the model communities initiative has been undertaken by the New Zealand Centre for Sustainable Cities. In order to establish a baseline for each of the four cities, the Transport and Lifestyle Survey was designed and conducted in face-to-face household surveys. Each person over the age of ten in a
household was invited to participate. The households were selected from a stratified random sample of both high and low deprivation mesh-blocks and in areas both close to and distant from the Model Communities Infrastructure. Follow-up surveys were planned for one and two year intervals (Chapman, 2012).

The surveys collected information on travel behaviour in general; frequency and mode of transport for journeys including those for work and school; factors influencing choice of route, mode and safety perceptions; general walking and cycling activity; transport habit strength, opinions about walking and cycling; cycling frequency and use of public transport, psychological well-being; and basic demographic information (Muggeridge, 2012).

The ACTIVE study was powered to detect a difference in the effect of the Model Communities programme on cycling and walking. The study was not specifically designed to analyse factors behind children’s mode choice to school, so this secondary analysis was expected to be limited in explanatory power.

3.2 Methods for the study on the children from the ACTIVE study

3.2.1 Selection of variables from the ACTIVE study survey
The ACTIVE data collected in the Transport and Lifestyle Survey for the years 2011 and 2012 in all four cities (Hastings, New Plymouth, Masterton and Whanganui), were explored to see which questions in the survey could inform analysis of children’s active transport to school in relation to factors already identified in the literature review. See Table 3.

Case studies of three households in different cities were constructed from the data collected to better understand the data variables and create a picture of a household including a focus on: the adults, children, places of work and school; how travel to work or school was normally done; the factors influencing the choice of route to school/work; the factors influencing the choice of mode of transport to these places; factors influencing safety perceptions; how frequently people walked or cycled; opinions about walking and cycling; ethnicity; and socio-economic status.
Each of the cities had the opportunity to add a few additional questions, which were not replicated in the other cities. The Transport and Lifestyle Survey varied between the baseline year (2011) and the second year (2012) and the following variables may have been useful but could not be obtained across both years:

- Factors influencing choice of mode of transport - this information was only collected for the city of Hastings in the baseline study data of 2011.
- Factors influencing safety perceptions - these data were only obtained for Hastings in the baseline study data of 2011.
- Variables about adult opinions of cycling and walking – these data were only collected for the baseline year and not collected for the second year of the study, 2012, but will be collected again in 2013.
### Table 3. Variables from the ACTIVE survey identified in the literature review

<table>
<thead>
<tr>
<th>Factors that influence active transport in children</th>
<th>ACTIVE Study questions/variables</th>
<th>Literature Review Summary and References</th>
</tr>
</thead>
</table>
| Distance                                          | School name                      | Shorter distance between home and school is associated with active transport to school (Davison, 2006; Ewing, 2004; Larsen, 2009; Martin, 2005; Panter, 2008; Pont 2009; Davison, 2008; Temperio, 2006).
Those who live within one mile of school are more likely to walk compared to those that live 1-1.5 miles or further away (Schlossberg, 2006; Yelavich, 2008; McDonald, 2008).
The majority of walkers in a study lived within 1.5 mile and cyclists within 2.5 miles. A third of parents who perceived distance as a barrier to their children’s active transport to school actually lived within 0.8 kilometres of the child’s school (Nelson, 2008). |
| Car ownership                                     | Do you have access to a car?     | Parents of children with two or more cars were more likely to drive to school (Bringolf-Isler, 2008).
Children’s opportunities for active travel were closely linked to parental scheduling and travel (Larsen, 2009). |
|                                                   | Home address                     |                                          |

Distance: School name, Home address

Car ownership: Do you have access to a car?
<table>
<thead>
<tr>
<th>Bicycle ownership</th>
<th>Do you have access to a functioning bike?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Date of birth</td>
</tr>
<tr>
<td></td>
<td>AT to school is more common among younger children aged between 8-11 years of age (Yelavich, 2008; Bringolf-Isler, 2008; Fulton, 2005). Primary schools are more numerous in number than secondary schools - it is likely therefore that younger children live closer to their primary school and are thus more likely to use AT: 18.5% of primary children aged 5-11 versus 15.3% of secondary age children aged 12-18 (Martin, 2005).</td>
</tr>
<tr>
<td>Gender</td>
<td>Gender</td>
</tr>
<tr>
<td></td>
<td>Boys are more likely than girls to use active transport across all age groups (Davison, 2008; Yelavich, 2008; Fulton, 2005; Nelson, 2008; Timperio, 2006; Larsen, 2009). Girls of an older age at high school were more likely to walk to school than younger girls aged 5-14 (McDonald, 2008)</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>Which ethnic groups do you belong to?</td>
</tr>
<tr>
<td></td>
<td>Children from Māori or Pacific Island children households were less likely to use AT than NZ European children (Yelavich, 2008; Davison, 2008).</td>
</tr>
<tr>
<td>Socioeconomic status</td>
<td>Name of school attended and the decile of the school</td>
</tr>
<tr>
<td></td>
<td>Increasing household income and increased car ownership per capita of the population have been associated with lower rates of active transport.</td>
</tr>
<tr>
<td>Child behaviour/perceptions (controlled indirectly by parent)</td>
<td>Parental concerns versus children's views (Collins, 2001)</td>
</tr>
<tr>
<td>------------------------------------------------------------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>Times travelled to school in last 7 days</td>
<td>Parental view of safety often different from children (Timperio, 2004)</td>
</tr>
<tr>
<td>How often to school in last 7 days via different modes</td>
<td></td>
</tr>
<tr>
<td>Presence of a physical condition preventing walking/cycling in the last 7 days?</td>
<td></td>
</tr>
<tr>
<td>What mode of transport would you choose if you were going to school?</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parental behaviour/perceptions</th>
<th>Parents as gatekeepers - Parental opposition to active travel to school is one of the main barriers to children walking or cycling to school.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Times travelled to work in last 7 days?</td>
<td>Parental views of distance whether perceived or real (Martin, 2005; Yeung, 2008; Timperio, 2004).</td>
</tr>
<tr>
<td>How often to work in last 7 days via different modes?</td>
<td>Risks of violence or injury (Bringolf-Isler, 2008; Brunton, 2003; Salmon, 2007).</td>
</tr>
<tr>
<td>Presence of a physical condition preventing walking/cycling in the last 7 days?</td>
<td></td>
</tr>
<tr>
<td>Question</td>
<td>Answer</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>What mode of transport would you choose if you were going to work?</td>
<td>The use of cars for transport has become a normalised behaviour which is established in early adolescence (Brunton, 2003; Lorenc, 2008), and to some extent in younger children (Lorenc, 2008). Parents can often restrict girl’s opportunities for active transport more than male children (Carver, 2010; Cooper, 2003; Davison, 2008). If parents value physical activity and support it, children are more likely to use active transport (Davison, 2008).</td>
</tr>
<tr>
<td>During previous 7 days on many days did you do moderate walking for at least 10 minutes?</td>
<td></td>
</tr>
<tr>
<td>Time spent doing moderate walking?</td>
<td></td>
</tr>
<tr>
<td>During previous 7 days on many days did you do vigorous walking/running for at least 10 minutes?</td>
<td></td>
</tr>
<tr>
<td>Time spent doing vigorous walking/running?</td>
<td></td>
</tr>
<tr>
<td>During previous 7 days on many days did you cycle at a regular pace for at least 10 minutes?</td>
<td></td>
</tr>
<tr>
<td>Time spent doing cycling?</td>
<td></td>
</tr>
</tbody>
</table>
During previous 7 days on many days did you cycle vigorously for at least 10 minutes?

Time spent cycling vigorously
3.2.2 Sample Selection
The inclusion criteria for being in the sample was children: between 10 and 18 years of age; in full time education attending either primary, intermediate or college level; and who walked, cycled, bussed or travelled by car to school.

Children who did not have an adult living in the same house and who took part in the study were excluded. This was a total of four children.

3.2.3 Use of Google Maps Street View
Virtual images could be used remotely by examining computer generated streetscape images derived from Google Maps Street View. These virtual images were used:

- to measure the distance between home and school by the most direct route (this may include main roads, but children could possibly have travelled by less direct routes in reality); and
- to categorise arterial and non-arterial roads in each of the four cities – see Figure 2.

Google Maps Street View has been validated as an efficient and reliable method of auditing the streetscapes associated with walking and cycling (Badland, 2010).

In addition the website http://nzschools.tki.org.nz/ school finder service was used to see if children were attending the school that was closest to them, or they were travelling further having chosen to attend a different school.

3.2.4 Route to school
Initially an attempt was made to classify the routes taken by children to school in order to try and discover whether environmental or neighbourhood characteristics supported active transport.

Most instruments (as discussed in the literature review) that measure or assess a neighbourhood or community features use street segments as the unit of observation. A neighbourhood is typically assessed by randomly selecting segments to provide an overall score of the ‘walkability’/’cycle-ability’ of a neighbourhood. Because the children in the study were likely to travel through a number of neighbourhoods to reach their destination and the survey did not ask them to specify the route used, it was not possible
to assess their whole route to school. Cycle-ability/walkability could vary across
neighbourhoods.

The characteristics that are relevant to cycling and walking may be different in
themselves and also different for adults than for children. For example, the surface of the
road may be relevant to cyclists, but will not have an impact on pedestrians. Conditions
may well apply for only part of a journey, for example, a cycleway separate from the
traffic may end abruptly, be interrupted by a road/junction/roundabout, or not follow a
child’s entire journey to school.

Therefore no established walkability tool leant itself to the analysis of children’s journeys
either walking or cycling to school.

In order to try and develop a new classification of children’s routes to school, questions
in the Transport and Lifestyle Survey (Appendix B) which asked about “factors influencing
choice of route” and “factors influencing safety perceptions” were used to develop a list
of factors that could be included (See Appendix C).

It was decided to use Google Street View to examine children’s routes to school and
attempt to classify features of the journey based on the questionnaire. However a
number of issues were identified with attempting to classify factors in relation to the
child’s journey to school (Appendix C).

**The main issues identified with attempting a classification of children’s routes to school**

- Google Street View displays the shortest route to a destination. The choice of
  route, direct or not, changes the distance travelled. A child may not take the most
direct route and short cuts through alleys or parks are not shown on Google
Street View. Also, children may enter or leave schools via back entrances or on
side roads and Google Street View only shows the route to the main entrance of a
school.

- The age of Google Street View images varied from 2008 to 2011 and therefore
  they may not reflect the road network at the time people were surveyed.

- The volume of traffic cannot be observed on Google and is unlikely to be
  consistent; it may be busy in the morning on arterial roads, but less busy at 3pm
when children leave school. Single or double lane roads do not necessarily reflect
volume of traffic.

- Specific conditions identified on a route, for example, the character of a
  pavement, may continually change over the route travelled to school.
- When a child cycles to school, they may not necessarily use the road, but cycle
  some or all of the way on the pavement.
- Weather conditions may be changeable in their influence and terrain (whether
  hilly or not) may play a role.
- In terms of using residential areas as a proxy for improved safety with “many eyes
  on the road”, there may be fencing along the street which obscures the view of
  the pavement from houses.
- The presence of dairies or shops may not be relevant to a child’s journey to
  school and pleasant views or interesting places may be of less relevance to a
  journey specific to transport purposes.
- The presence of parks can be viewed positively as a potential short cut or
  pleasant scenery, but also negatively because of reduced public visibility.
- The presence of lampposts was universal in the cities and would be very unlikely
  to be relevant as children generally travel to and from school in daylight hours.

An alternative method to classifying children’s routes to school was chosen. The number
of arterial roads which children either travelled along or crossed on their journey to
school was used to indicate the amount of traffic that may be encountered and the
increased safety risk of traversing intersections. Arterial roads are those that
predominantly carry through traffic from one region to another and intra-regionally form
principal avenues of travel for traffic movement (NZTA, Traffic Control Devices Manual,
2010).
Distance A to B – this includes travelling on one non-arterial road and crossing one arterial road = 1 arterial road.

Distance A to C - includes travel on one non-arterial road and two arterial roads and crossing one arterial road = 3 arterial roads

Distance A to D - includes travel on one non-arterial road and two arterial roads and crossing one arterial road and one non-arterial road = 3 arterial roads

Distance A to E - includes travel on one non-arterial road and two arterial roads and crossing two arterial roads and one non-arterial road = four arterial roads
3.3 Analysis

The data collected from both 2011 and 2012 from the survey were analysed and presented in tabular form with descriptive text.

Bivariate regressions were done to determine whether potential relationships existed between active transport and factors that may have influenced behaviour.
Chapter 4: Results

4.1 Case Studies

The case studies are described here to assist understanding of the scope of the data from the Transport and Lifestyle Surveys conducted as part of the ACTIVE study. Considering a household as opposed to individuals alone allowed the opportunity to understand what factors had an impact on family behaviour and how the adult's behaviour corresponded with the children's mode of transport to school.

4.1.1 Hastings

A household in Hastings was composed of two adults, a man and a woman, with two children. The boy, aged sixteen, attended a high school (0.813km from home) and the younger girl, aged twelve, attended an intermediate school (2.16km from home). The boy also had a part-time job at a fast food restaurant.

In the previous week the man had travelled once to work, the woman 10 times and the boy three times to his part-time job. The man used a form of transport which was not specified, but was not a car, bicycle, walking or public transport. The woman always travelled by car and the boy went to work by car once, but by bicycle on the other two occasions. The boy did not attend school in the previous seven days and the younger girl only went to school once by walking.

In making a choice about which route to travel, the factors reported to be important or very important were enjoyment and cycle surface quality for the boy; personal safety, convenience and time were important for the girl; the quickest and most direct route along with personal safety were most important factors for the woman; and for the man, the quickest most direct route and convenience were of greatest importance.

In the choice of mode of transport, the factor noted as very important or important for the boy was enjoyment; for the girl getting there quickly, personal safety, convenience, enjoyment and health were all important; for the woman getting there quickly was important; and for the man getting there quickly, personal safety, risk of injury and convenience were all important factors.
The only member of the household without access to a bike was the girl. In the previous week both the girl and the man had a physical condition that prevented them from cycling or walking; possibly they were ill, as the man only went to work once and the girl only attended school once. Both adults had access to a car. Of the adults, only the woman did moderate walking exercise three times a week for 25 minutes each time. Neither of the adults used bikes for exercise.

The mode of transport most readily chosen for the adults to travel to work was by car and the most likely mode chosen by the boy and girl for travelling to school was walking.

In the previous year the man and boy had ridden a bike, but in the previous four weeks, only the man had ridden a bike on 10-14 days. No data were reported for the boy, although he had clearly cycled to his part-time job twice in the previous week.

The most important factors influencing safety perceptions for the boy were driver behaviour and street lighting; for the girl street lighting; for the woman parking provisions, traffic volume, driver behaviour and street lighting were all important; and for the man traffic volume and parking provision were important factors.

The children both put a higher value on the ‘goodness’ of walking than their parents and also thought walking was ‘more realistic’ than their parents. All the family believed that walking was a ‘wise’ thing to do. Although the boy and woman felt walking was more safe than not, the man felt it was unsafe and the girl was neutral.

All the family, except the man, believed that cycling was ‘good’ and also ‘pleasant’ and ‘wise’. The woman felt it was the most unsafe, followed by the man, then the girl. However the boy felt that cycling, as a means of transport, was safe.

4.1.2 Whanganui
A family group in Whanganui, all of European ethnicity, consisted of two adults, a male and female, and three female children, twins aged 15 and one aged 13 years of age. One girl attended an intermediate school and the elder twins attended a college. The twins both walked 3.9 km to school and the younger girl walked 4.4km to school.

The man had travelled to work seven times in the previous week by car. The woman was not in employment, but used a car for five journeys to the supermarket in the previous
week. The three children travelled to school five, four and five times respectively during the week, mostly by walking but occasionally by car. On one occasion, one child had used the bus.

Of the two female children who provided responses, the factors that most influenced their choice of route were the quickest or most direct route and convenience. Additionally, one of the girls also rated personal safety and the quality of the surface for walking as very important. While one girl rated personal safety as very important, the other rated it of relatively little importance. Similarly in considering enjoyment in influencing the choice of route, one rated it very important and the other of relatively little importance.

Only one girl had access to a functioning bike and both adults had access to a car. Over the previous week all members of the household had undertaken moderate walking, the man on five days for two hours each day, the woman on three days for three hours, and all three children on seven days for approximately 90 minutes on each day. One of the girls had done moderate cycling on one day for twenty minutes. The transport mode of choice for each of the three children for going to school was walking.

All except the woman put a high value on the belief that walking as a means of transport was good. All except one of the girls felt that walking was unpleasant. Only one child reported walking as sensible, the rest of the family thought it less so. While the adults believed walking to be more unrealistic as a means of transport the children all held the view that it was more realistic than the adults. Similarly in comparing whether walking as a means of transport was ‘wise’ or ‘foolish’, the adults leaned more toward ‘foolish’ than the children. The family felt generally that walking was unsafe, the man and one child, more than the others. While the entire household agreed that cycling was a ‘good’ means of transport, they agreed that it was not a ‘wise’ means of transport.

The woman and two of the children had ridden a bicycle in the last 12 months, but in the previous four weeks the woman had not ridden it at all, one of the children had ridden on between five and nine days and the other child on 20 days or more.
4.1.3 New Plymouth

A New Plymouth household consisted of a man and two children, a boy aged 12 who attended intermediate school and a girl aged 10 years at primary school. They were all of European ethnicity.

The man worked full time and had travelled to work nine times in the previous week by car. Both children had walked to school, the boy 0.9km and the girl, 1.3km. The factors that determined the choice of route to work for the man were the quickest or most direct route and personal safety. The children were influenced by the same factors, but in addition, the boy was also influenced in his choice of route by enjoyment and the girl by convenience. Both children could have taken alternative routes to their schools along minor roads and through a park area which may have been quicker than their route via road. However it is not possible to tell which route they would have taken; the route through the park may have been more enjoyable, which was a factor of importance mentioned by the boy but the quickest most direct route was also of importance. The road route involved a main arterial road, but most of the journey was along a cycle lane on the road, which was not separated from the car traffic.

The two children participated in other active pastimes, the girl in gymnastics three times a week and the boy karate, once a week. Both children were driven to these activities.

Each of the family had access to a functioning bike and the man had access to a car. The man reported moderate and vigorous walking as well as moderate and vigorous cycling in the previous week. Apart from walking to school, the children reported moderate and vigorous cycling in the previous week. The only activity where the man chose to walk was trips to the park, while the children chose walking not only for school, but also for trips to shopping, the park and the dairy.

All the family had ridden their bikes in the previous month, the man and the boy both between one and four times. The girl had ridden her bike on 10-19 days in the previous month. None of the family had used public transport in the prior month.

In terms of their opinions on walking as a means of transport, the man felt it was ‘good’, ‘wise’, ‘pleasant’ and ‘sensible’ but unlike his children, he felt it was ‘unrealistic’. The two
children agreed with the man except on the belief that it was unrealistic where they both felt that it was realistic. With regard to safety, the boy felt it was safer than the man and the girl, who believed it to be the least safe.

Among the family the opinions on cycling, as a means of transport, were similar with regard to cycling being good, safe, pleasant and realistic. With regard to safety, the boy felt it was safer than the man and the girl, again believed it to be unsafe. In comparison to walking, their scores indicated that cycling was considered less safe than walking.
4.2 Descriptive tables and data

This section describes the aggregated data, to which the above case studies formed a part. The total number of children aged 10-18 years of age that were included in this study was 71.

Four different modes of transport were included for analysis and are shown in Table 4.

Table 4. Number and proportion of children using different travel modes (main mode only) in their journey to school.

<table>
<thead>
<tr>
<th>Mode of transport</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active transport*</td>
<td></td>
</tr>
<tr>
<td>Walking</td>
<td>29 (41%)</td>
</tr>
<tr>
<td>Cycling</td>
<td>8 (11%)</td>
</tr>
<tr>
<td>Car</td>
<td>21 (30%)</td>
</tr>
<tr>
<td>Bus</td>
<td>13 (18%)</td>
</tr>
<tr>
<td>Total</td>
<td>71 (100%)</td>
</tr>
</tbody>
</table>

*For this analysis, walking (29 children) and cycling (eight children) have been combined into ‘active transport’, a total of thirty-seven children (52%).

The data collected for the ACTIVE study were collected between 28 May and 2 October in 2011 and 28 June and 10 October in 2012 and although some families participated in the survey in both years, they were only counted once and new families were included from the second year of data collection. The periods of data collection were traditionally winter months and therefore the numbers of children using active transport to travel to school in the study may be conservative.
Table 5. Number and proportion of children using different travel modes (main mode only) in their journey to school by gender.

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active transport*</td>
<td>17 (53%)</td>
<td>20 (51%)</td>
<td>37 (52%)</td>
</tr>
<tr>
<td>Car</td>
<td>9 (28%)</td>
<td>12 (31%)</td>
<td>21 (30%)</td>
</tr>
<tr>
<td>Bus</td>
<td>6 (19%)</td>
<td>7 (18%)</td>
<td>13 (18%)</td>
</tr>
<tr>
<td>Total</td>
<td>32 (100%)</td>
<td>39 (100%)</td>
<td>71 (100%)</td>
</tr>
</tbody>
</table>

*walking and cycling combined

Thirty-two males and 39 females were included in the research (Table 5). 55% of the children in the study were female and 45% male. These proportions remained consistent for each of the modes of transport to school.

Table 6. Number and proportion of children using different travel modes in their journey to school by age.

<table>
<thead>
<tr>
<th></th>
<th>Less than 13</th>
<th>≥13</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active transport*</td>
<td>19 (54%)</td>
<td>18 (50%)</td>
<td>37 (52%)</td>
</tr>
<tr>
<td>Car</td>
<td>10 (29%)</td>
<td>11 (31%)</td>
<td>21 (30%)</td>
</tr>
<tr>
<td>Bus</td>
<td>6 (17%)</td>
<td>7 (19%)</td>
<td>13 (18%)</td>
</tr>
<tr>
<td>Total</td>
<td>35 (100%)</td>
<td>36 (100%)</td>
<td>71 (100%)</td>
</tr>
</tbody>
</table>

*walking and cycling combined

Those children aged less than 13 used all modes of transport to school at similar rates to those aged 13 or over (Table 6).
Table 7. Number and proportion of children using different travel modes in their journey to school by distance between home and school

<table>
<thead>
<tr>
<th></th>
<th>Less than 2km</th>
<th>2.1 – 4km</th>
<th>4.1 – 6km</th>
<th>Less than 6km</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active transport*</td>
<td>21 (84%)</td>
<td>10 (45%)</td>
<td>4 (27%)</td>
<td>2 (22%)</td>
<td>37 (52%)</td>
</tr>
<tr>
<td>Car</td>
<td>3 (12%)</td>
<td>10 (45%)</td>
<td>7 (47%)</td>
<td>1 (11%)</td>
<td>21 (30%)</td>
</tr>
<tr>
<td>Bus</td>
<td>1 (4%)</td>
<td>2 (10%)</td>
<td>4 (27%)</td>
<td>6 (67%)</td>
<td>13 (18%)</td>
</tr>
<tr>
<td>Total</td>
<td>25 (100%)</td>
<td>22 (100%)</td>
<td>15 (100%)</td>
<td>9 (100%)</td>
<td>71 (100%)</td>
</tr>
</tbody>
</table>

*walking and cycling combined

Thirty-five per cent of children lived within two kilometres of their school.

As shown in Table 7, the proportion of children who used active transport to school decreased with increasing distance from the school. Fifty-seven per cent of those children that used active transport lived within two kilometres of the school. Twenty one out of a total of 25 children who lived within two kilometres of the school used active transport. Only five per cent of those who used active transport travelled more than six kilometres to school.

While 84% of those who used active transport lived within four kilometres and 57% within two kilometres, 62% of those that travelled by car also lived within four kilometres, and 14% within two kilometres.

For those that lived more than six kilometres from school the most common mode of transport to school was the bus.
Only 23% of all journeys to school involved one or less arterial roads to traverse or cross, 39% involved between two and four and 38% involved five or more (Table 8).

Active transport was more common than other modes of transport, where there was one or less arterial roads to traverse along or intersect (88%). The proportion of children who used active transport to school remained consistent where there were up to four arterial roads on the journey, but rates of active travel dropped off when arterial roads involved in the journey increased over five. However it may be that with increased arterial roads, distance also increased.

Although travel to school by bus was associated with the number of road intersections, either traversed or intersected, this was also associated with distance. This trend was less apparent among those who used a car to travel to school: 76% of those using active transport compared with 62% of those travelling to school by car traversed or crossed up to four arterial roads.

<table>
<thead>
<tr>
<th></th>
<th>0-1</th>
<th>2-4</th>
<th>5 or more</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Active transport</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(walking and cycling combined)</td>
<td>14 (88%)</td>
<td>14 (50%)</td>
<td>9 (33%)</td>
<td>37 (52%)</td>
</tr>
<tr>
<td><strong>Car</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 (12%)</td>
<td>11 (39%)</td>
<td>8 (30%)</td>
<td>21 (30%)</td>
</tr>
<tr>
<td><strong>Bus</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0 (0%)</td>
<td>3 (11%)</td>
<td>10 (37%)</td>
<td>13 (18%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>16 (100%)</td>
<td>28 (100%)</td>
<td>27 (100%)</td>
<td>71 (100%)</td>
</tr>
</tbody>
</table>

*Table 8. Number and proportion of children using different travel modes in their journey to school by the number of arterial roads traversed or intersections on the route to school.*
Table 9. Number and proportion of children using different travel modes in their journey to school and those that attended the closest school to their home address

<table>
<thead>
<tr>
<th></th>
<th>Children who attended the school closest to their home address</th>
<th>Children who did not attend the school closest to their home address</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Active transport</strong></td>
<td><strong>29 (67%)</strong></td>
<td><strong>8 (29%)</strong></td>
<td><strong>37 (52%)</strong></td>
</tr>
<tr>
<td><strong>Car</strong></td>
<td><strong>9 (21%)</strong></td>
<td><strong>12 (43%)</strong></td>
<td><strong>21 (30%)</strong></td>
</tr>
<tr>
<td><strong>Bus</strong></td>
<td><strong>5 (12%)</strong></td>
<td><strong>8 (29%)</strong></td>
<td><strong>13 (18%)</strong></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>43 (100%)</strong></td>
<td><strong>28 (100%)</strong></td>
<td><strong>71 (100%)</strong></td>
</tr>
</tbody>
</table>

*walking and cycling combined

Table 9 shows that almost two-thirds (61%) of children in the study attended the school closest to their home address. Of those that used active transport over three-quarters (78%) attended the school closest to their home address compared to only 43% of those who went to school by car and 38% of those who used the bus. When children did not attend the nearest possible school to their home address, they were more likely to use either car or bus modes of transport.
Table 10. Number and proportion of children using different travel modes in their journey to school by ethnicity.

<table>
<thead>
<tr>
<th></th>
<th>Māori</th>
<th>European</th>
<th>Other/not stated</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Active transport</strong></td>
<td>9 (43%)</td>
<td>26 (58%)</td>
<td>2 (40%)</td>
<td>37 (52%)</td>
</tr>
<tr>
<td><strong>Car</strong></td>
<td>3 (14%)</td>
<td>15 (33%)</td>
<td>3 (60%)</td>
<td>21 (30%)</td>
</tr>
<tr>
<td><strong>Bus</strong></td>
<td>9 (43%)</td>
<td>4 (9%)</td>
<td>0 (0%)</td>
<td>13 (18%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>21 (100%)</td>
<td>45 (100%)</td>
<td>5 (100%)</td>
<td>71 (100%)</td>
</tr>
</tbody>
</table>

*walking and cycling combined

Māori made up 30% of those included in the study, compared to those of European ethnicity which made up 63% (Table 10). Māori were represented more among those that travelled to school by bus (43% of all those that travelled by bus) compared to Europeans (9%). Over half (58%) the European children used active transport to school, compared to 43% of Māori. One third of all Europeans travelled to school by car, compared to 14% of Māori. No Pacific Island or Asian children were included in the study.

Table 11. Number and proportion of children using different travel modes in their journey to school by socioeconomic status (decile† of school)

<table>
<thead>
<tr>
<th></th>
<th>1-3</th>
<th>4-7</th>
<th>8-10</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Active transport</strong></td>
<td>17 (63%)</td>
<td>14 (39%)</td>
<td>6 (75%)</td>
<td>37 (52%)</td>
</tr>
<tr>
<td><strong>Car</strong></td>
<td>5 (19%)</td>
<td>15 (42%)</td>
<td>1 (13%)</td>
<td>21 (30%)</td>
</tr>
<tr>
<td><strong>Bus</strong></td>
<td>5 (19%)</td>
<td>7 (19%)</td>
<td>1 (13%)</td>
<td>13 (18%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>27 (100%)</td>
<td>36 (100%)</td>
<td>8 (100%)</td>
<td>71 (100%)</td>
</tr>
</tbody>
</table>

*walking and cycling combined

† A decile is a 10% grouping, there are ten deciles and around 10% of schools nationally are in each decile. A school’s decile rating indicates the socio-economic rating of the communities from which its students are
drawn. Decile 1 schools are the 10% of schools with the highest proportion of students from low socio-economic communities, whereas decile 10 schools are the 10% of schools with the lowest proportion of these students (Ministry of Education website).

The sample included only eight children from higher decile schools (deciles 8-10) and of these three-quarters used active transport to school.

Sixty-three per cent of those that attended a lower decile school used active transport to school. The greatest number of children who used a car to travel to school attended schools in deciles 4-7 (Table 11).

Sixty-three per cent of children attending lower decile schools used active transport compared to 19% using a car and 19% travelling by bus.

*Table 12. Number‡ and proportion of children using different travel modes in their journey to school by parental rates of exercise in the previous week.*

<table>
<thead>
<tr>
<th>Child’s travel mode to School</th>
<th>Parents walk or cycle moderately</th>
<th>Parents walk or cycle vigorously</th>
<th>Less than moderate levels of walking/cycling</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active transport*</td>
<td>13 (45%)</td>
<td>14 (61%)</td>
<td>14 (58%)</td>
<td>41 (54%)</td>
</tr>
<tr>
<td>Car</td>
<td>11 (38%)</td>
<td>4 (17%)</td>
<td>7 (29%)</td>
<td>22 (29%)</td>
</tr>
<tr>
<td>Bus</td>
<td>5 (17%)</td>
<td>5 (22%)</td>
<td>3 (13%)</td>
<td>13 (17%)</td>
</tr>
<tr>
<td>Total</td>
<td>29 (100%)</td>
<td>23 (100%)</td>
<td>24 (100%)</td>
<td>76 (100%)</td>
</tr>
</tbody>
</table>

*walking and cycling combined

‡ Where a parent did different types of exercise, the most vigorous type of exercise was included, with moderate walking being the least vigorous and vigorous cycling being the most vigorous.

A total of 73 parents were included in the survey data. Where a parent had two or three children who travelled by different means, the parents were counted for each child, and therefore may have been counted more than once in the analysis in Table 12.
Sixty-one per cent of the children who used active transport to school and 22% who travelled by bus had one or more parents who did vigorous exercise in the previous week, compared to 17% of children who travelled to school by car. Similarly 45% of the children, who travelled by active transport to school, had one or more parents who had exercised moderately in the previous week, compared to the parents of the 38% of children who travelled to school by car.

Table 13. Factor that most influenced choice of route for those children that walked or cycled to school

<table>
<thead>
<tr>
<th>Child’s travel mode to School</th>
<th>Quickest/most direct route</th>
<th>Personal safety</th>
<th>Convenience</th>
<th>Enjoyment</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walk</td>
<td>15 (83%)</td>
<td>11 (92%)</td>
<td>4 (80%)</td>
<td>5 (83%)</td>
<td>3 (75%)</td>
<td>38 (84%)</td>
</tr>
<tr>
<td>Bicycle</td>
<td>3 (17%)</td>
<td>1 (8%)</td>
<td>1 (17%)</td>
<td>1 (17%)</td>
<td>1 (25%)</td>
<td>7 (16%)</td>
</tr>
<tr>
<td>Total</td>
<td>18 (100%)</td>
<td>12 (100%)</td>
<td>5 (100%)</td>
<td>6 (100%)</td>
<td>4 (100%)</td>
<td>45 (100%)†</td>
</tr>
</tbody>
</table>

† Where children gave more than one factor that was either “of some importance”, “important” or “very important”, this was included, and therefore the total is more than the total of children that walked or biked to school.

Forty per cent of children, who walked or cycled to school, reported that the quickest most direct route to school was either of ‘some importance’, ‘important’ or ‘very important’ in their choice of route (Table 13). Personal safety influenced the choice of route for 27% of those that walked or cycled to school. Convenience and enjoyment were also factors for both cyclists and walkers.
Table 14. Number and proportion of children using different travel modes in their journey to school by parent’s mode of transport to work ‡

<table>
<thead>
<tr>
<th></th>
<th>Parent walked/ cycled</th>
<th>Parent by car</th>
<th>No travel to work</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Active transport</strong>*</td>
<td>6 (67%)</td>
<td>21 (57%)</td>
<td>13 (45%)</td>
<td>41 (54%)</td>
</tr>
<tr>
<td><strong>Car</strong></td>
<td>3 (33%)</td>
<td>12 (32%)</td>
<td>7 (24%)</td>
<td>22 (29%)</td>
</tr>
<tr>
<td><strong>Bus</strong></td>
<td>0 (0%)</td>
<td>4 (11%)</td>
<td>9 (31%)</td>
<td>13 (17%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>9 (100%)</td>
<td>37 (100%)</td>
<td>29 (100%)</td>
<td>76 (100%)</td>
</tr>
</tbody>
</table>

*walking and cycling combined

‡ Where a parent used more than one mode of transport to work in the previous week, the mode that was used the most was selected. No parent travelled by bus and only one by another means.

Of those parents that worked (total = 47), over three-quarters (79%) travelled to work by car, only 19% used active transport (Table 14). Among the children that used active transport to get to school, approximately half the parents travelled to work by car, while 15% walked. None of the parents of children who travelled to school by bus, travelled to work by walking. Those children who travelled to school by bus had a higher percentage of parents who did not travel to work (they may have been unemployed, but it is not possible to tell from the data).
Table 15. Number and proportion of children using different travel modes in their journey to school by access to a functioning bike

<table>
<thead>
<tr>
<th></th>
<th>Child access to functioning bike</th>
<th>No access to a functioning bike</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Active transport</strong></td>
<td>25 (45%)</td>
<td>11 (79%)</td>
<td>37 (52%)</td>
</tr>
<tr>
<td><strong>Car</strong></td>
<td>21 (38%)</td>
<td>0 (0%)</td>
<td>21 (30%)</td>
</tr>
<tr>
<td><strong>Bus</strong></td>
<td>10 (18%)</td>
<td>3 (21%)</td>
<td>13 (18%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>56 (100%)</td>
<td>14 (100%)</td>
<td>71 (100%)</td>
</tr>
</tbody>
</table>

*walking and cycling combined

Only two-thirds (25/37) of children who used active transport to school had access to a functioning bicycle compared to 100% of children, who travelled to school by car and three-quarters (10/13) of children, who travelled by bus (Table 15).

Table 16. Number and proportion of children using different travel modes in their journey to school by parent’s access to functioning bike.

<table>
<thead>
<tr>
<th></th>
<th>Adult access to functioning bike</th>
<th>No access to a functioning bike</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Active transport</strong></td>
<td>26 (45%)</td>
<td>17 (68%)</td>
<td>43 (52%)</td>
</tr>
<tr>
<td><strong>Car</strong></td>
<td>21 (36%)</td>
<td>4 (16%)</td>
<td>25 (30%)</td>
</tr>
<tr>
<td><strong>Bus</strong></td>
<td>11 (19%)</td>
<td>4 (16%)</td>
<td>15 (18%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>58 (100%)</td>
<td>25 (100%)</td>
<td>83 (100%)</td>
</tr>
</tbody>
</table>

*walking and cycling combined

Although there were 73 parents in the data, a parent may have more than one child, who may use a different mode of transport from siblings, and therefore may be counted more than once.
Only 60% of parents of children who used active transport to school, had access to a functioning bicycle, compared to 84% of parents of children who travelled by car and 73% of parents of children who travelled by bus (Table 16).

**Table 17. Number and proportion of children using different travel modes in their journey to school by parent’s access to functioning car.**

<table>
<thead>
<tr>
<th></th>
<th>Adult access to a car</th>
<th>No access to a car</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active transport*</td>
<td>42 (53%)</td>
<td>1 (33%)</td>
<td>43 (52%)</td>
</tr>
<tr>
<td>Car</td>
<td>25 (31%)</td>
<td>0 (0%)</td>
<td>25 (30%)</td>
</tr>
<tr>
<td>Bus</td>
<td>13 (16%)</td>
<td>2 (67%)</td>
<td>15 (18%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>80 (100%)</strong></td>
<td><strong>3 (100%)</strong></td>
<td><strong>83 (100%)</strong></td>
</tr>
</tbody>
</table>

*walking and cycling combined

Adult access to a car was universal for the parents of children who travelled to school by car, 98% of those that used active transport and slightly less at 87% for parents of those who travelled by bus to school (Table 17).

### 4.3 Description of ACTIVE children logistic regression

A logistic model was fitted to a binary variable defined as 1 if the child walked or cycled to school and 0 otherwise. Explanatory variables are shown in Table 19, which include the log of the distance between home and school.

This transformation was used as the odds of using active means of transport fell approximately linearly with increasing distance (see Figure 3), so this relationship was best modelled in the logit space using the log transform.

Although no factor apart from distance had an estimated coefficient that was statistically significantly greater than zero in the model, all factors with a potential aetiological link to
active travel were nevertheless left in the model. The exclusion of these factors had little
effect on the estimated parameter for logdistance when a more parsimonious model was
refitted with only one explanatory variable, logdistance. Although the remaining factors
did not provide additional statistically significant explanatory power, the estimated odds
ratios were generally in the direction expected: for example, the odds of a child aged 13
or over walking and cycling was 1.86 times the odds for a child aged under 13.

Table 18. Explanatory variables

<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>Confidence Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 13 years N vs Y</td>
<td>1.857</td>
</tr>
<tr>
<td>gender Female vs Male</td>
<td>0.952</td>
</tr>
<tr>
<td>SES under decile 5 0 vs 1</td>
<td>1.136</td>
</tr>
<tr>
<td>maori 0 vs 1</td>
<td>1.214</td>
</tr>
<tr>
<td>city Hastings vs Whanganui</td>
<td>0.817</td>
</tr>
<tr>
<td>city Masterton vs Whanganui</td>
<td>0.36</td>
</tr>
<tr>
<td>city New Plymouth vs Whanganui</td>
<td>0.403</td>
</tr>
<tr>
<td>Parent not walk 0 vs 1</td>
<td>1.415</td>
</tr>
<tr>
<td>Log distance</td>
<td>0.158</td>
</tr>
</tbody>
</table>

Figure 3. Relationship between age and distance (km) from school
In this analyses distance was by far the strongest predictor of active travel to school; all other factors were not statistically significant. However, this latter finding is largely a sample size issue; it cannot be said that the other factors are not important, but only that the sample size available could not demonstrate their importance.
Chapter 5: Discussion

This dissertation study explored the multiple factors that might influence the use of active transport by children to school. These included: the distance from the child’s home to their school; arterial roads that traverse or intersect the route to school; demographic variables including gender, age, ethnicity and socio-economic status; parent’s choice of mode of transport compared to their children’s; the amount of exercise parents take and its relationship to their children’s mode of transport to school; and the influence of access to either a bicycle or a car in decisions to use active transport to work or school.

5.1 Key findings

A shorter distance between home and school was the strongest predictor of the use of active transport to school.

A journey to school involving a greater number of arterial intersections was associated with lower numbers of children using active transport to school. However increased intersections might be correlated with greater distance.

Attending the school closest to home was associated with active transport. Children that used active transport were more likely to attend the school closest to home (78%) compared to 43% of those that travelled to school by car.

Children that used active transport to school were more likely to have a parent that either did moderate or vigorous exercise, but this association was not statistically significant in a model that included distance from school.

The choice of route to school for those children that used active transport was influenced more by the quickest most direct route to school rather than personal safety concerns.

Although adult access to a car was almost universal, access to a functioning bicycle was also high, yet the utilisation of bicycles by adults was minimal.

5.2 Rates of active transport

The number of children being driven to school in this study was 30%, which is lower than the 58% nationally, reported in 2007-11 by the Ministry of Transport (Ministry of Transport, 2012). It is unclear why the survey found much lower rates. It is possible that
these cities have lower rates, but the New Zealand Travel Survey estimates are not available at that level of disaggregation. Another possible reason is that there may have been some self-selection where the survey, which was clearly focused on cycling and walking, yielded a better response from active travellers. Internationally rates of walking to school are usually greater than those of cycling. This study’s proportion of children that cycled to school (11%) compares poorly to the 49% of children who cycle to school in the Netherlands (Ministry of Transport, Public Works and Water Management, 2009). The proportion of children who walked to school in this study was 41% which compared favourably with the Netherlands (37%) (Ministry of Transport, Public Works and Water Management, 2009) and was higher than rates for the whole of New Zealand, which were reported as 22% (Ministry of Transport, 2012). As mentioned above, the high rates for this current study may have been influenced by those people most interested in active transport self-selecting to participate in the study.

5.3 Distance

A large number of studies have found that a shorter distance between home and school is associated with active transport to school (Davison, 2006; Ewing, 2004; Larsen, 2009; Martin, 2005; Panter, 2008; Pont 2009).

More than half (52%) of the total ACTIVE child sample used active transport and of those, 57% lived within two kilometres of their school, compared to 27% of those that lived between 2.1 and four kilometres and 11% of those that lived between 4.1 and 6 kilometres from school. Almost a third (30%) of the total sample used a car to travel to school and of these, 14% lived within 2 kilometres, 48% between 2-4 kilometres, and 33% between 4-6 kilometres. Although the car was used for more lengthy journeys in general, the use of the car increased dramatically once the distance rose above two kilometres. Logistic regression analysis revealed that distance was the strongest predictor of active transport to school with the other factors (age, gender, SES, ethnicity, city and parent’s exercise) not statistically significant.

Studies consistently report that shorter distance from home to school is positively associated with active modes of transport. For example, children that live within one mile (1.6 km) were more likely to walk, but at a distance of 1.5 miles (2.4 km) or greater there
was a sharp drop off in the proportion walking (Schlossberg, 2006; Yelavich, 2008; McDonald, 2008). Over a third (35%) of children in the current study lived within two kilometres of their school and of these 84% used active transport to school. Two-thirds (66%) of children in the current study lived within four kilometres of their school and there was a drop in proportion to 66% who used active transport; as distance increased, the proportion of children using active transport dropped.

Only 12% of children in this study that travelled under two kilometres to school used a car as their mode of transport, which compares favourably to national figures: 31% of vehicle trips in urban areas were two kilometres or less (Ministry of Transport, 2007). In total, 57% of car journeys were less than four kilometres in the study, but only 14% of bus journeys were under four kilometres. In contrast, 84% of those that used active transport travelled less than four kilometres.

There is a lack of agreement about what is a reasonable distance for children to walk at different ages and this generates uncertainty about what is reasonable to inform discussion and policies to encourage walking. The shortest distance walked in this study was 274 metres and the furthest was 7.5 kilometres. Similarly, an acceptable cycling distance from school has not been well studied: in the current study the shortest distance cycled was 470 metres and the furthest was 4.3 kilometres. This study was too small for any range to be proposed as “acceptable” based on the active distances travelled by the children.

Studies have reported that parental estimations of acceptable distances for children to cycle are variable and reveal that the perception of distance may differ hugely between parents, not only in terms of the acceptable distance but what a child is physically capable of in terms of stamina and fitness. Distance is one of the most common reasons proffered by parents for disallowing active transport; for example, for 10-12 year olds, parents believed 1.6 kilometres was an acceptable distance (Timperio, 2004). However in the current study over a fifth (23%) of children less than 13 years of age walked or cycled more than two kilometres to school.
School zoning was originally intended to ensure every child was able to attend her or his local school, and zoning was reasonably well-enforced by the then-Department of Education. Children currently have the right to attend their local school, but if there is an enrolment scheme in place, then while places must be available in a school for those who live locally, others can ballot for out-of-zone places. An enrolment scheme is a means of limiting the roll to prevent overcrowding at a school, and enables the Ministry of Education to make best use of the current accommodation at schools in the surrounding area (Ministry of Education, 2009).

Zoning has been suggested as a policy to ensure that children attend their local or nearest school and consequently reduce the rates of car use for the school run. However, children do not always attend the nearest school to their home. A study of Christchurch schools in 2008 (Thomson, 2010) found that 53% of parents sent their children to a school that was not the closest to their home and 46% of the 424 parents sampled did not send their child to the school for which they were zoned. Findings from the Christchurch study may not be generalisable to the smaller cities included this study and distance might not always be a factor that is considered in parental choice of school. In the current study over a third (39%) of children did not attend the closest available school to their home, despite two-thirds (66%) of the children living within four kilometres of the school.

Schools are permitted to define their own home zone which is required to be clearly delineated and which students must “find it reasonably convenient” to attend. They are required to include at least a portion of the immediate neighbourhood, although the specific size of this area is not mandated, meaning that there is no government oversight or strict criteria as to how home zones are drawn (New Zealand Ministry of Education, 2009). State-integrated schools can specify students meeting the requirements of the school mission and may draw from a wider geographic area. However, schools located in high-income neighbourhoods that are within two kilometres of a low-income community are 2.55 times more likely to have adopted enrolment schemes, than are similar high-income schools located more than two kilometres away from the nearest low income schools (Thomson, 2010). Therefore, because enrolment policies are more widespread in
higher-income neighbourhoods and may be designed to preserve access to residents living in predominantly higher income areas, lower-income children living within walking distance of the school may then be excluded.

5.5 Travel along or across arterial roads

It is possible that safety as well as distance was a consideration in the children’s journeys. A large group of children who used active transport (38%) had to negotiate one arterial intersection at most on their route, compared to 12% of those that travelled by car and 0% of those that travelled by bus. Those that travelled by bus, not only travelled longer distances to school, but three-quarters (77%) of them traversed five or more arterial intersections compared to only a quarter (24%) of those that used active transport. However, the majority of car travellers (62%) traversed four or less arterial intersections compared to three-quarters (76%) of those who used active transport, although not as many car travellers lived as close to their school as those that used active transport.

It was outside the scope of this study to examine what public transport facilities were available, or whether buses followed routes past schools, or ran regularly at school starting and home times. There may have been school buses in operation in some schools, particularly for children who lived more rurally, although the urban focus of the ACTIVE survey would not have sampled these children. Similarly, it was not known how much active transport was involved in public transport journeys and how much walking might be involved at either end of the bus journey, as only the ‘main’ mode of transport was reported.

5.5.1 Congestion

There is some debate about the contribution of school traffic to total traffic volume on the roads. Some research has estimated school traffic to be approximately eight per cent of the total volume of traffic, and that a 70% reduction in mileage, during school holiday periods, is due to employees taking time off to coincide with their children’s holidays. Thus, removing the school run from the volume of traffic may have little effect on total volume (Bradshaw, 2000). However other research in New Zealand has estimated that school traffic, in places such as Auckland, contributes nearer to 40% volume of traffic around school start and finish times (Auckland Sustainable Cities Programme, 2004).
area of contention in the debate appears to focus on whether a journey in which the school drop off is incorporated into the journey to work is included in school traffic. These linked journeys with a number of destinations before reaching work add complexity to understanding the effect of school traffic.

5.5.2 Traffic calming
Safety related aspects of the local road environment have been associated with active travel. Google Maps Street View which was used to study the street access to the schools that children in the study attended revealed different levels of traffic calming. While there was usually signage to indicate a school, a crossing outside the school and frequently traffic calming measures in the immediate vicinity of the school, these things were generally absent for the rest of the journey. There is an association between the presence of controlled crossings, (Davison, 2006), improved routes to the school, traffic speed limits and bike paths (Eyler, 2007) and increased active transport to school. However, when school crossings and reduced speed limits only apply in close proximity to the school, for example, a 250 metre radius, children are less protected further away from the school. It appears that accidents to children occur infrequently in the immediate school area, where traffic controls are evident, and more frequently in other areas usually involving major arterial roads (Kingham, 2011). These road safety considerations may account for the increased likelihood of walking or cycling to school among children who live nearer to the school, as greater distance increases the chances of having to negotiate intersections and arterial roads. This may be particularly important in the context of findings from the current study that showed that children place a greater priority on directness of the route over safety.

5.5.3 Connectivity
This is the ease of getting from home to school along existing streets and pathway structure. Street connectivity has been found to be associated with greater rates of children walking to school. Both Hastings and New Plymouth have invested in developing urban environments to encourage walking and cycling and have invested in new cycle lanes or paths with an emphasis on increasing connectivity (New Zealand Transport, 2010). However, some of the separate cycle paths terminate at intersections or roundabouts, potentially the most dangerous sites on a journey. In contrast, countries
such as the Netherlands, Denmark and Germany have a multi-focused approach including integrated and extensive systems of separate cycling facilities, intersection modifications and priority traffic signals and traffic calming. By addressing the numerous factors that either enable or present barriers to cycling, a multi-focused approach has contributed to increased rates of cycling (Pucher, 2010). Similarly in Berlin, 3,800 kilometres of city streets (72% in total) are traffic calmed with speed limits of 30km/hour or less providing an extensive network of streets amenable to active transport (Jacobsen, 2006).

The current study used the most direct route to school to measure distance and counted the number of arterial roads crossed. The presence of a busy road has been associated with lower rates of active commuting to school, particularly among 5-6 and 10-12 year olds (Davison, 2006), so it is possible that younger children may have avoided the busier roads and taken routes avoiding arterial roads, even though this might have lengthened the journey. Short cuts and indirect routes that may have avoided arterial roads could make active transport journeys safer, but it was not possible to derive information on the actual routes used in this study. Therefore even if the connectivity of roads is good, the fact that they are busy arterial routes may make active transport less appealing and children’s journeys to avoid busy roads may become longer if quieter routes are not well connected.

A lack of opportunity to cross busy main roads combined with limited visibility, could be a deterrent to active transport despite the close distance from school. Connectivity is high when the streets are arranged in a grid pattern, whereas low connectivity is found in the layout of some modern suburbs, which utilise few intersections and have a number of cul-de-sacs or long curvilinear roads that do not offer connectivity.

5.5.4 Safety
Active transport, particularly cycling, is often perceived as a dangerous pursuit and the benefits in terms of health and environmental benefits are often traded off against concerns about safety and the risk of injury. The counties that have the best pedestrian safety (The Netherlands, Sweden, Finland, Germany and Denmark) have a strong
commitment to supporting high levels of safe walking and cycling and have implemented programmes to facilitate this.

Children’s travel may be more influenced by safety issues such as traffic speed or the presence of sidewalks, which is consistent with findings that children are less likely to use active transport if they have to cross busy roads (Giles-Corti, 2011). The shortest route between home and school, or seemingly best connected, may not be the safest and hence chosen route (Timperio, 2006).

In this study, children who used active transport reported the factors that influenced their choice of route to school. Approximately 40% of those who both walked and cycled reported that the quickest, most direct route was of ‘some importance’, ‘important’ or ‘very important’ in determining their choice. Personal safety was of greater importance to those that walked (29%) than those who cycled (14%). The directness or speed of the route appears to imply the shortest route to school and that children may be choosing to negotiate arterial roads if these offered a quicker or shorter journey. However, the awareness of safety was also clearly a consideration, but it is not possible to tell if concern for personal safety would be enough to elect an alternative to the quickest route. The parents could potentially influence the balance between choosing a direct route and choosing a safer route.

Cycling-related injuries are one of the top three causes of unintentional injury related hospitalisations for children in New Zealand, with children between 10 and 14 years of age accounting for the highest number of all cyclist hospitalisations (57%) (Tin Tin, 2010). New Zealand children appear to be particularly vulnerable, when compared with other OECD countries, having the second worst fatality rate per average number of kilometres travelled (Christie, 2007). The way in which these statistics are reported to the public along with extensive reporting of any child cycle injuries may have an influence on parental perceptions of the safety of active transport. Parents may measure the importance of any factor, including safety, by the ease with which they recall it. The ease of recall is very much influenced by the extent of coverage given to child road injuries in the media (Kahneman, 2011).
In New Zealand, initiatives to support students to use active transport are promoted by the Ministry of Education and schools are encouraged to work with the local community to develop travel plans. It is a mandatory Ministry requirement for schools to consider traffic management in the design of a school. The Ministry does not have a policy on the number of car parks that a school should have, but local councils may have requirements in their district plans and councils may be required to conduct traffic impact assessments if more parking around a school is planned. School decisions only impact on areas around the immediate school in terms of managing traffic flows and parking (Ministry of Education, 2013).

The result of these policies is a diverse range of initiatives, but no national-level policy or strategy that sets out the specific transport requirements for schools, and the system requirements that are needed to produce these outcomes. Current initiatives are relatively fragmented, with no requirement for schools or funding agencies to prioritise school travel plans, despite a range of potentially significant benefits (MacKie, 2010). The top-performing OECD countries, in terms of child road safety, have a strong commitment to fostering high levels of walking and cycling, and most have implemented a comprehensive package of integrated traffic safety measures focused on children.

5.6 Relationship between active transport to school and demographic variables

5.6.1 Gender
Studies have found rates of active transport to be greater among males than females (Davison, 2008; Yelavich, 2008; Larsen, 2009), but the findings of this study did not support this, with active transport slightly more common among girls (54%) than boys (46%), although this difference was not statistically significant. More girls used car transport (57%) than did boys (43%).

5.6.2 Age
It might be expected that younger children are more likely to be transported to school by car for safety reasons and in the current study those children aged 13 or over had an 86% higher odds of using active transport than those aged less than 13. However, this result
was not statistically significant and the findings are not supported by other studies which report younger children being more likely to use active transport (Yelavich, 2008; Fulton, 2005). However, this finding might be confounded by the fact that younger children often live closer to primary schools than older children to secondary schools, which are fewer in number.

There is very little information about the development of the skills required to perform independent travel and at what age these are acquired. The perception of road danger requires a level of cognitive development and the amount of mental effort required to safely negotiate roads decreases with age. Maturation, experience and cognitive processing are all factors that affect the ability of children to recognise a safe or dangerous crossing site. Competence in some areas of cognition does not guarantee ability in others, for example, children may recognise a safe or dangerous crossing site but have difficulty applying their safety knowledge in constructing a safe way to cross. Many studies state that up to the age of 10 years, children fail to anticipate potential danger in different crossing sites in order to be able to take appropriate action (Tabibi, 2012; Pfeffer, 2005). Some research indicates that “visual crowding” or clutter from many different factors in the street or neighbourhood may distract children (Kovesdi, 2013). The New Zealand Transport Agency advises that children under ten years of age should be accompanied by an adult when using a bicycle on the road (New Zealand Transport Agency, 2011).

5.6.3 Socioeconomic status
In the current study the decile of the school was obtained for each school that the children attended. However, it is recognised that whatever decile a school may be, the population of the school may be heterogeneous and a low decile school may include some children from high socio-economic backgrounds and vice versa. Almost two-thirds of children (63%) of those at low decile schools used active transport compared to 19% from lower decile schools that travelled to school by car. Three-quarters (75%) of those at high decile schools used active transport; however there were low numbers of high decile schools included in the study. Trends over time have seen children from lower SES backgrounds using active transport to school more than children from higher SES backgrounds (Salmon, 2005; Yelavich, 2008; Davison, 2008). This could be associated
with higher car ownership and greater numbers of cars per household so that higher SES children are being driven to school more often. A similar proportion of children in the medium decile schools (deciles 4-7) used car transport to school compared to active transport (42% versus 39%).

Both crime and child traffic injuries are higher in less equal societies (Christie, 2004; Wilkinson, 2009) and these two factors are also two of the most frequently reported reasons that parents put forward for restricting their children’s active transport. Ironically, children from lower socio-economic communities, where there is a greater likelihood of crime, are more likely to use active transport, or possibly the difference is due to higher SES people being more car dependent. It has been suggested that more equal societies are characterised by greater levels of trust and social cohesion as well as lower levels of violence (Wilkinson, 2009).

In this study, lower decile schools had higher rates of active transport among the children that attended them (63%). However, the inequality in terms of crime or injuries is more likely to affect parents’ willingness to allow their children to have the freedom and independence in travelling to school that more equal societies enjoy because of greater levels of cohesion. An alternative explanation is that children from lower SES backgrounds do not have access to a car for transport.

5.6.4 Ethnicity

Māori were more highly represented in the current study than in the New Zealand population (30% versus 15% respectively). However, both Hastings and Whanganui have a proportionately higher population of Maori, 22.9% and 21% respectively (See Appendix C). While only 14% of Māori in the study travelled to school by car, 43% used active transport and 43% used the bus. The numbers of Māori participants were too small to identify ethnic differences in active travel but other research findings report greater active transport among Māori (Yelavich, 2008; Davison, 2008).
5.7 Parental choices, behaviours and the “school run” and its relationship to children’s mode of transport to school

Children need to be able to take risks, make mistakes and learn about the consequences of risk-taking as part of development. It is difficult to know to what degree children are excluded from decision making processes, in terms of how their journeys to school are organised within the very private family setting and how this changes with increased maturity and age. Parents over time negotiate increased freedom with their child and weigh up allowing more independence with social and community expectations of what is understood by a ‘good parent’ (Gill, 2007).

Regardless of the physical distance, a child’s mode of transport to school may be influenced more by their parent’s travel mode to work, particularly if the parent is car dependent and there was evidence of this in the current study. Time is also a major constraint and if both parents are in paid employment the time to walk children to school is limited. It may be quicker and more convenient to drop a child at school on the way to work and transport children to after school activities.

At the 2006 Census, two thirds of people used a car as their main means of travel to work and approximately 5% walked or jogged to work. Half of all people who walked to work were aged less than 35 years. Although cycling to work is most common in the 25-50 age groups, those that are likely to have children, three quarters of the cyclists were men. Women who had children were less likely to use public transport to work than women without children (3% versus 9%). The majority of women with children drove to work (Statistics New Zealand, 2006). In this study 79% of those parents that worked, used a car to travel to work and only 19% used active transport.

However involving parents in getting children to use active transport is vital because parental opposition is one of the main barriers for children walking or cycling to school. Strategies to promote active transport need to take into account different school settings for different families (family composition, work commitments, parents own travel modes. In this study only 15% of the parents, of children who used active transport to school, used active transport to get to work.
It appears that parents frequently drop children off at school on their journey to work; two-thirds of fathers drop off their children at school going on to work from the school (Hall, 1998). Thus the effects of the school run are not just focused on the school destination, but have a wider effect on the onwards journeys of adults.

Children are more likely to use active transport, where the father is responsible for taking the children to school (Merom, 2006). However this does not mean that if a mother is working that the father will be the one to take the children to school and it has been suggested that the greater number of women in the workforce who have children has resulted in less active transport to school, particularly when research has shown that children are more likely to walk if a parent does not go to work (McDonald, 2008). Shared responsibilities between parents and work demands may be strong influencing factors. Once the decision is made to drive to work, a series of other journeys by car are built in with this decision so that children do not have the option of using active transport to school. Family or micro-level influences on active transport may be more influential than environmental changes (Ziviani, 2004) and changing adult’s decisions about travel to work may be just as important as promoting active transport for children.

5.8 Parental rates of exercise and its relationship to children’s mode of transport to school – valuing physical activity

Whether both parents considered the health benefits of physical activity important in their lives and the lives of their children has been found to be associated with children’s rates of active transport (Merom, 2006; Ziviani, 2004; Davison, 2008). While this study did not directly ask adults about the value they placed on physical activity, their rates of activity were recorded in terms of the amount of moderate or vigorous cycling and walking performed in the previous week. A slightly greater proportion of children who travelled to school by active transport (45%) had a parent that did moderate exercise compared to (38%) of parents of children who used a car. However a greater proportion of parents of children that used active transport (61%) did vigorous exercise than parents of children who travelled to school by car (17%). It could be suggested that parents who
do more vigorous exercise and value exercise more, are more likely to allow their children to use active transport to school.

Parents play a key role in modelling behaviours and research supports their influence in the early establishment of habits, particularly when the perception of safety and comfort of a car is established in early adolescence (Lorenc, 2008). Children’s own travel experience shapes their future ideas of travel options and if they perceive car travel as positive and accept car ownership norms, they are more likely to plan to drive when they are older (Sigurdardottir, 2013).

Further research may be required to investigate if children who are transported to school by car have different levels of leisure time physical activity to children who use active transport to school. It is possible that parents transporting children to sporting locations for activities could mean that children are participating in more extra-curricular sporting activities and participating in a greater amount of exercise than children who use active transport to school. However, in general active transport to school has been found to be associated with higher levels of physical activity compared to passive means of transport to school (Cooper, 2006; Davison, 2008; Sirard, 2005), particularly for boys. There is a difference between cycling and walking - those that cycle were up to six times fitter than those who walked (Cooper, 2006). Therefore the relative benefits of active transport across different groups in the population may vary. However, active transport to school has been shown to be associated with higher levels of active travel to other neighbourhood destinations. Those who actively commuted to school were 30% more likely to actively commute to other neighbourhood destinations, suggesting additional energy expenditure benefits beyond active trips to and from school (Dolman, 2007).

5.9 Access to a car and bicycle and its relationship to active transport to school and work – attitudes and perceptions

An initial layer of decision making among adults about whether a child needs to be accompanied on the journey to school is influenced by road safety fears, the risk of harassment or violence from other children, and the threat of other adults (Bringolf-Isler, 2008; Brunton, 2003; Salmon, 2007). However a second layer of decision making, once it
is decided a child needs to be accompanied, is influenced by factors including car
ownership, convenience, distance from school and number of children at different
schools. In this study, access to a car was almost universal among adults (96%) which
would make the choice of using a car easy for most people. However, only 87% of
parents of children who used the bus to travel to school had access to a car; 11 out of the
13 children who travelled by bus had at least one parent at home who was not in
employment and possibly had no access to a car, although one was available in most of
the households.

Car ownership in New Zealand is high; New Zealand has one of the highest rates of motor
vehicle ownership in the world at 712 per 1,000, compared to 480 in Denmark, 527 in the
Netherlands, 572 in Germany, 519 in the United Kingdom and 797 in the United States of
America (World Bank, 2010).

Of the 76 parents included in the study, 29 (38%) did not travel to work in the previous
week. Of the remaining 47 parents, 37 travelled to work by car (79%). Only six parents
used active transport to work, considerably less that the volume of children that used
active transport to school and despite high rates of access to a functioning bike among
parents. Bicycle ownership in New Zealand households, with one or more children, is
reported to be 70%; 69% of children aged 5-12 and 60% of 13-17 year olds reported
having ridden a bike in the last year, but fewer reported having ridden in the last week
(34% and 21% respectively). For those under 18 years of age, 30% of cycling time is spent
travelling for education (Ministry of Transport, 2011).

The proportion of adults in this study who had access to a functioning bicycle was 70%.
Nationally, households with children are far more likely to have bicycles: nearly 70 per
cent of households of a family with children have one or more bicycles (Ministry of
Transport, 2013). However, only three adults had used a bicycle to travel to work in the
previous week and only 11 had used a bicycle either for moderate or vigorous exercise.
Seventy-nine per cent of children in the study had access to a functioning bicycle, but
only eight children used them for transport to school.

Education and improved road safety measures for children using active transport are a
step to encouraging more to use these modes of transport, but for most countries that
have been successful in increasing rates of cycling and walking there has been a simultaneous discouragement of car use and efforts to make it a less attractive option. For example, in Freiburg, Germany, a comprehensive approach has been taken where the speed limit in 90% of the streets is 30km/h, and car-free residential areas for 15,000 people are provided with the result that 24% of trips every day are on foot, 28% by bicycle, 20% by public transport and only 28% by car (Whitelegg, 2012). However New Zealand cities are less amenable to active travel and public transport than the more compact European cities.

5.10 Public health and policy implications

Heart disease, cancer, lung disease and diabetes are among the most frequent causes of death and behavioural factors including physical activity patterns, contribute to morbidity and mortality. Multiple interventions, political, economic and social are required to initiate and maintain behaviour change in individuals. Interventions related to health ideally need to address all the multiple layers of influence including individual, households, schools and communities up to and including the policy level. Public health measures that only address the individual without recognising the context in which they live will not be successful. The current study confirmed what much research has already shown about the multiple factors that influence decisions about children’s active transport to school.

Findings from this study and also a Christchurch study (Thomas, 2008) revealed that many parents do not send their child to the closest available school. A change in policy or the way that school zones are managed could facilitate a greater number of children to attend the closest school and thus increase the opportunity for active transport. An increase in the number of children walking or cycling to school could have a potential knock on effect in addressing a number of public health issues, including reducing child obesity levels, reducing traffic congestion and emissions and reducing pedestrian and cyclist injuries. With more children walking or cycling, their greater presence on the streets may reduce both perceptions of, and actual crime.

The current study found that when parents did moderate or vigorous exercise, their children were more likely to use active transport. The value placed on physical health and
exercise is instilled early in a child’s development and where parents value the benefits of exercise, it is more likely that children will develop similar lifetime habits. Public health initiatives delivered at the level of the household and individual have shown previous evidence of success. The buy-in and example of parents, as gatekeepers to a child’s opportunity to use active transport to school, are critical to the success of any public health measures. These need to take into account and address the issues that are relevant to family functioning, for example, work demands, if they are to be successful.

Although bicycle ownership in the current study was high among adults and children, their utilisation was minimal, with adults preferring to travel by car. Limitation of the future growth in traffic volume has the potential to reduce child mortality if policy can counter the current attraction and ease of use of the motor vehicle.

### 5.11 Strengths and Weaknesses of the methodology and data

Personal face-to-face interviews were used in the ACTIVE study, which was conducted with all people over ten years old in randomly selected households in four cities. The face-to-face interview is useful in that the interviewer is able to clarify any questions and ensure the sequence of items being collected is followed, so that the questionnaire is completed in full. Therefore the information collected is based on an accurate understanding of the questions by the respondents. This is a particularly good method when, as in this questionnaire, some of the questions are gaining information about the subjective perceptions of respondents. The interviewer is better able to explore the opinions and behaviours of the respondents’ (Dane, 1990).

However, there is a risk of bias when households are invited to participate in a survey obviously focused on walking and cycling choices as transport modes: those who use active forms of transport may be more interested in the subject matter and therefore more readily agree to participate. This may have meant that a greater number of people who utilise active modes of transport were included in the survey. However this argument could be countered by the fact that the survey was conducted in the months of mainly June and July, traditionally colder and wetter months for the New Zealand climate, and rates of cycling and walking may have been be lower at this time of year.
The numbers of users of active transport in the survey may therefore be conservative and might have been higher had the survey been conducted in the summer months.

The sample size of children for this study was small and did not allow many relevant associations between active transport choices and child/parent factors to be studied in detail. The survey was not originally designed specifically for children, who were a sub-group of the entire survey population.

As the ACTIVE study is a quasi-experimental design, the control cities were chosen to be similar to the treatment cities, which have different characteristics to larger cities in New Zealand and also to small towns. This means that the associations found in the study may not be readily generalised to the rest of New Zealand.

The availability of public transport routes close to where the children lived was not explored. Children who do not live on a bus route may be more likely to use active transport or car to school.

5.12 Further research
This study did not record whether journeys both ways were by active transport but only journeys to school and it may be possible that some children use different modes to or from school. One study found that children were more likely to walk or cycle home from school (72%) rather than to school (62%), which could indicate that children’s opportunities for active travel were closely linked to parental scheduling and travel (Larsen, 2009). Car journeys by children may be more frequent in the morning to fit in with parental work schedules. Also it would have been interesting to know if the children that walked to school had walked alone or been accompanied by an adult or other children in order to explore the social aspects of walking to school.

The ACTIVE survey does not report the walking or cycling that is linked with other modes of transport and may therefore underestimate the true prevalence of active transport to school. Information on combined mode journeys to school could be a useful measure for future research. It would be useful to investigate if children who used active transport used this means for other journeys in their neighbourhood, to shops or parks or to visit
friends and whether they are achieving more exercise through these more informal means than through organised sporting activities. If children who travel to school by car are achieving exercise recommendations through other activities, it may be worth identifying groups who would gain most benefit from active transport and promoting it to them. It is not possible to understand the choice of route for children without understanding the options open to them. Further study could explore cyclists’ actions to mitigate risks or navigate hazards in specific traffic situations, for example, by alternating cycling on the road with cycling on the pavement.

As an exploration of inequalities in access to education, further research could investigate if children from lower socio-economic areas are travelling further to school due to zoning and whether they are excluded from access to schools in higher socio-economic areas.
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Appendix A. Literature Review Methods
A search of electronic databases was undertaken from 2005 to the present using the following:

- Medline database
- CINAHL
- PsychINFO
- Google/Google Scholar

Relevant websites including:


New Zealand Transport Agency - [www.nzta.govt.nz](http://www.nzta.govt.nz)

The bibliographies of retrieved papers were also searched to identify additional articles

References provided by experts in public health were retrieved

Key words used in the searches included:

Child; children; active transport; bike; bicycle; cyclist; cycling; pedestrian; walking;

These were combined in separate searches with search terms for each of the sections of the literature review to include injury; safety; barriers; enablers; attitudes; perceptions; interventions; walkability

Studies were limited to the English language.

No filter based on study design was used.

Studies were selected according to their relevance to the research questions.
**Appendix B. Transport and Lifestyle Survey**

TRANSPORT AND LIFESTYLE SURVEY

--- In Confidence ---

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<tr>
<th>Sample No.</th>
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<th>Telephone number for quality control purposes:</th>
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<th>Town/City</th>
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**INTRODUCTION**

Today I’ll be asking about your travel over the last seven days. I also have a few questions about physical activity, your habits and perceptions in relation to walking and cycling, and some background questions. Here are some showcards I’ll use, as we go.

1. **Looking at card A, could you please tell me which of these activities apply to you at the moment.**
   
   *(Showcard A)*
   
   *(Respondent may choose more than one)*
   
   - Student – Full-time ..................  □ 1
   - Student – Part-time ..................  □ 2
   - Work – Full-time ....................  □ 3
   - Work – Part-time .....................  □ 4
   - Work – Casual ........................  □ 5
   - Looking for work/unemployed .......  □ 6
<table>
<thead>
<tr>
<th>Question</th>
<th>Response</th>
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<tbody>
<tr>
<td>2. Do you have more than one job?</td>
<td>Yes</td>
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<tr>
<td></td>
<td>No</td>
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<tr>
<td>I would now like to ask you about your main job, that is, the job in</td>
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<tr>
<td>which you usually work the most hours.</td>
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<td>3. What kind of job do you do</td>
<td>Job title (e.g. primary teacher…):</td>
</tr>
<tr>
<td>(in your main job or activity outside the home, where you work the</td>
<td></td>
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<tr>
<td>most hours)?</td>
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<tr>
<td>4. And could I have the exact address where you have worked (in your</td>
<td>Identification</td>
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<td>main job) in the last 7 days?</td>
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|                                                                         | Street    
|                                                                         | Suburb    
|                                                                         | Town/City |
| OR | Home .................................................. | □ |
|    | (If not studying, skip to Q.16)                |   |
| OR | No fixed place of work ........................... | □ |
## JOURNEY TO WORKPLACE

I would now like to ask you about your journey to your main place of work in the last 7 days.

5. **How many times did you travel to this place in the last 7 days?**

   \[ \square \] times

   *(If 0, skip to Q.7)
   *If not studying skip to Q.10*

6. **How often, over the last 7 days, did you travel to this place in these different ways?**

   *(Showcard B)*

   \[
   \begin{array}{ccc}
   \text{Walk / run} & \text{Cycle} & \text{Bus} \\
   \square \text{A} & \square \text{B} & \square \text{C} \\
   \text{Car} & \text{Car Driver} & \text{Car Passenger} \\
   \square \text{D} & \square \text{E} & \square \text{F} \\
   \end{array}
   \]

   *[Write number of times in each box, as necessary]*

## JOURNEY TO EDUCATION

7. **What level of education are you doing—primary, secondary or post-secondary?**

   \[
   \begin{array}{l}
   \text{Primary/Intermediate} \quad \square \text{1} \\
   \text{Secondary} \quad \square \text{2} \\
   \text{Post-secondary} \quad \square \text{3} \\
   \end{array}
   \]

   What is the name and location of your school or educational institution?

   __________________________________________________________

   Extra-mural study \[ \square \]

   Street No. ______

   Street ____________________________

   Suburb ____________________________

   Town/City __________________________

   \[ \square \square \square \square \square \square \]

I would now like to ask you about your journey to your place of education in the last 7 days.

8. **How many times did you travel to this place in the last 7 days?**

   \[ \square \] times

   *(If 0, skip to Q.10)*
9. **How often, over the last 7 days, did you travel to this place in these different ways?**  
   *(Showcard B)*  
   
   [Write number of times in each box, as necessary]

<table>
<thead>
<tr>
<th>Walk / run</th>
<th>Cycle</th>
<th>Bus/School bus</th>
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<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
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<table>
<thead>
<tr>
<th>Car Driver</th>
<th>Car Passenger</th>
<th>Other</th>
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<tr>
<td>D</td>
<td>E</td>
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**FACTORS INFLUENCING CHOICE OF ROUTE**

Ask the following question if the respondent has walked or cycled to work or school in the last 7 days (i.e. take into account the responses to Qs 6 and 9). If not a walker or cyclist, skip to Q.H1

I would now like to ask you about your route to your workplace or place of education. I will list a few factors that may influence your choice of route. Could you please rate these factors according to their importance to you? *(Showcard C)*

10. Being the quickest or most direct route  
    
11. Personal safety (for example well-lit, fewer intersections, slower road and traffic…)  
    
12. Convenience (for example goes past shops…)  
    
13. Enjoyment (for example goes through pleasant green space, good views, past interesting places, quiet…)  
    

FACTORS INFLUENCING SAFETY PERCEPTIONS

Ask the following question of all respondents who work or attend education. If neither student nor worker, skip to Q.16

I would now like to focus on safety in getting to your workplace or school.

I will list a few safety factors: could you please rate each of them according to how important they are to your choice of route. (Showcard C)

a  Speed of traffic on the road

b  Traffic volume on the road

c  Driver behaviour on the road (for example, some drivers being
I would now like to ask you about reasons why you choose to walk, or drive a car, etc. to your workplace or school.

I will list a few factors that may or may not influence your choice of mode.
Could you please rate these factors according to their importance to you? *(Showcard C)*
<table>
<thead>
<tr>
<th></th>
<th>Getting there as quickly as possible</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>Personal safety (for example, if I were to walk home in the evening…)</td>
</tr>
<tr>
<td>c</td>
<td>Risk of injury (for example, if I were to cycle…)</td>
</tr>
<tr>
<td>d</td>
<td>Convenience (for example, I may decide to stop on way)</td>
</tr>
<tr>
<td>e</td>
<td>Enjoyment (for example, enjoying exercise, or enjoying driving…)</td>
</tr>
<tr>
<td>f</td>
<td>Health (for example, keeping healthy by walking…)</td>
</tr>
<tr>
<td>g</td>
<td>Environment (for example, taking into account emissions…)</td>
</tr>
<tr>
<td>h</td>
<td>Cost</td>
</tr>
<tr>
<td>i</td>
<td>Another factor (please specify and rate)</td>
</tr>
</tbody>
</table>
**JOURNEY FOR SHOPPING**

I would now like to ask you about a shopping destination. Think of the place where you typically go the most often, not necessarily the place where you spend the most time or money. This could be a supermarket or your local dairy, a hardware or clothing store etc…

16. **Could I have the name of this place and the street it is on?**

   Identification _________________________
   ______________________________________
   Street No. ______
   Street ________________________________
   Suburb _______________________________
   Town/City ______________________________

17. **How many times did you visit this place in the last 7 days?**

   [If 0, skip to Q.19]

18. **How often, over the last 7 days, did you travel to this place in these different ways?**
   *(Showcard B)*

   *[Write number of times in each box, as necessary]*

<table>
<thead>
<tr>
<th>Walk/run</th>
<th>Cycle</th>
<th>Bus</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>Car Driver</td>
<td>Car Passenger</td>
<td>Other</td>
</tr>
<tr>
<td>D</td>
<td>E</td>
<td>F</td>
</tr>
</tbody>
</table>
I would now like to ask you about a leisure destination. Think of the place where you typically go the most often, not necessarily the place where you spend the most time or money. This could be a sports club, a library, a beach, a movie theatre, a pub or park, etc…

<table>
<thead>
<tr>
<th>Question</th>
<th>Text</th>
</tr>
</thead>
</table>
| 19. | **Could I have the name of this place and the street it is on?**
| Identification | _________________________
| | ____________________________________ |
| Street No. | ______ |
| Street | __________________________________ |
| Suburb | __________________________________ |
| Town/City | ______________________________ |

| 20. | **How many times did you visit this place in the last 7 days?**
| | □ times 
| (If 0, skip to Q.22) |

| 21. | **How often, over the last 7 days, did you travel to this place in these different ways?**
| | (Showcard B) |
| | [Write number of times in each box, as necessary] |
| Walk / run | □ A |
| Cycle | □ B |
| Bus | □ C |
| Car Driver | □ D |
| Car Passenger | □ E |
| Other | □ F |
ACCOMPANYING FAMILY AND FRIENDS

I would now like you to think about trips that are not shopping or leisure but involve accompanying someone, or involve taking family or friends somewhere. So think of the place where you typically go the most often for this sort of trip. This could be taking a child to school, taking whanau to marae, or family to church, or taking a friend shopping etc… (It excludes carpooling however).

**SEQUENCE GUIDE:**  
If no such trip…………………………. □ Not Applicable (Skip to Q.25)

<table>
<thead>
<tr>
<th>Q.22.</th>
<th>Could I have the name of the place where you go, and the street it is on?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Identification ________________________</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Street No. ______</td>
</tr>
<tr>
<td></td>
<td>Street ___________________________</td>
</tr>
<tr>
<td></td>
<td>Suburb ___________________________</td>
</tr>
<tr>
<td></td>
<td>Town/City ___________________________</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q.23.</th>
<th>How many times did you visit this place in the last 7 days?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>□ times</td>
</tr>
<tr>
<td></td>
<td>(If 0, skip to Q.25)</td>
</tr>
</tbody>
</table>
24. **How often, over the last 7 days, did you travel to this place in these different ways?** *(Showcard B)*

[Write number of times in each box, as necessary]

<table>
<thead>
<tr>
<th></th>
<th>Walk / run</th>
<th>Cycle</th>
<th>Bus</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Car Driver</th>
<th>Car Passenger</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D</td>
<td>E</td>
<td>F</td>
</tr>
</tbody>
</table>

**FACILITATING CIRCUMSTANCES**

25. **Do you have access to a functioning bike?**

Yes ........................ 1

No ......................... 2

26. **Do you have access to a car?**

Yes ........................ 1

No ......................... 2

27. **Do you have a physical condition that has prevented you from walking or cycling at all in the last 7 days?**

Yes ........................ 1

No ......................... 2

*(If yes, skip to Q.36)*

**PHYSICAL ACTIVITY**

Now think about the time you spent walking at a moderate pace in the last 7 days. This includes at work and at home, walking to get from place to place, AND any other walking that you might do for recreation, sport, exercise, or leisure. A moderate pace means you breathe somewhat harder than normal …

28. **During the last 7 days, on how many days did you do moderate walking for at least 10 minutes at a time?**

Days per week [0-7]

(If 0, skip to Q.32)

Don’t know / Not sure ................... 8

29. **Thinking about those days when you walked for at**

Hours per day [0-16]
last 10 minutes at a time, how much **time**, over the day, did you usually spend doing moderate walking?

| Minutes per day [0-960] | Don’t know / Not sure .......... | 8 |

Now, think about the time you spent walking **vigorously** (or running) in the last 7 days. Vigorous walking (or running) is when you breathe **much** harder than normal.

30. **During the last 7 days, on how many days** did you walk **vigorously** or run for at least 10 minutes at a time?

| Days per week [0-7] | Don’t know / Not sure .......... | 8 |

(If 0, skip to Q.32)

31. **Now think about those days when you walked vigorously or ran for at least 10 minutes at a time. How much time**, over the day, did you usually spend walking vigorously or running?

| Hours per day [0-16] | Minutes per day [0-960] | Don’t know / Not sure .......... | 8 |

Now think about the time you spent **cycling** at a **regular pace** in the last 7 days. This includes cycling around work and around home, cycling to get from place to place, AND any other cycling that you might do for recreation, sport, exercise, or leisure… A regular pace means you breathe somewhat harder than normal …
<table>
<thead>
<tr>
<th>Question</th>
<th>Response Options</th>
</tr>
</thead>
</table>
| 32. During the last 7 days, on how many days did you cycle at a regular pace for at least 10 minutes at a time? | □ Days per week [0-7]  
(If 0 days per week, skip to Q.36)  
Don’t know / Not sure ................... □ 8 |
| 33. Thinking about those days when you cycled at a regular pace for at least 10 minutes at a time, how much time, over the day, did you usually spend cycling? | □□□ Hours per day [0-16]  
□□□ Minutes per day [0-960]  
Don’t know / Not sure ................... □ 8 |
| Now, think about the time you spent cycling vigorously in the last 7 days. Vigorous cycling is when you breathe much harder than normal. | |
| 34. During the last 7 days, on how many days did you cycle vigorously for at least 10 minutes at a time? | □ Days per week [0-7]  
(If 0, skip to Q.36)  
Don’t know / Not sure ................... □ 8 |
| 35. Now think about those days when you cycled vigorously for at least 10 minutes at a time. How much time, over the day, did you usually spend cycling vigorously? | □□□ Hours per day [0-16]  
□□□ Minutes per day [0-960]  
Don’t know / Not sure ................... □ 8 |
## HABITS AND PERCEPTIONS

I will now mention some transport situations. Please indicate, as quickly as possible for each of these situations, which transport mode springs to mind that you would choose. There are no right or wrong answers, but it is important that you answer as quickly as you can, and state the transport mode that first comes to mind. *(Showcard D)*

<table>
<thead>
<tr>
<th>36. Which mode of transport would you choose if you are:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Going shopping in town? ........................................</td>
</tr>
<tr>
<td>Going to work? .....................................................</td>
</tr>
<tr>
<td>Going to school or educational facilities? ..................</td>
</tr>
<tr>
<td>Going to sports or other recreational activities? ..........</td>
</tr>
<tr>
<td>Going to the nearest park or green space for a walk? ......</td>
</tr>
<tr>
<td>Going to the nearest supermarket? .........................</td>
</tr>
<tr>
<td>Visiting someone who lives elsewhere in town? .............</td>
</tr>
<tr>
<td>Going to the beach? ..............................................</td>
</tr>
<tr>
<td>Going to the local dairy? .......................................</td>
</tr>
</tbody>
</table>
**OPINION ABOUT WALKING**

Now, I would like to ask you a few questions about your opinion about walking and cycling as a means of transport, that is, for getting from place to place. Please indicate by circling a number on the scales on this page, and the next, how much you agree or disagree with the following statements about walking: *(Place page in front of respondent).*

<p>| | | | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>37a.</td>
<td>Walking as a means of transport belongs to my daily or weekly routine</td>
<td>Agree</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>b.</td>
<td>It would make me feel strange if I did not walk as a means of transport</td>
<td>Agree</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>c.</td>
<td>Walking as a means of transport is something that I have done for a long time</td>
<td>Agree</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>d.</td>
<td>I never walk as a means of transport</td>
<td>Agree</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>e.</td>
<td>Walking as a means of transport is something that is typically me</td>
<td>Agree</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>f.</td>
<td>It is easy and natural for me to walk as a means of transport</td>
<td>Agree</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>g.</td>
<td>I automatically walk as a means of transport</td>
<td>Agree</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>48.</td>
<td>In your opinion, walking as a means of transport is:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>Bad</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>Good</td>
</tr>
<tr>
<td>b.</td>
<td>Pleasant</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>Unpleasant</td>
</tr>
<tr>
<td>c.</td>
<td>Sensible</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>Not sensible</td>
</tr>
</tbody>
</table>
d. Realistic 1 2 3 4 5 6 7 Unrealistic

c. Foolish 1 2 3 4 5 6 7 Wise

f. Safe 1 2 3 4 5 6 7 Unsafe

Please circle a number on the scales on this page also.

39a. Most of my friends would approve of me walking as a means of transport
    Agree 1 2 3 4 5 6 7 Disagree

b. Most people who are important to me approve of my walking as a means of transport
    Agree 1 2 3 4 5 6 7 Disagree

c. Most people who are important to me walk as a means of transport
    Agree 1 2 3 4 5 6 7 Disagree

d. Most people like me walk as a means of transport
    Agree 1 2 3 4 5 6 7 Disagree

40a. I feel capable of walking as a means of transport
    Agree 1 2 3 4 5 6 7 Disagree

b. It is not possible for me to walk as a means of transport
    Agree 1 2 3 4 5 6 7 Disagree

c. I am confident that I can walk as a means of transport
<table>
<thead>
<tr>
<th></th>
<th>Agree</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>d.</td>
<td>I intend to walk more often as a means of transport in the near future</td>
<td>Agree</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
</tbody>
</table>

**OPINION ABOUT CYCLING**

Please indicate by circling a number on the scales on this page and the next, how much you agree or disagree with the following statements about cycling.

| 41a. | I often cycle as a means of transport | Agree | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Disagree |
| b. | It would make me feel strange if I did not cycle as a means of transport | Agree | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Disagree |
| c. | Cycling as a means of transport belongs to my daily or weekly routine | Agree | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Disagree |
| d. | It is not easy and natural for me to cycle as a means of transport | Agree | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Disagree |
| e. | Cycling as a means of transport is something that is typically me | Agree | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Disagree |
f. I have **not** cycled as a means of transport for a long time

<table>
<thead>
<tr>
<th>Agree</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>Disagree</th>
</tr>
</thead>
</table>

42. In your opinion, cycling as a means of transport is:

- **a.** Bad
  | Agree | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Good |
  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | **Good** |

- **b.** Pleasant
  | Agree | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Unpleasant |
  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | **Unpleasant** |

- **c.** Sensible
  | Agree | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Not sensible |
  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | **Not sensible** |

- **d.** Realistic
  | Agree | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Unrealistic |
  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | **Unrealistic** |

- **e.** Foolish
  | Agree | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Wise |
  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | **Wise** |

- **f.** Safe
  | Agree | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Unsafe |
  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | **Unsafe** |

Please circle a number on the scales on this page also.

43a. Most people like me cycle as a means of transport

<table>
<thead>
<tr>
<th>Agree</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>Disagree</th>
</tr>
</thead>
</table>

b. Most people who are important to me cycle as a means of transport

<table>
<thead>
<tr>
<th>Agree</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>Disagree</th>
</tr>
</thead>
</table>

c. Most of my friends would approve of me cycling as a means of transport

<table>
<thead>
<tr>
<th>Agree</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Question</td>
<td>Agree</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>---</td>
<td>---------------------------------------------------------------------------</td>
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<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>d.</td>
<td>Most people who are important to me would approve of my cycling as a means of transport</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>44a.</td>
<td>It is not possible for me to cycle as a means of transport</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>I am confident that I can cycle as a means of transport</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>I do not feel capable of cycling as a means of transport</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td>I intend to cycle more often as a means of transport in the near future</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Thank you for answering those questions

AWARENESS
<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Now a few more general questions.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45a. <strong>Have you heard of the iWay programme?</strong></td>
<td>Yes ...........................................</td>
<td></td>
<td>No <em>(Skip to Q. 48)</em> ...............</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45b. <strong>How did you hear about it?</strong></td>
<td>Social media</td>
<td>Newspaper</td>
<td>Radio</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outside advertising</td>
<td>Word of mouth</td>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>E</td>
<td>F</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>46. <strong>On a scale from 1 to 7 (1 meaning ‘nothing’, 7 meaning ‘a lot’), how much do you know about it?</strong></td>
<td>Nothing</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>47. <strong>Have you taken part in any of the organised iWay activities?</strong></td>
<td>Yes ...........................................</td>
<td></td>
<td>No <em>(Skip to Q. 50)</em> ...............</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# CYCLING AND PUBLIC TRANSPORT

## Question 48
In the last 12 months, that is since __________ last year, have you ridden a bicycle at all?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ 1</td>
<td>☐ 2</td>
</tr>
</tbody>
</table>

## Question 49
Thinking about just the last four weeks, how often have you ridden a bicycle? *(Showcard E)*

<table>
<thead>
<tr>
<th>Not at all</th>
<th>On 1-4 days</th>
<th>On 5-9 days</th>
<th>On 10-19 days</th>
<th>On 20 days or more</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ A</td>
<td>☐ B</td>
<td>☐ C</td>
<td>☐ D</td>
<td>☐ E</td>
</tr>
</tbody>
</table>

## Question 50
And in the last 12 months, have you used public transport to travel in your local area at all?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ 1</td>
<td>☐ 2</td>
</tr>
</tbody>
</table>

## Question 51
Thinking about just the last four weeks, how often have you used public transport to travel in your local area? *(Showcard F)*

*(Read if questioned: Please include school bus journeys, but we are not asking about long-distance bus or train journeys over one and a half hours long).*

<table>
<thead>
<tr>
<th>Not at all</th>
<th>On 1-4 days</th>
<th>On 5-9 days</th>
<th>On 10-19 days</th>
<th>On 20 days or more</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ A</td>
<td>☐ B</td>
<td>☐ C</td>
<td>☐ D</td>
<td>☐ E</td>
</tr>
</tbody>
</table>
### WELL-BEING AND DEMOGRAPHIC INFORMATION

And now, just a few questions about how you have been feeling in recent weeks. *(Showcard G)*

<table>
<thead>
<tr>
<th>Question</th>
<th>Scale</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>52a. How much of the time, during the last month, have you felt calm and peaceful?</td>
<td>1, 2, 3, 4, 5</td>
<td>None of the time, Little of the time, Some of the time, Most of the time, All of the time</td>
</tr>
<tr>
<td>52b. How much of the time have you been a very nervous person?</td>
<td>1, 2, 3, 4, 5</td>
<td>None of the time, Little of the time, Some of the time, Most of the time, All of the time</td>
</tr>
<tr>
<td>52c. How much of the time have you felt down?</td>
<td>1, 2, 3, 4, 5</td>
<td>None of the time, Little of the time, Some of the time, Most of the time, All of the time</td>
</tr>
<tr>
<td>52d. How much of the time have you been a happy person?</td>
<td>1, 2, 3, 4, 5</td>
<td>None of the time, Little of the time, Some of the time, Most of the time, All of the time</td>
</tr>
<tr>
<td>52e. How much of the time have you felt so down in the dumps that nothing could cheer you up?</td>
<td>1, 2, 3, 4, 5</td>
<td>None of the time, Little of the time, Some of the time, Most of the time, All of the time</td>
</tr>
</tbody>
</table>

53. And now, three final questions.

When were you born (month and year)?

m m y y y y
### Questionnaire Content

**54. (All ages) Looking at card H, which of these ethnic groups do you belong to? (Show card H)**

- Code: ................................................
- Don’t know ......................................
- Object to stating ............................

<table>
<thead>
<tr>
<th>Code</th>
<th>Don’t know</th>
<th>Object to stating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**55. (If 16 years or older) And from card I, which of these categories best represents your personal income before deductions like tax or superannuation? (Show card I)**

- Code: ................................................
- Don’t know ......................................
- Object to stating ............................

<table>
<thead>
<tr>
<th>Code</th>
<th>Don’t know</th>
<th>Object to stating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**End of interview, thank respondent.**
Appendix C. Questions from the ACTIVE Transport and Lifestyle Survey Questionnaire and issues with using the questions to inform a classification of children’s journeys

<table>
<thead>
<tr>
<th>Questions from the Transport and Lifestyle Survey</th>
<th>Issues with using the question to inform a classification of children’s journeys</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factors influencing choice of route</td>
<td></td>
</tr>
<tr>
<td>Q.10. Being the quickest or most direct route</td>
<td>The most direct route to school can be observed from a map. However children may not use the most direct route for safety reasons, for example, to avoid main roads or junctions that are difficult to navigate. The most direct route may be off-road, through an alley-way or across a green space.</td>
</tr>
<tr>
<td>Q.11. Personal safety (for example well-lit, fewer intersections, slower road and traffic...)</td>
<td>Safety features will be of importance to children and/or their parents. Street lighting may not be too important as children travel to and from school in daylight hours, but some children may stay for after school activities and travel home later. A greater number of intersections will increase a pedestrian’s and cyclist’s need to negotiate traffic, particularly for cyclists when turning right or at a roundabout. Controlled intersections with traffic lights may be safer than uncontrolled intersections. Road speed limits can be recorded but the actual speed of the traffic and the density of traffic at different times of day is not reported.</td>
</tr>
<tr>
<td>Q.12. Convenience (for example, goes past shops...)</td>
<td>The presence of shops, or a dairy along the route may be preferable to children, but the general presence of a variety of shops may be of little interest to younger children.</td>
</tr>
</tbody>
</table>
Q.13. Enjoyment (for example goes through pleasant green space, good views, past interesting places, quiet..)

The aesthetic qualities of a route may increase pleasure and could also offer alternative routes, for example, through a park rather than around it via road. However parks or quiet areas may be avoided for safety reasons.

Q.14. The quality of the surface for cycling or walking (for example smooth surface for cycling, not muddy, few steps etc.)

The pavement or road surface quality will affect walking or cycling. The pavement may be continuous or interrupted by driveways which present a danger.

The closeness of the pavement to the kerb will increase the sense of danger compared to a pavement back from the kerb. Concrete pavements will be smooth as opposed to those that are gravel, muddy or unmaintained.

The smoothness and maintenance of the road surface will make a difference to cyclists. Similarly whether the road is single or double lane or the cycle path is separated from the traffic. Arterial roads may present more hazards to cyclists.

**Factors influencing safety perceptions**

<p>| a. Speed of traffic on the road | This cannot be observed on Google road view and the speed of traffic may vary across a route. Residential areas will be presumed to be 50km but speed limits may vary on arterial roads. Traffic volume may be increased particularly when children are on their way to school and as a result the speed may be reduced due to congestion. Congestion and cars trying to park near a school may be more dangerous. Traffic speed may be greater, due to less volume at the time that children travel home from school. |
| b. Traffic volume on the road | May have the effect of making cyclists less visible and reduce their opportunities to cross into traffic for turning right. Traffic volume will make it more difficult for pedestrians to cross at unassisted crossings. It is possible that arterial routes can be presumed to have a greater traffic volume and also roads with more than one lane. It will not be possible to measure this. |
| c. Driver behaviour on the road (for example, some drivers being impatient or unobservant..) | Driver behaviour towards cyclists and pedestrians may influence safety. It will not be possible to measure this. |
| d. Street lighting on the way | See Q.11 above. |
| e. Reassuring presence of people on the footpath | It could be possible to use houses facing the street as a proxy for human presence or number of pedestrians that use a road. It will not be possible to measure the presence of people using Google road view. |
| f. Number of intersections/road crossings on the route | It is possible to measure the number of intersections and in the case of cyclists, break these into left turns, right turns, roundabouts and T-junctions. Zebra crossings and assisted crossings, either lights or a road patrol could improve safety. For pedestrians crossing main roads will be different to side roads with an island half way. |
| g. Parking provision (for | Not relevant to pedestrians. It will not be possible to know |</p>
<table>
<thead>
<tr>
<th>your mode of transport</th>
<th>which schools have parking provisions for bikes.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>h. Presence of a route separated from motor traffic</strong></td>
<td>The presence of cycle-paths will give cyclists the benefit of greater safety, as will pavements that have a grass verge between them and the road. It is not possible to know whether cyclists use the road or the pavement in the course of their journey.</td>
</tr>
</tbody>
</table>
Appendix D. Comparison of four cities in the ACTIVE study

<table>
<thead>
<tr>
<th></th>
<th>Hastings</th>
<th>New Plymouth</th>
<th>Masterton</th>
<th>Whanganui</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population (2006 Census)</td>
<td>70,824</td>
<td>68,901</td>
<td>22,623</td>
<td>42,639</td>
</tr>
<tr>
<td>Maori (% of population)</td>
<td>16,233 (22.9%)</td>
<td>9,369 (13.6%)</td>
<td>3,726 (16.4%)</td>
<td>9,078 (21%)</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>4.5%</td>
<td>4.8%</td>
<td>4.8%</td>
<td>6.6%</td>
</tr>
<tr>
<td>Access to 1 motor vehicle</td>
<td>36%</td>
<td>40%</td>
<td>40%</td>
<td>44%</td>
</tr>
<tr>
<td>Access to 2 motor vehicles</td>
<td>38%</td>
<td>38%</td>
<td>37%</td>
<td>33%</td>
</tr>
<tr>
<td>Access to 3 or more motor</td>
<td>16.8%</td>
<td>14.1%</td>
<td>14%</td>
<td>11%</td>
</tr>
<tr>
<td>vehicles</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No access to a motor vehicle</td>
<td>8%</td>
<td>8%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Mean Summer (January) temperature</td>
<td>25.5˚</td>
<td>17.5˚</td>
<td>18.1˚</td>
<td>17.2˚</td>
</tr>
<tr>
<td>Mean Winter (July) temperature</td>
<td>13.9˚</td>
<td>9.3˚</td>
<td>7.6˚</td>
<td>8.6˚</td>
</tr>
<tr>
<td>Average Summer rainfall (January)</td>
<td>66mm</td>
<td>97mm</td>
<td>44mm</td>
<td>62mm</td>
</tr>
<tr>
<td>Average Winter rainfall (July)</td>
<td>64mm</td>
<td>143mm</td>
<td>91mm</td>
<td>88mm</td>
</tr>
</tbody>
</table>
Statistics from Census 2006, Statistics New Zealand

Climate from NIWA Climate Data