The mechanisms and types of non-motor vehicle injuries to pedestrians in the transport system and indicated infrastructure implications

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An important note for the reader

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Abbreviations and acronyms

ACC: Accident Compensation Corporation

CBD: central business district

FHWA: Federal Highway Administration (USA)

M: mean

MoT: Ministry of Transport

MUA: main urban area

NS: not significant

NZHTS: New Zealand Household Travel Survey

NZTA: NZ Transport Agency

OECD: Organisation for Economic Cooperation and Development

RCA: road controlling authority

SD: standard deviation

SPSS: Student Predictive Statistical Software

TA: Territorial Authority

χ^2: chi-square statistic

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Executive summary

This research project was carried out during 2008–2010 with the objective of determining the extent and causes of non-motor vehicle injuries to pedestrians. Non-motor injuries include those produced by such events as trips, falls, knocks and collisions with obstacles. In the health sector, these events are often classified under the general area of falls. A review of the literature found that most pedestrian injuries in New Zealand involve no motor vehicle interaction and are therefore not reported as part of traffic crash data. However, the review indicates non-motor vehicle related pedestrian injury is a significant contributor to road network trauma cases.

New Zealand has a safe system approach to road safety, under which Road Controlling Authorities have a responsibility to minimise injury on their road networks, irrespective of whether the injury involves motor vehicles or not. In New Zealand, around 700 pedestrians are admitted to hospital each year as a result of slips, trips and stumbles in the road environment, and so the problem is not insignificant. However, knowledge about the circumstances and mechanisms of pedestrian injuries is lacking, particularly how these aspects relate to road and pathway infrastructure. This project seeks to remedy this lack. Two sources of information and data were used:

- Accident Compensation Corporation (ACC) claims for pedestrian injury occurring on or near the road, where motor vehicles were not involved
- a structured survey using face-to-face interviews of pedestrians injured on roads or footpaths.

Survey participants ranged in age from 1.6 years (where the parent undertook the interview, as they were present at the time of the accident) to 97.5 years, with an average age of 52 years. Ages of pedestrians injured are relatively evenly distributed but with a perceptible bulge towards older age groups.

The sample was predominantly female. This was not a response bias to the survey, as the full sample of Wellington region injuries provided by the ACC was 61% female. The New Zealand Household Travel Survey (2003–2009) shows that in main urban centres, females make about 30% more walking trips and spend 25% more time walking than men, so it follows that female accident frequencies would be expected to be higher because of their greater exposure to walking.

Analysis of the data showed most injuries occurred on the roadside in residential areas, followed by the central business district and smaller shopping areas. Few accidents were reported in rural and industrial areas. Vertical changes, particularly kerbs, are a key cause of pedestrian trips and falls. These accident types are particularly problematic when a pedestrian steps up as opposed to stepping down. Uneven construction was the most commonly reported hazard type in roadside pedestrian accidents. The most common surface type pedestrians slipped, tripped or fell on was asphalt/bitumen (34%) followed by concrete (31%), which is likely to reflect a high exposure to these surface types. Of the injuries sustained, 43% were sprains and strains. Serious injuries such as fractures accounted for between 12% and 15% of injuries. Less than 3% of injuries were to the head. Factors that amplified the severity of injuries included the road or path surface, pedestrians' inattention, type of footwear worn, and whether walking or running.

Pedestrians typically agreed (87%) that they were physically fit, with only 3% reporting they were suffering from an illness and 4% reporting that they were suffering from a previous condition (injury/frailty/sickness) at the time of the accident. Approximately 45% of participants agreed or strongly agreed they had some level of distraction at the time of their accident.

A sample of 14 accident sites was examined to determine whether the sites complied with basic pedestrian level of service criteria. The 2009 *New Zealand pedestrian planning guide* was used to help determine site standard compliance. All sites had characteristics related to the accident that were unsatisfactory by expert opinion and, in seven cases, also according to the published criteria.

The report recommends formal recognition of the problem, and measures to prevent and mitigate non-motor vehicle pedestrian injury as an integral and important part of road safety are required. A suggested approach is through bringing prevention and mitigation measures consciously and deliberately into the road safety mainstream under the safe system approach. This would require promulgating a policy that, at local, regional and national levels, all road safety strategies, safety management systems and associated action plans should specifically have regard to these injury events, and that these pedestrian injuries should be regarded on a level playing field with motor vehicle crashes.

This study found a need to instigate research to provide improved data and analysis tools to prioritise such countermeasures vis-à-vis other uses of road safety funds and improved data for input into such analysis tools. Further, a national guide is needed for pedestrian road safety audits and inspections covering both motor vehicle and non-motor vehicle risk.

Abstract

Research carried out in 2008–2010 examined the quantum and causes of non-motor vehicle injuries to pedestrians through a structured interview survey. Pedestrians sustaining injuries in locations away from the road network (eg in parks) were excluded, as the emphasis was on the role of road and footpath features. The highest proportion of trips and falls (34%) was sustained while stepping over a kerb. A further 18% were caused by irregularities in the path or road surface. Factors that amplified the severity of injuries included the road or path surface, pedestrians' inattention, type of footwear worn, and whether walking or running. Two main issues were identified from the study. These were: (1) people tripped and fell more often on poorly maintained surfaces as opposed to poorly designed areas, and (2) the severity of the injuries is directly related to the surface. The study recommends improving the definition of kerbing in key pedestrian areas and improving the maintenance regime of footpaths and roads used by pedestrians, eg crossings. The study also found that it is necessary to instigate research to provide improved data and analysis tools to prioritise such countermeasures vis-à-vis other uses of road safety funds and improved data for input into such analysis tools. Further, a national guide is needed for pedestrian road safety audits and inspections covering both motor vehicle and non-motor vehicle risk.

1 Background

1.1 Rationale for carrying out this work

Walking is an active transport mode that can improve the liveability of our urban areas, help integrate our transport networks, reduce transport emissions and improve public health. It is important for the future growth of walking that the public has confidence in its ability to do so safely on the street network. This means putting effort into identifying under what circumstances pedestrian injury events occur and hence to instigate effective mitigation measures.

Section 2.2 shows that most pedestrian injuries involve no motor vehicle interaction and are therefore not reported as part of traffic crash data. Knowledge about the circumstances and mechanisms of pedestrian injuries is lacking, particularly how these aspects relate to infrastructure. This is a state of affairs that needs to be remedied if we are to fully achieve the potential of walking as a serious mode of transport. Before any systematic remedial action can be taken, the infrastructural impediments to walking on New Zealand roads and roadsides need to be documented. This project seeks to remedy this lack of knowledge, using analyses of data related to the circumstances surrounding Accident Compensation Corporation (ACC) claims for pedestrian injury occurring on or near the road when motor vehicles were not involved.

The ACC, New Zealand's no-fault, state-owned injury compensation and rehabilitation provider, keeps records of pedestrian injury claims. From these records, we are able to extract those that were not related to motor vehicles.

Much information on the circumstances of the injury is not held by the ACC. This includes information about the geographical location of the injury event, the infrastructure involved and its condition, the time of day, lighting etc. To get this information accurately enough for it to be useful, a home interview survey of injured people is required. This report describes how such a survey was carried out and analysed. The research was carried out in the following stages:

1. A literature search of existing knowledge both here and overseas was undertaken, in conjunction with an analysis of information held by the ACC in its database related to pedestrian injuries occurring in the road corridor and not involving a motor vehicle.
2. A home interview survey of injured pedestrians was designed. This involved creating a sampling framework to ensure a representative sample was attained, as well as designing a questionnaire to identify any environmental elements that may have contributed to the accident.
3. A pilot home interview survey of injured pedestrians was required to fine-tune the questionnaire and interviewing techniques in order to maximise the information gained from the full survey that followed.
4. A full home interview survey of injured pedestrians was undertaken.
5. The data was analysed.

Further details on the survey are supplied in chapter 3.

To our knowledge, no previous study of this sort has been made where details of the circumstances of pedestrian injury are elicited through a home interview survey of injured people and related to infrastructure characteristics. Well carried out household interview surveys can achieve response rates of around 75%, which is what we expected to achieve in this case.

1.2 The research context under a safe system approach to road safety

New Zealand has a safe system approach to road safety, under which Road Controlling Authorities (RCAs) have a responsibility to minimise injury on their road networks, irrespective of whether the injury involves motor vehicles or not. Their networks include the roadway and areas near the roadway used by pedestrians. Thus the responsibilities of mitigation fall upon the RCAs[1]. It is expected that the information this report provides will be used by RCAs to improve their ability to carry out their mitigation responsibilities.

1 RCAs in New Zealand are the Territorial Local Authorities, which administer local roads, and the NZ Transport Agency (NZTA), which administers state highways.

2 Literature review

2.1 Introduction

Non-motor vehicle pedestrian injury on the road transport network as administered by RCAs is an area that has received little attention in the road safety literature. This review of the available literature indicates that non-motor vehicle related pedestrian injury is a significant contributor to road trauma. Non-motor injuries include those produced by events such as trips, fall, knocks and collisions with obstacles. In the health sector, these events are often classified under the general area of falls. As the transport system includes all users under a safe system approach, this problem is an important consideration for RCAs.

2.2 The extent of the problem

The problems associated with a lack of information in this area are recognised by the New Zealand Walking and Cycling Strategy's (Ministry of Transport (MoT) 2005) 'Priority 9':

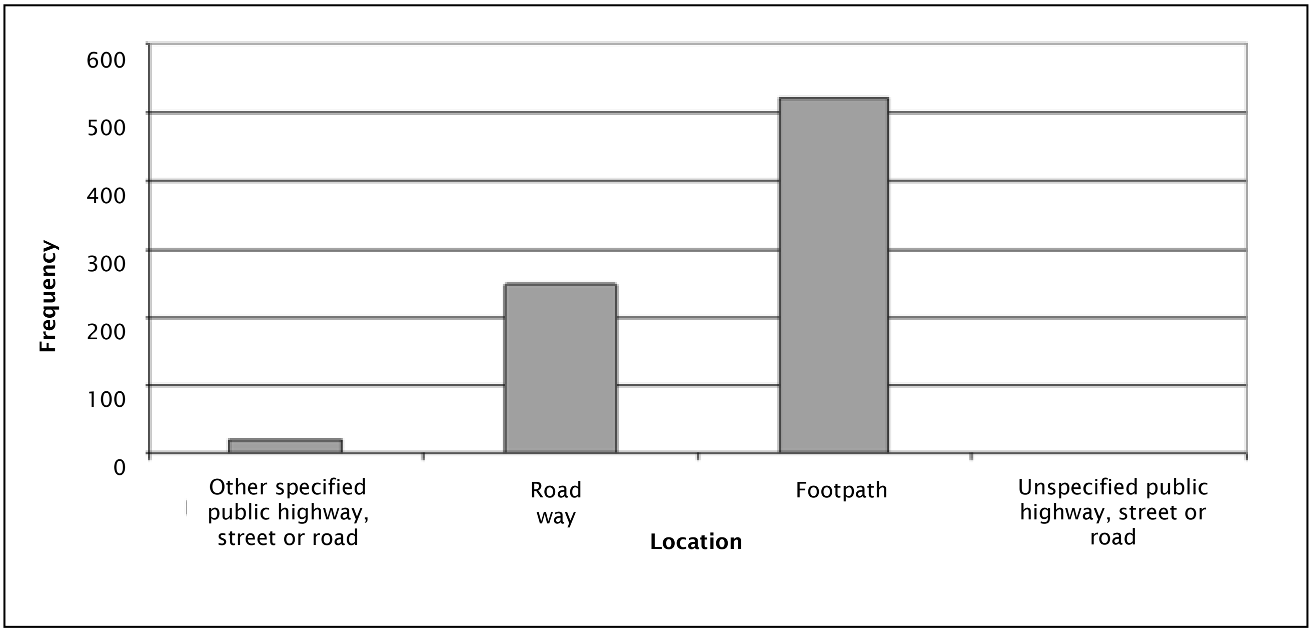
> *Poorly designed and ill-maintained infrastructure also poses risks for pedestrians and cyclists. For example, inadequate design or maintenance of footpaths, cycleways and main carriageways can increase their risk of falling. For child cyclists, the cycle itself can also contribute to risk if it is inappropriate for the rider. Limited information is available on non-motor-vehicle-related injuries to pedestrians and cyclists in New Zealand, and road safety strategies to address such injuries have received less focus than strategies to reduce crashes involving motor vehicles.*

The literature survey carried out in the course of this research indicates most pedestrian injuries occur on the footpath, involve no motor vehicle and consequently are not reported as part of traffic crash data. Approximately 30,000 pedestrian claims are made to ACC per year, yet around 90% do not involve a moving motor vehicle. Of the approximately 2600 more serious entitlement claims[2] per year, around 80% do not involve a moving motor vehicle[3]. According to National Health statistics, in New Zealand, around 700 pedestrians are admitted to hospital each year as a result of slips, trips and stumbles in the road environment. This is broadly similar to the 677 pedestrians admitted for injuries caused by motor-vehicle collisions in the 2009 calendar year and the ~1000 reported as injured in motor vehicle crashes by the New Zealand Police per year.

2 Entitlement claims are claims that include entitlement payments, such as weekly compensation, rehabilitation services, housing modifications, etc. Generally, these only need to be paid for moderate or serious injuries.

3 These numbers are from analyses of data provided by the ACC. The claims we have considered are labelled 'pedestrian' and, for this purpose, are claims where the scene of the accident was recorded on the ACC45 form as the road and no moving motor vehicle was involved.

Figure 2.1 Location of street and highway falls 2007 (data provided by Injury Prevention Research Unit)



As in New Zealand, non-motor vehicle pedestrian injuries in Australia are classed as falls on highways and streets. This term covers a wide variety of circumstances including trips, slips and collisions with obstructions. According to Berry and Harrison (2007), in 2003–2004, 4587 hospitalisations were recorded in Australia because of falls classified as 'on street or highway'[4]. This is 72% greater than the 2666 pedestrian hospitalisations associated with motor vehicles. The Federal Highway Administration (FHWA) in the USA (1999) describes a project where data was collected prospectively at eight hospital emergency departments over approximately one year in three states: California, New York and North Carolina. Information was gathered on 2509 persons treated for injuries incurred while bicycling or walking. Sixty-four percent of the reported pedestrian injury events did not involve a motor vehicle. Seventy-eight percent of the non-motor vehicle pedestrian injury events occurred in non-roadway locations such as footpaths, parking lots or off-road trails, leaving 22% on the road. The most important category for this study, 'sidewalk', was 58% of the non-roadway, non-motor vehicle total. The study reported an age-related distribution (figure 2.3) of non-roadway and non-motor vehicle pedestrian injuries. This indicates that the importance of these events increases with chronological age, which would link with the well-known phenomenon of increased fragility with age. This is a generally similar pattern to that observed in the New Zealand hospital admissions data.

4 The author's analysis of the ACC claims data indicate that nearly 25% of claims that initially appeared to be associated with roads and roadsides were found not to be thus associated. The authors do not know how many New Zealand or Australian hospitalisations classified as 'on street or highway' were not associated with roads and roadsides.

Figure 2.2 Injuries by age group from falls on 'street or highway' in Australia (adapted from Berry and Harrison 2007)

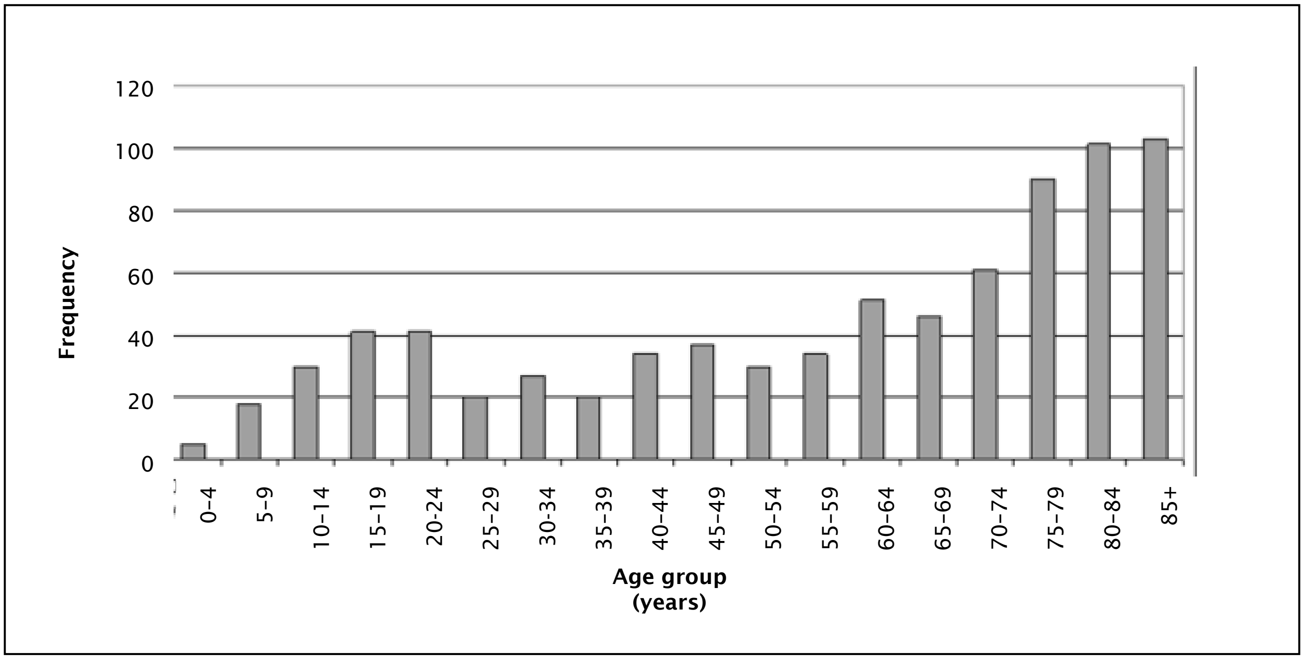
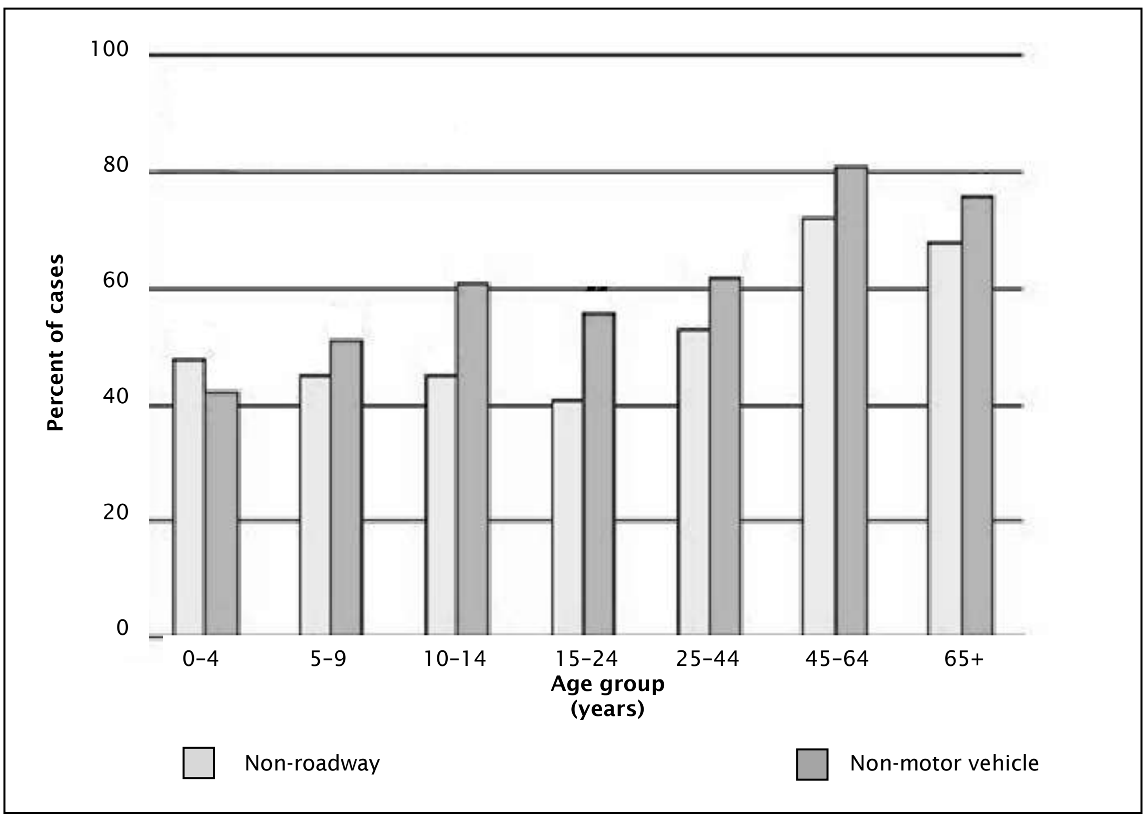


Figure 2.3 Age distribution of non-roadway and non-motor vehicle pedestrian injuries (modified from FHWA 1999)



2.3 The role of the infrastructure and its condition

It is a truism that when any physical activity increases, injuries associated with that activity will increase, unless the risks associated with that activity are reduced. Thus, unless the safety of the infrastructure associated with the walking environment is improved enough to counterbalance the greater exposure to risk associated with expected increases in walking, pedestrian injuries not related to motor vehicles can be expected to increase in future. Infrastructure, in this context, is the walking environment including walking surfaces, road crossing points, covers to services, and obstacles like bollards, seats, trees, signs etc. Bird et al (2007) analysed the effect of differing heights of footway defect, and the overall exposure of pedestrians to these defects on the number or insurance claims received. They found that:

> *…the probability of an accident occurring increases logarithmically until a defect height of about 40mm, after which the probability remains constant. At higher step heights the defect is more likely to be noticed so the risk does not increase further.*

See figures 2.4 and 2.5 for a visual representation of Bird et al's findings.

Figure 2.4 Comparison of the expected number of pedestrian accidents across defect height for different levels of pedestrian traffic flow (adapted from Bird et al 2007)

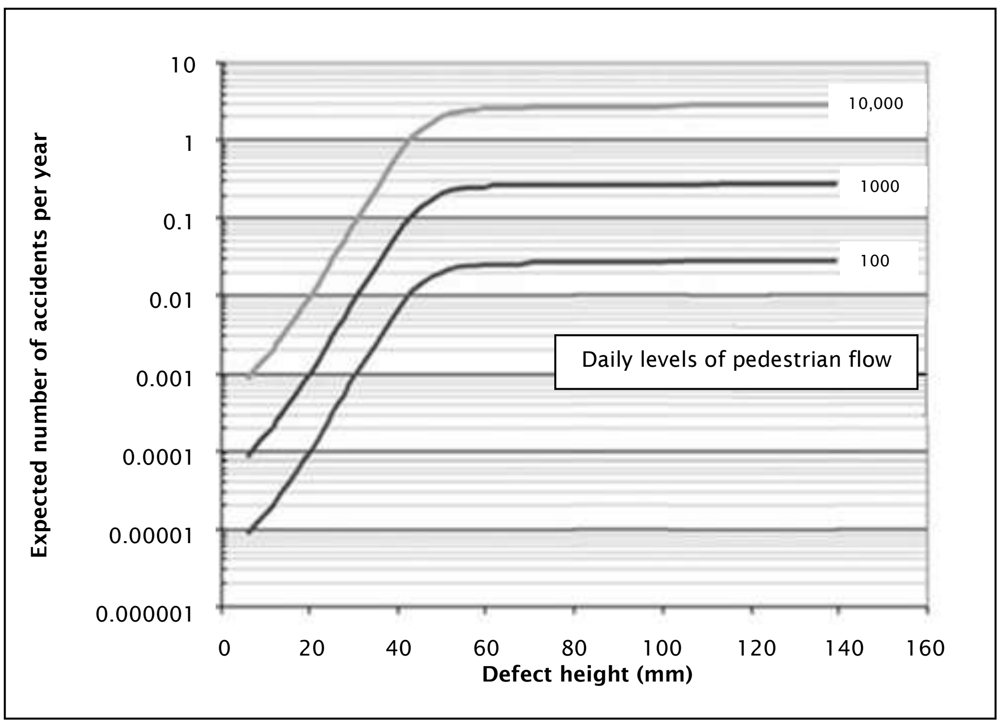


Figure 2.5 Probability of catching a foot at an abrupt height change (adapted from Bird et al 2007)

In the United Kingdom, it was reported that in 1995 (Kindred Associations, cited in Davies (1999)), some local authorities were paying more for injury compensation claims from footway falls than they were spending on footway maintenance. More recently, it was reported (Doncaster Free Press 2008) that:

> *Suffolk County Council has paid out almost £200,000 in compensation over the last four years to people hurt in falls caused by damaged pavements or potholes. The council has had 192 claims since 2004 but only 19 secured payouts ranging from £50 to £47,613, with the total amount paid being £190,905, an average of more than £10,000 per successful claim.*[5]

In the United States, Eck and Simpson (1996) analysed hospital data and carried out a telephone survey on rural non-motor vehicle pedestrian accidents in Monongalia County, West Virginia. Two general types of surface-condition problems were identified: slippery surfaces caused by accumulation of snow and ice, and surface holes or openings.

In a Swedish study of hospitals investigating all pedestrian accidents, Berntman and Modén (1996) found, in a series of hospital studies covering all pedestrian accidents, that most pedestrian accidents involve falling or slipping on icy or snowy surfaces, with 65–80% being of this type. Similarly, Eilert-Petersson and Schelp (1998) reported that for all patients living in the county of Västmanland, Sweden, who had visited a physician or dentist because of a non-fatal injury during one year, pedestrian injuries were found to account for 41% of all injuries in the traffic area. Wintery conditions were clearly associated with increased injury rates, with 51% of injuries occurring between November and January (Northern Hemisphere winter). Falls caused 82% of the injuries, mostly from slipping, particularly in urban areas. Persons who had slipped often made more than one

5 Comparable costs are not available from ACC, as ACC claims include a substantial bulk-funded component that cannot be associated with individual claims.

visit to a hospital emergency department, and were hospitalised more often than those who had stumbled[6]. These studies suggest weather conditions altering the walking surface condition are a complicating factor in these types of injuries.

Ayres and Kelkar (2006) categorised potential trip points as those with abrupt elevation changes greater than 1.3cm. They found that one mixed-use area (shopping and residential) contained about 30 trip points per km (not including kerbs), compared to 12 trip points per km in a residential area and no trip points in a mall (including the parking area).

2.4 Individual factors

2.4.1 Age of injury victims

The statistics indicate that older people in particular have problems walking safely. According to the Pedestrian Association (1995) in the United Kingdom:

> *...55% of people in retirement have a problem with cracked and damaged pavements, 40% say there is too much traffic, 31% fear uncleared snow and wet leaves, 29% have a problem with cyclists on the pavement, 27% with vehicles parked on the pavement, 20% are in difficulty because there is no pedestrian crossing and 15% need more time to cross.*

Figure 2.6 compares fall hospitalisation by age in Canterbury, New Zealand, for those aged over 65 years for falls at home, on the road and in residential institutions. Road falls increased until a peak was reached between the ages of 80 and 90 years. Figure 2.7 shows a similar pattern for fall-related deaths. The same presentation (Armstrong 2005) estimated that for the 65+ year age group, the risk of falling per hour on the road was approximately five times the risk of falling per hour at home after adjusting for sleep.

6 The accidents were not reported in the form of rates.

Figure 2.6 Comparison of hospitalisations from falls across age group and fall type for people aged 65+ years (adapted from Armstrong 2005)

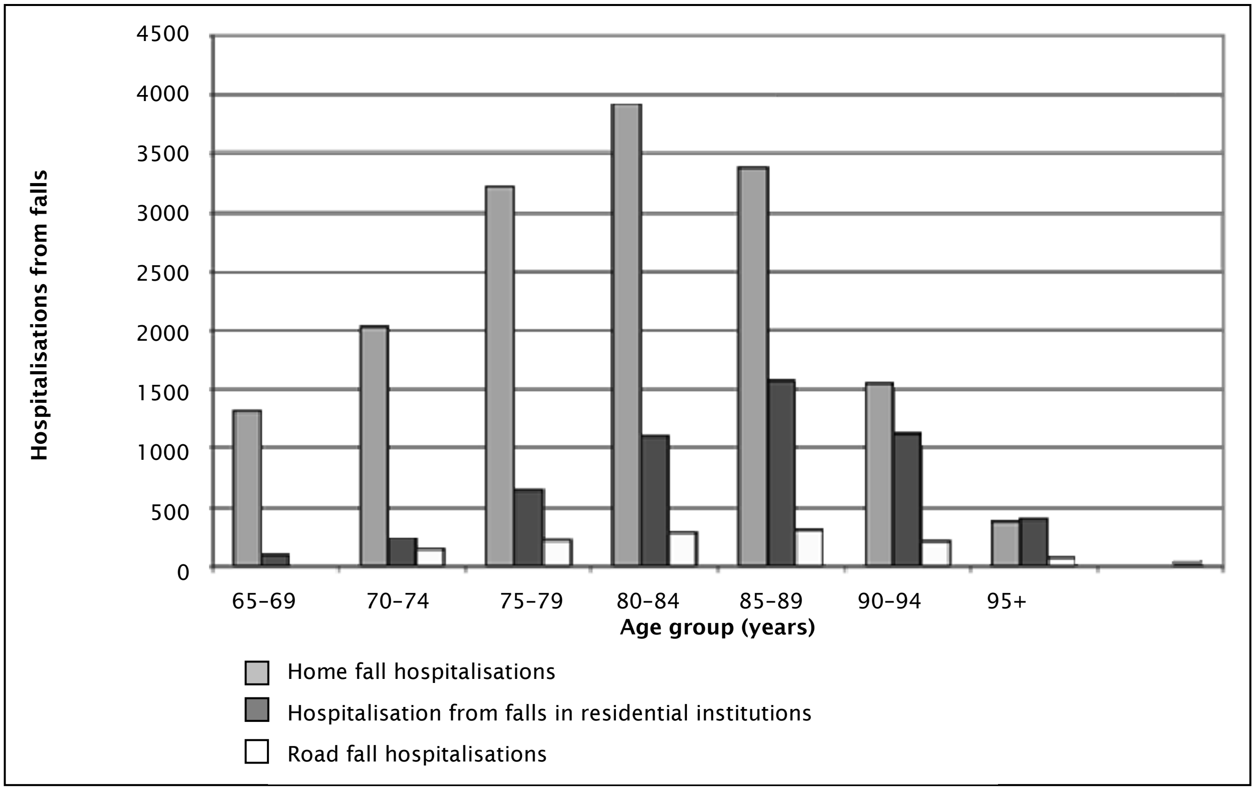
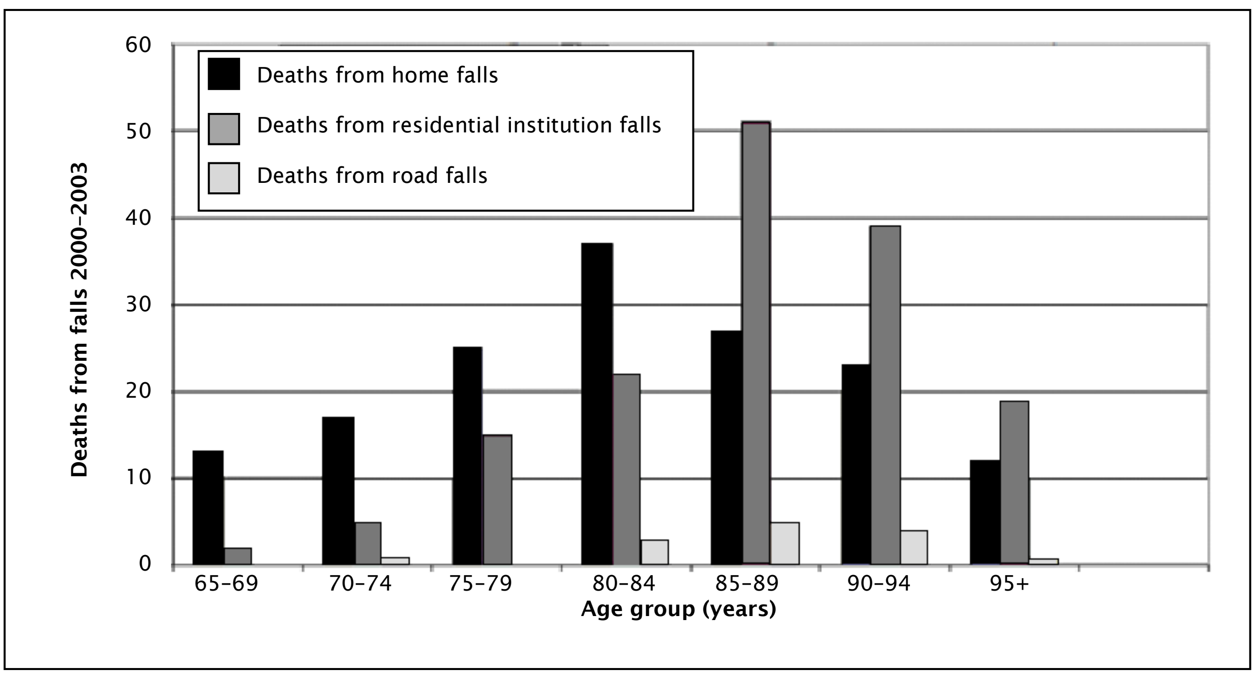


Figure 2.7 Comparison of fatalities from falls across age group and fall type for people aged 65+ years (adapted from Armstrong 2005)



2.4.2 Fatigue

In a study examining the influence of fatigued leg muscles on slip-based falls, Parijat and Lockhart (2008) found that fatigued quadriceps induced suboptimal leg movements, which in turn were associated with slip accidents. They also found that fatigued knee extensor muscles reduced joint support. This would partially explain why people running or in a hurry to get somewhere frequently incur these accident types. Another factor, of course, is increased friction demand.

In a review of work-related falls from roofs, fatigue was found to be a major contributor (Hsiao and Simeonov 2001). Their explanation was that fatigue impedes the nervous system, increasing the reaction time required to moderate balance in both normal and emergency balance control situations. Therefore, situations where balance could be lost would be more commonplace, and the ability to recover from losing balance would be slower when fatigued.

2.4.3 Distraction

Gauchard et al (2001) suggest that in addition to age, fatigue and physical health, another intrinsic factor implicated in pedestrian slips, trips and falls relate to attention being diverted into other activities while walking. Leclercq and Thouy (2004) also report that accidents where environmental factors (such as uneven surfaces) are implicated do not occur in isolation of other contributing factors, citing preoccupation and time constraints as being relevant.

In an experimental study, Weerdesteyn et al (2003) had people walk on treadmills and avoid obstacles on the treadmill, with half of the subjects also given a secondary task (an auditory distracter task). Failure rates of obstacle avoidance were significantly higher when the distracter task was present (20.3%) than when participants were only avoiding the obstacle (9%). The failure rate increased even though the distracter task was only auditory, as opposed to visual or physical in nature. If an auditory distracter task interrupts obstacle avoidance, it would follow that talking to other pedestrians or talking on a cell phone would interrupt obstacle awareness and avoidance while walking.

3 Method

3.1 ACC pedestrian injury claims

The ACC keeps records of pedestrian injury claims by collecting information on treatment costs, injury mechanism, type of injury and the basic geographical location where the injury occurred, using the ACC45 claim form (see appendix C). From these records, we were able to extract pedestrian injuries that were not associated with motor vehicles. It is known that much information on the circumstances of the injury is not held by the ACC. This includes detailed information about the geographical location of the injury event, the infrastructure involved and its condition, time of day, lighting etc. To understand the role of infrastructure in the accident – given its absence from the claim form – a home interview survey of injured people was mounted in order to obtain the required information.

3.2 Sample universe and sample frame

The home interview survey for this project was carried out at dwellings in urban areas around the Wellington region. This allowed the study to go ahead without involving excessive travel by interviewers, thus making prudent use of resources. The urban form in the Wellington region is sufficiently typical of New Zealand urban areas to generalise well to the rest of the country. The characteristics of the sample related to other comparable areas of New Zealand are dealt with in section 4.1.1.

No known previous study of this sort has been undertaken in which details of the circumstances of pedestrian injury are elicited through a home interview survey of injured people and related to infrastructure characteristics. Mail-out surveys, such as those carried out by Munster et al (2001) and Schneider et al (2006) for cycle crashes, have met with disappointing results, involving low response rates from those successfully contacted. Well-conducted household interview surveys can achieve response rates of around 75% of those successfully contacted, which is close to what was eventually achieved in this study.

The sample universe was all non-motor vehicle related pedestrian injuries occurring from accidents near or on roads to people residing in areas under the jurisdiction of the Territorial Authorities (TAs) of the Wellington Region (Wellington City, Hutt City, Upper Hutt City, Porirua City and Kapiti Coast District), which lie within main urban areas (MUAs) as defined by Statistics New Zealand. Places near roadways include areas such as footpaths, grass verges and traffic islands.

Those who were injured by other mechanisms or in other settings were excluded from the study. This included accidents that did not occur on or nearby a road, such as accidents that occurred on a walking track, park or golf course. Rare non-accident events were deemed outside the scope of this study and were removed. These include mugging, fight injuries[7] or sudden physical disability (such as muscle cramp or collapsing because of a pre-existing medical condition).

7 Some cases of injuries from muggings and fights could possibly be related to the lighting infrastructure from the personal security point of view. However, this study focused on the direct effects of the infrastructure, so they were not part of the sample universe.

Accidents that were motor vehicle related collisions were removed, ie those caused by collisions (or evasive manoeuvres to avoid collisions) with motorists. Pedestrian accidents where the person was distracted by motorists or hastened their movement because of motorists were included. Collisions with other pedestrians or cyclists also remained in the sample (pedestrians include those using rollerblades, push scooters, skateboards and mobility scooters for the purpose of this research).

The intended sample frame was all ACC claims related to relevant injuries to people living in the study areas who suffered accidents in the period December 2008–May 2009 inclusive. In practice, a few people from earlier months also appeared in the sample supplied by the ACC and these were included. A small number of injuries happened elsewhere in the country to people in the sample. These were included if they occurred in urban areas. No population delimiters were used in the study design, apart from being able to communicate in person with the interviewer. Interpreters and proxies for children were permitted.

3.3 Comparison areas In terms of walking exposure

In terms of walking exposure, the comparison areas were the MUAs outside the sample frame. They are Whangarei, Auckland, Hamilton, Tauranga, Rotorua, Gisborne, Napier/Hastings, New Plymouth, Wanganui, Palmerston North, Nelson, Christchurch, Dunedin and Invercargill.

Auckland MUA is subdivided into four zones: Central Auckland, Northern Auckland (including Orewa), Western Auckland (including Kumeu and Waimauku) and Southern Auckland (including Papakura). Hamilton MUA is subdivided into three zones: Hamilton, Te Awamutu and Cambridge. The Napier/Hastings MUA is subdivided into two zones: Napier and Hastings. Wellington MUA is subdivided into five zones: Wellington, Upper Hutt, Lower Hutt, Kapiti and Porirua. The South Island does not have zones within MUAs.

In terms of ACC claims, the comparison was with a random sample of qualifying claims from the following TAs: Whangarei, Waitakere, Auckland, North Shore, Hamilton, Tauranga, Rotorua, Gisborne, Napier, Hastings, New Plymouth, Wanganui, Palmerston North, Nelson, Christchurch, Dunedin and Invercargill. As none of these claimants were interviewed, the exclusion of non-qualifying claims was carried out purely through reading the free text description on the ACC45 form. This description may not always reveal whether an accident occurred in a rural or an urban area. Thus the comparison group may contain a small proportion of accidents from rural parts of the catchment TAs.

3.4 Ethical considerations

The project was submitted to the ACC ethics committee and approved. It was also brought to the attention of the secretariat of the New Zealand Health and Disability Ethics Committees, which subsequently advised us that the subject matter was outside the committees’ area of interest.

3.5 How the sample was gathered

The ACC provided 1432 cases that were coded in their database for an injury taking place in the Greater Wellington Region, with the road as the injury scene. Table 3.1 outlines how this sample was refined to give a final sample of 491. Accident cases that did not include text indicating the occurrence of a slip, trip or fall in their description on the claim form[8] were removed, as were those where the description on the claim form indicated an off-road location, and those where the people lived outside of the sample catchment area[9], leaving a sample of 1174, 82% of the original list from ACC.

People in the sample of 1174 were sent official letters by the ACC, explaining the aim of this study and offering them the ability to be removed from the survey by calling a free-phone number. The ACC45 claim form details, including the names and contact details of those who did not choose to remove themselves, were then released to Opus. Attempts were made to contact those living in urban locations by phone in order to establish their willingness to participate and to establish that the accident met the key criteria of being a non-motor vehicle accident that occurred on or beside the road.

Phone contact was made by trained interviewers who later visited the people who had consented over the phone to be interviewed. The interviewers were instructed, in accordance with good practice, to make at least four attempts to reach each person by telephone. Of the 689 contacted, 55 did not meet the criterion of the injury occurring on or near the road. One hundred and sixty-six people refused the interview and a further 430 were not contacted.

In the final sample, 537 participants were surveyed in their homes, 14 of which were referrals. Referrals occurred where someone else in the household at the time had an accident that met the criteria and volunteered to engage in an interview. After the data were collected, 46 cases were removed subsequent to a final set of filter questions (see appendix A), leaving a final sample of 491.

The response rate of those eligible who were contacted was thus 75% including referrals, or 74% excluding referrals. It is unknown what proportion of people who initially refused would have been eligible.

8 The ACC45 claim form contains a section for a text description of the incident.

9 Occasionally, the address given on the ACC claim form may be different from the residence of the claimant.

Table 3.1 Summary of refinements resulting in the final sample

Refinements involved in providing final sample	Change in the number of cases	New number of cases
Total sample provided by the ACC	0	1432
Limited to slips, trips and falls in the Greater Wellington catchment area	-258	1174
Not able to contact	-430	744
Refused to do interview	-166	578
Agreed to do interview but did not meet criteria (after a short phone interview)	-55	523
Referrals (from other residents at the location of the interview)	+14	537
Final refinement	-46	491

3.6 Survey phases

The survey followed normal practice by including a pre-pilot phase, a pilot phase and then the full survey. The purpose of these phases was to refine the survey instrument and the survey methodology as much as possible at an early stage, to avoid having to make adjustments later on.

3.7 The pre-pilot survey

The survey instrument was first tested in a pre-pilot phase using an in-house interviewer trained in the background to the research, interviewing techniques, data entry, and health and safety. Seven middle-aged participants were selected from a convenience sample of volunteers who had recently experienced a pedestrian accident. The survey included 73 questions regarding the circumstances surrounding their accident and the injury sustained. The survey used pen and paper as well as electronic mapping images, and were conducted by a trained interviewer. No accidents examined involved motor vehicles. The data from the pre-pilot survey was analysed to assess the ability of the questions to produce meaningful results. A small number of questions were identified as receiving very consistent answers across participants, suggesting item changes that would lead to better differentiation between cases. It was also found that in the majority of cases, the participant did not fall but instead collided with or tripped on a stationary object in the walking environment. Following the analysis of the pre-pilot data, a number of questions were subsequently altered for inclusion in the pilot phase.

3.8 The pilot survey

3.8.1 How the pilot survey was carried out

After making an appointment, the surveyor visited the respondent to carry out the interview. Each surveyor carried consent forms, which respondents signed before beginning the survey. If the injury victim did not complete the consent form, the interview was terminated. The injury victims were made aware that they could withdraw from the process at any time. The survey could be carried out on paper or using an electronic version of the instrument on a laptop computer. The system that was used in a particular situation was left to the discretion of the interviewer. The laptop used was wireless internet enabled. This meant that the respondents were able to be shown the site on the road network where their injury occurred on Google Map Street View™ and to point out to the interviewer the exact geographical location where the injury took place. This was able to be saved along with the other survey information for use in analyses and for possible site visits.

The information collected from the survey was saved as it was entered into the computer. The computer software was set up to prevent questions being missed or answers lacking in basic cogency being entered. Data were exported to the statistical software package Student Predictive Statistical Software (SPSS)™, where future analyses would be conducted.

3.8.2 Issues arising from the pilot

The first 50 interviews were treated as a pilot survey. Three-quarters of those contacted consented to participate, a satisfactory outcome. The survey length, including the use of Google Map Street View™, was satisfactory, both in terms of surveying practicalities and burden on respondents, as the duration of the interview was around 20–30 minutes, which is within the normal range of lengths for such surveys. Lessons learnt from the pilot survey fed into procedures used for the full survey.

3.9 Material covered in the questionnaires

The final questionnaire (see appendix A) contained 73 items. The first 18 items examined where the accident occurred, validated that the accident matched the ACC data file and used filtering questions to ensure that the accident met the sample criteria (see section 3.5). Where possible, Google Map Street View™ was used to identify the exact location of the accident, and a screen capture of each accident site was taken.

The next 26 items focused on the environmental characteristics of the accident. These items included questions about:

- lighting
- weather conditions
- type of walking environment (central business district (CBD), rural, residential etc)
- walking surface types (eg asphalt/bitumen, concrete, tiles/pavers/bricks)
- hazard visibility
- whether the surface they slipped, tripped or fell onto influenced the severity of the accident.

Perceptions of surface slipperiness and roughness were also measured, including self-other perceptions of whether the surface was too rough (easy to trip on), too smooth (slippery) or about right for themselves, for a vulnerable user (eg a frail elderly person or small child) and for a ‘typical’ New Zealander.

Personal characteristics were examined with 15 items in the next section. These items asked about aspects that may have contributed to the accident by making the user more vulnerable to the environment, such as footwear, health, fatigue, visual impairments, what they were carrying and whether they were in a hurry. The following section examined the influence of other people or distraction at the time of the accident (12 items). Distractions included activity use (eg cellphone, music player or book), whether they were accompanied by another person, whether they collided with another person, and how distracted they were by motor vehicles, advertising signage, conversation or by watching other people.

Finally, two items examined how the accident could have been prevented and who was responsible for the accident.

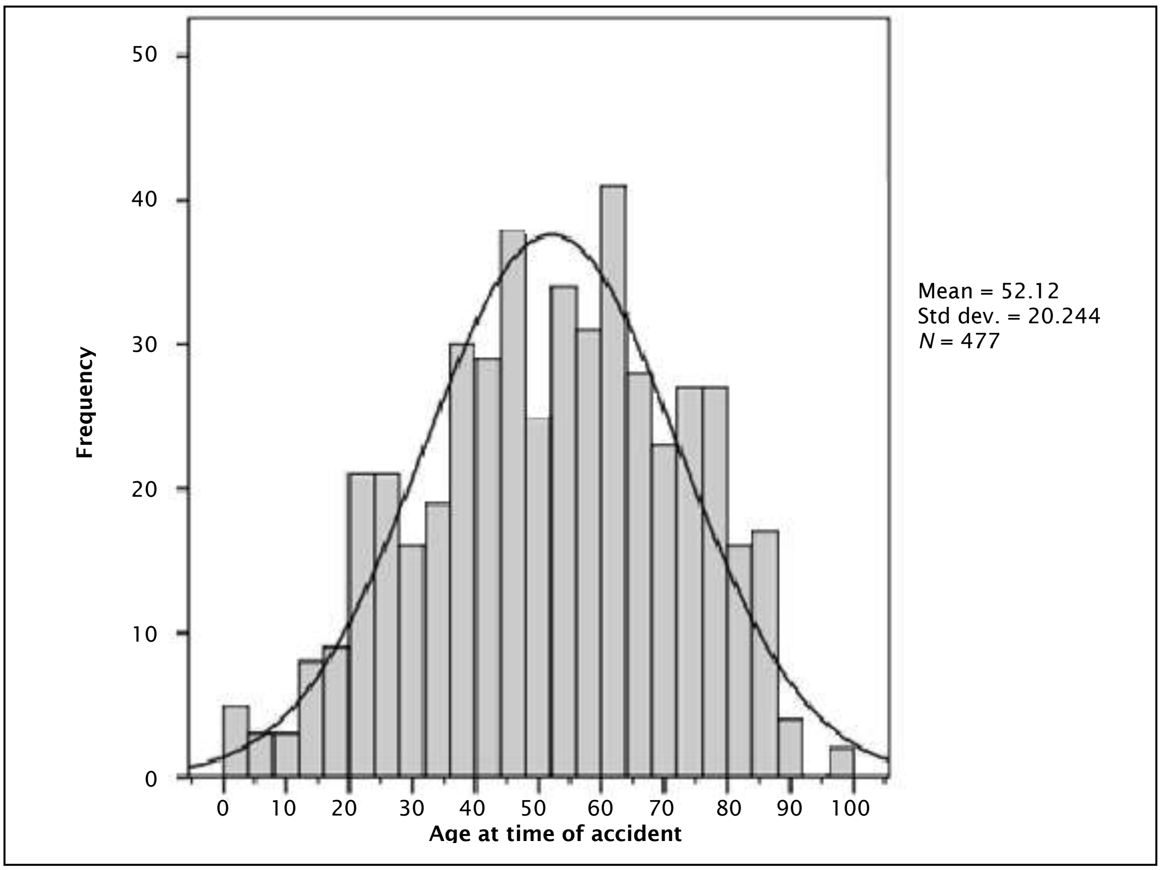
4 Results

4.1 Participant characteristics

4.1.1 Age, gender and ethnicity

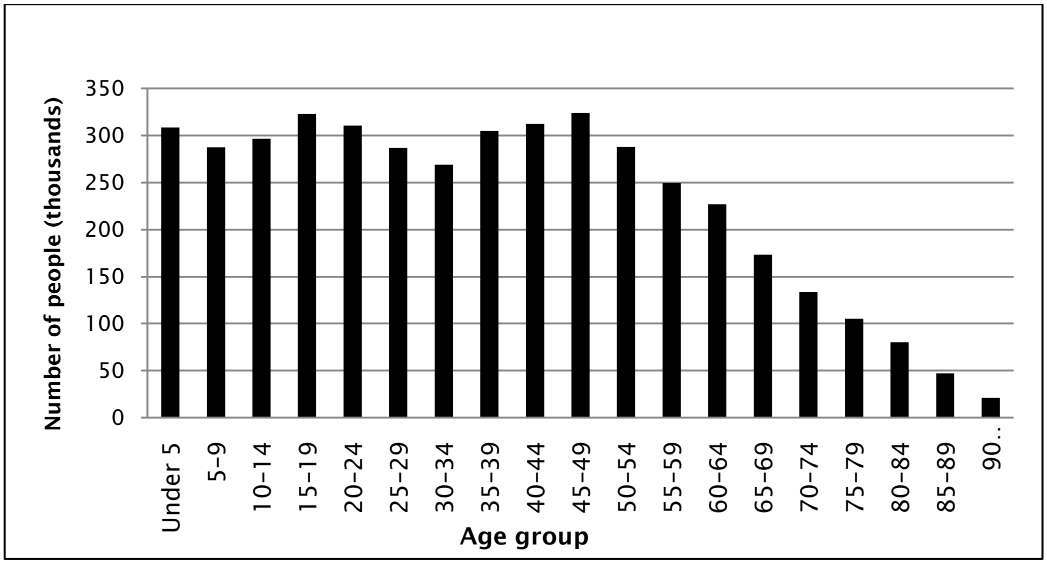
Participants ranged in age from toddlers (1.6 years, where the parent undertook the interview, as they were present at the time of the accident) to elderly pedestrians (97.5 years), with an average age of 52 years. Figure 4.1 shows that the ages of pedestrians injured are relatively evenly distributed about the mean, but with a perceptible bulge towards older age groups. It is instructive to note that the percentage of this sample aged 64 and over is around 29%, while the estimated New Zealand population percentage aged 65+ is 12.8% (Statistics New Zealand 2010).

Figure 4.1 Histogram of participant age in years, taken from the time of the accident



For comparison, figure 4.2 shows the Statistics New Zealand population estimates for 2009 by age.

Figure 4.2 Statistics New Zealand population estimates for 2009 by age (all New Zealand)



The sample was predominantly female, which was not a response bias to the survey, as the full sample of Wellington region injuries provided by the ACC was 61% female. The New Zealand Household Travel Survey (NZHTS) 2003–2009 shows that in MUAs, females make about 30% more walking trips and spend 25% more time walking than men, so it follows that female accident frequencies would be expected to be higher because of their greater exposure to walking.

The primary ethnicity was European (see table 4.1). Six of the 491 participants were residents of Wellington who had accidents while travelling outside the Wellington region (three in Auckland and three in Hawke's Bay).

Table 4.1 Descriptors for participant characteristics

Participant characteristic		***N***	**Percentage**
Gender	Female	316	64.4%
	Male	161	32.8%
Ethnicity	European	349	73.2%
	Asian	20	4.2%
	Maori	15	3.1%
	Pacific Islander	4	0.8%
	Residual categories*	71	14.9%
	Other	18	3.8%

* These categories are described by ACC as being 'repeated value, response unidentifiable, response outside scope [or] not stated.' (pers. comm. from anonymous ACC spokesperson)

4.1.2 Comparative New Zealand urban sample

To evaluate any potential age bias in the sample of interviewees, a comparison sample of 1500 accidents was drawn from urban areas outside of Wellington[10]. Three hundred and fifty-two accidents not relevant to this study were removed (such as people suffering muscle injury while running, or assaults). A significant age bias appeared in the sample, where pedestrian accidents of younger people were under-sampled and older pedestrian accidents were over-sampled compared with the ACC claims[11], as shown in table 4.2. Where age-related effects were found, they show relative differences in the types of accidents that affect different age groups, not the actual proportion of accidents that would be observed in the population.

Table 4.2 Comparison of the age characteristics in the Wellington sample with accidents from other urban areas in New Zealand

Age		Wellington sample (actual interviews)	Wellington sample from which those interviewed were drawn	New Zealand urban areas sample
0–14	*n*	14	60	82
	%	3.2%	5.3%	7.1%
15–24	*n*	32	168	206
	%	7.3%	14.9%	17.9%
25–44	*n*	108	344	332
	%	24.6%	30.4%	28.9%
45–64	*n*	165	349	308
	%	37.6%	30.9%	26.8%
65–79	*n*	81	140	152
	%	18.5%	12.4%	13.2%
80+	*n*	39	70	68
	%	8.9%	6.2%	5.9%
Total	*n*	439	1131	1148
	%	100.0%	100.0%	100.0%

The proportion of males and females in the Wellington sample were compared with accidents from other urban areas in New Zealand (table 4.3).

The results show that proportionately more females had pedestrian accidents in Wellington urban areas compared with other urban New Zealand areas[12]. This bias was also observed in the sample of pedestrians in this study[13], indicating that in this respect, it is consistent with the study population.

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10 The other New Zealand urban areas in the comparison sample included the following : Whangarei, Waitakere, Auckland, North Shore, Hamilton, Tauranga, Rotorua, Gisborne, Napier, Hastings, New Plymouth, Wanganui, Palmerston North, Kapiti, Wellington, Lower Hutt, Upper Hutt, Nelson, Christchurch, Dunedin and Invercargill.

11 χ^2 (N = 1587, 5) = 56.71, p< 0.001

12 χ^2 (N = 2279, 1) = 105.10, p < 0.001

13 χ^2 (N = 1587, 1) = 84.89, p < 0.001

Table 4.3 Comparison of proportion of males and females in the Wellington sample with accidents from other urban areas in New Zealand

Age		Wellington sample (actual interviews)	Wellington sample from which those interviewed were drawn	New Zealand urban areas sample
Male	*n*	149	433	686
	%	33.9%	38.3%	59.8%
Female	*n*	290	698	462
	%	66.1%	61.7%	40.2%
Total	*n*	439	1131	1148
	%	100.0%	100.0%	100.0%

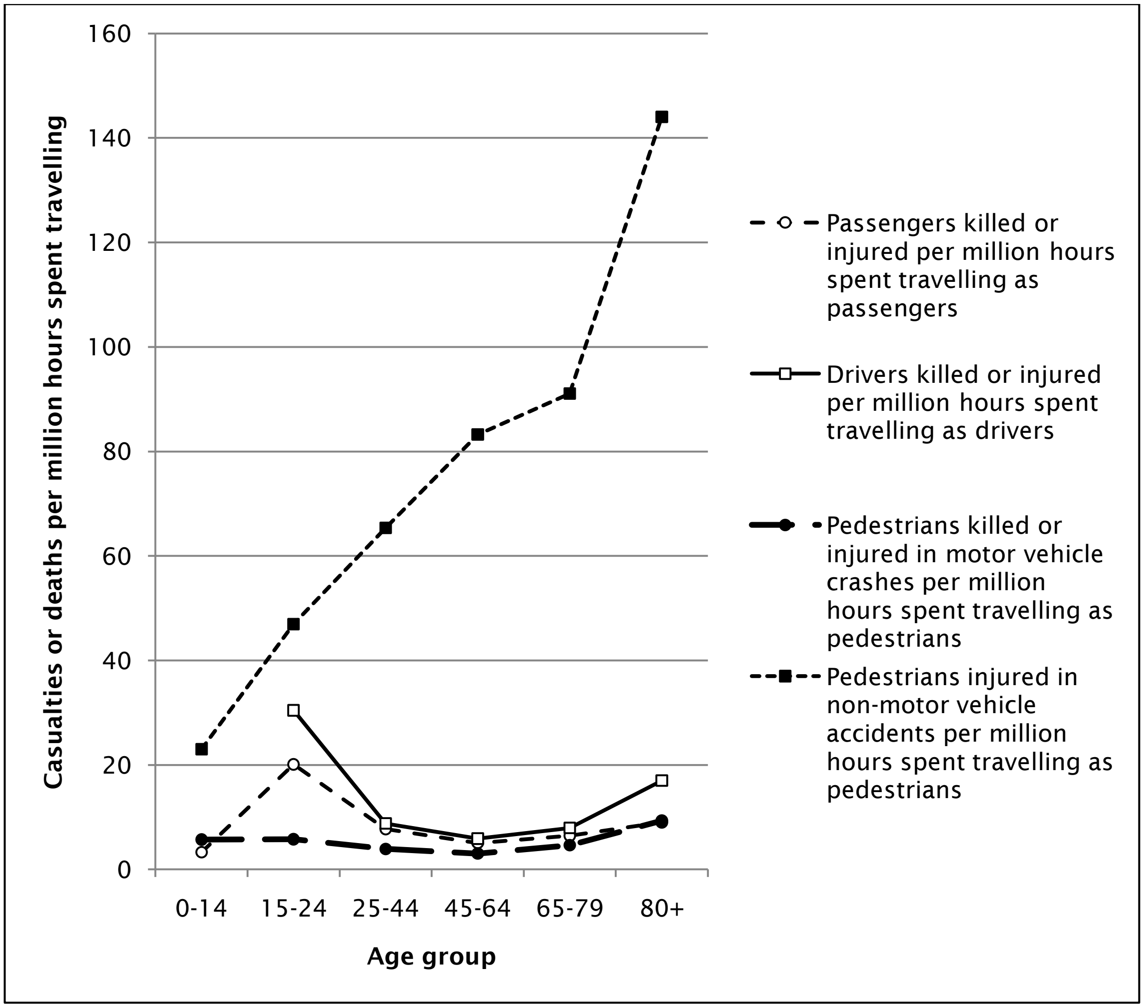
4.1.3 Exposure related rates for accidents

Non-motor vehicle pedestrian injuries (ie those associated with the road and roadside) in New Zealand MUAs per million hours spent walking, by age, are outlined in figure 4.3. Figure 4.3 also compares these statistics with passengers, drivers and pedestrians killed or injured in New Zealand urban motor vehicle crashes reported to the police by age**.** NZHTS data provided the average annual walking exposure levels by age using data from July 2003 to June 2009. In all cases, as in figure 4.3, once middle age is reached, the injury rates tend to increase with age. This is in line with what is generally found when exposure-related risks from activities are tabulated against age. Future demographic change will result in a steady increase in the number of older people. Thus, the increased rate with age indicates that absolute numbers of injuries in this age group are likely to increase substantially, with predicted increases in older age groups (figure 4.4) as the population of New Zealand ages, unless countermeasures can be developed. How this will affect the overall burden of pedestrian injury is outside our scope.

Figure 4.3 also shows that non-motor vehicle injuries and deaths are reported in much greater quantities than motor vehicle injuries[14]. For the 80+ age group, the difference approaches an order of magnitude. How the severity of the injuries and their reporting rates compare could be the subject of another project.

14 These rates are quotients of estimates made using assumptions which are approximate. Thus they are not precise. An assumption not otherwise mentioned in the text relates to the fact that travel survey data are annual while the ACC data covered the six-month period of December 2008 to May 2009 inclusive. In order to estimate an annual rate, the numbers of accidents were simply doubled. Also, the catchment area of ACC claims outside the Wellington region could not be exactly matched to the MUAs outside the Wellington region, from which the walking exposure estimates were derived.

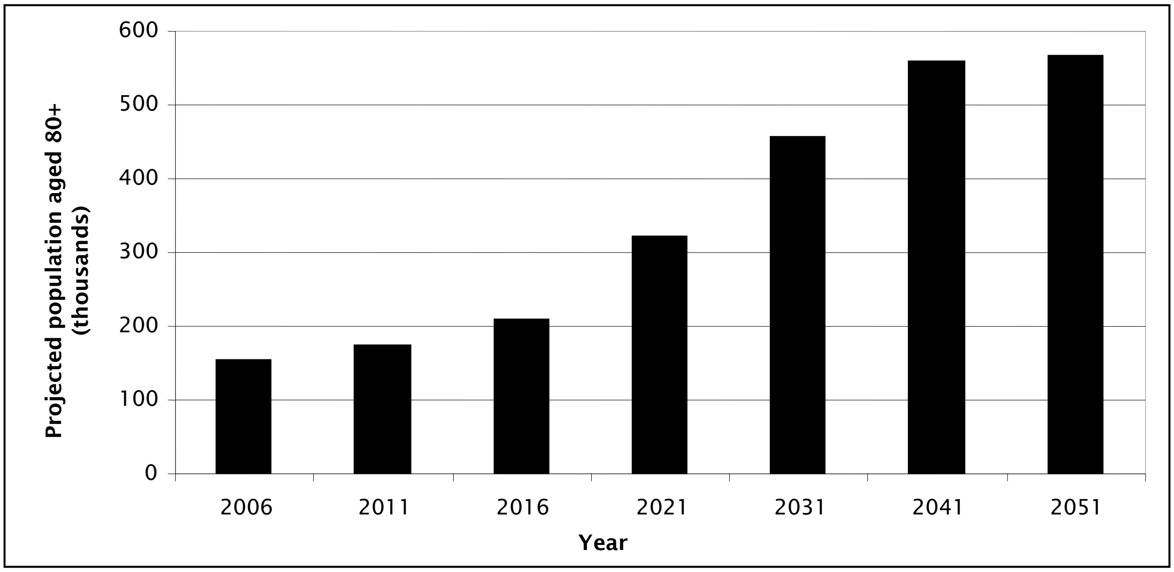
Figure 4.3 New Zealand pedestrian injuries in MUAs not involving motor vehicles per million hours spent walking, by age, compared to passengers, drivers and pedestrians killed or injured in urban* motor vehicle crashes by age



* Vehicle trips were considered ‘urban’ if the speed limit was 70km/hr or lower.

Future demographic change will result in a steady increase in older people, both in absolute numbers and as a percentage, with the rate of increase growing rapidly around 2020 as shown in figure 4.4. Thus, the increased rate with age indicates that absolute numbers of non-motor vehicle pedestrian injuries in this age group are likely to increase substantially in the future unless countermeasures can be developed.

Figure 4.4 Projected 80+ age group population by year, base year 2006



Note to figure 4.4: Data courtesy of Statistics New Zealand. Charts use Statistics New Zealand projections, base 2006, assuming medium fertility, medium mortality and long-run annual net migration of 10,000.

4.2 Environmental characteristics

4.2.1 Accident location

The results of this study show that most injuries occurred in residential areas, followed by the CBD and smaller shopping areas (see table 4.4). Few accidents were reported in rural[15] and industrial areas. It would be expected that less walking would occur in rural or industrial areas than in residential or shopping areas, and it is not really plausible that pedestrian infrastructure in industrial locations is superior to that in the other three predominant locations. Our sample was of people living in urban areas, so one would expect their accidents to be biased towards urban locations. Exposure to different walking locations implicitly has some influence, as the level of infrastructure provided is likely to match walking demand in those areas (from CBD to rural). The data collected may thus, to some extent, reflect the amount of walking done in the various locations.

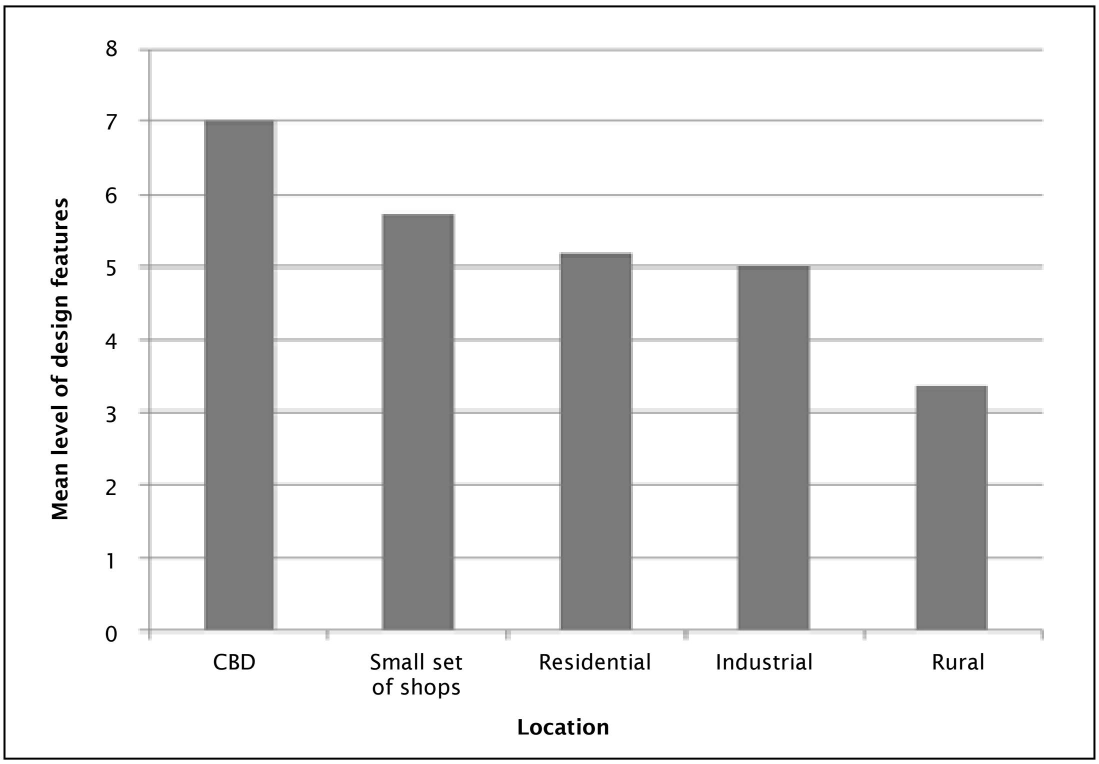
15 All the accidents occurred in MUAs. Some of these were classified as rural as they occurred at locations that had a rural outlook.

Table 4.4 Descriptions for environmental characteristics

Location	*N*	Percentage
Residential	233	47.5%
CBD	183	37.3%
Small set of shops	47	9.6%
Rural	20	4.1%
Industrial	8	1.6%

The respondents rated the environments in which their injuries occurred on a scale of one to ten according to the presence of design features they perceived as necessary to make a pleasant environment for walking. The means of these ratings by location are shown in figure 4.5. One can see that commercial/retail areas elicit a more favourable response than residential and industrial, with rural areas receiving a less than pleasant rating.

Figure 4.5 Mean level of design features to make a pleasant walking environment by location



Slips were more common in rural locations and knocks were more common in the vicinity of small sets of shops (χ^2(12, N = 422) = 23.97; $p < 0.05$)[16]. This is seen in figure 4.6, which describes the accident type (fall,

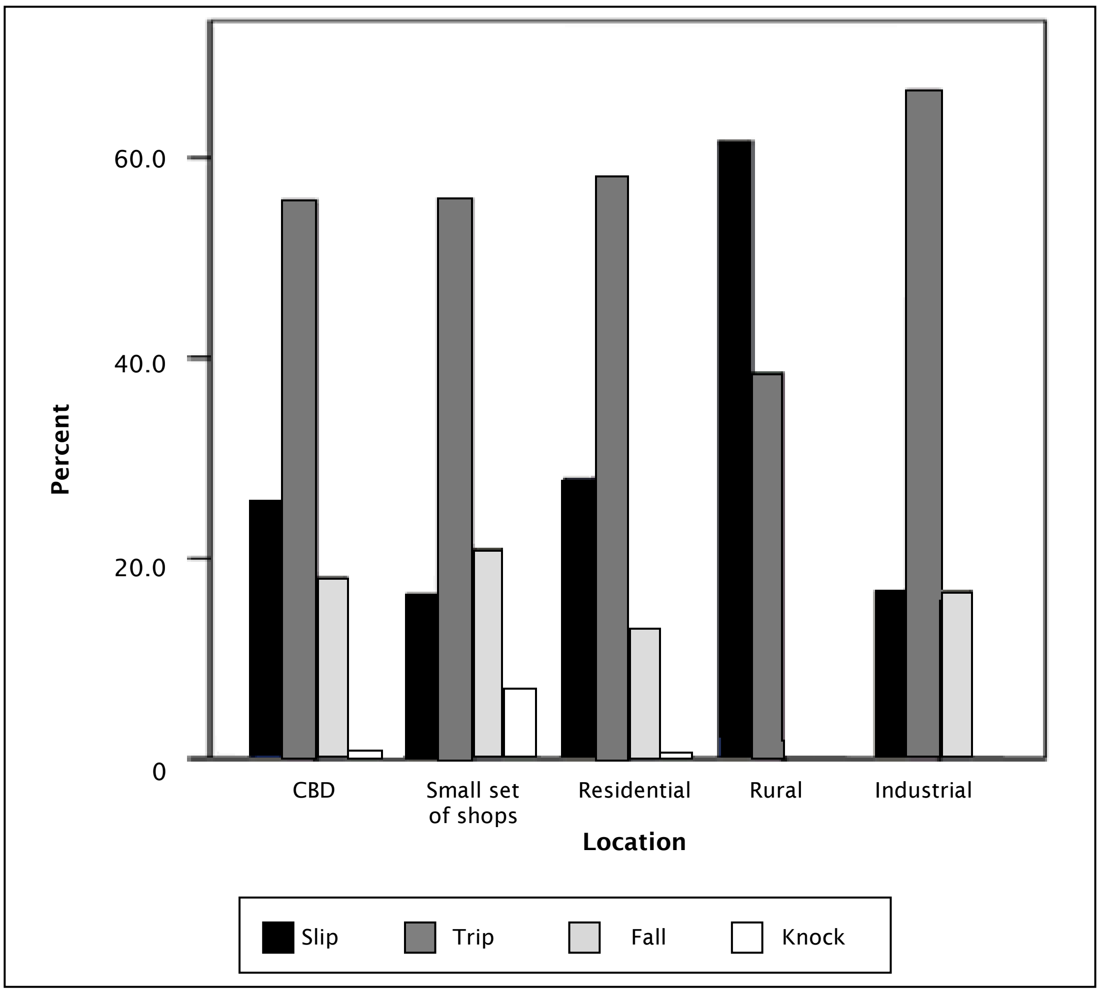
16 The Chi-square (χ^2) goodness of fit statistic used here tests whether distributions of categorical variables differ from one another by examining whether the observed frequencies are the same as the expected or probable frequencies. A χ^2 test of independence is used as the data is nominal (ie no relationship exists between the categories and the order of the categories is arbitrary). For more information on χ^2 tests, see Agresti (1996).

slip, trip, knock) in relation to location. No influence on accident type was detected for either pedestrian travel speed (walking, jogging or running; χ^2 (9, N = 420) = 12.81; p = 0.17, not significant (NS)) or general road location (roadside or on-road; χ^2 (3, N = 422) = 5.02; p = 0.17, NS).

Slips, trips, falls and knocks are defined as:

- slip = slipping on a surface
- trip = tripping over an obstacle
- a fall = simply falling because you were imbalanced
- knock = knocked over by someone or something.

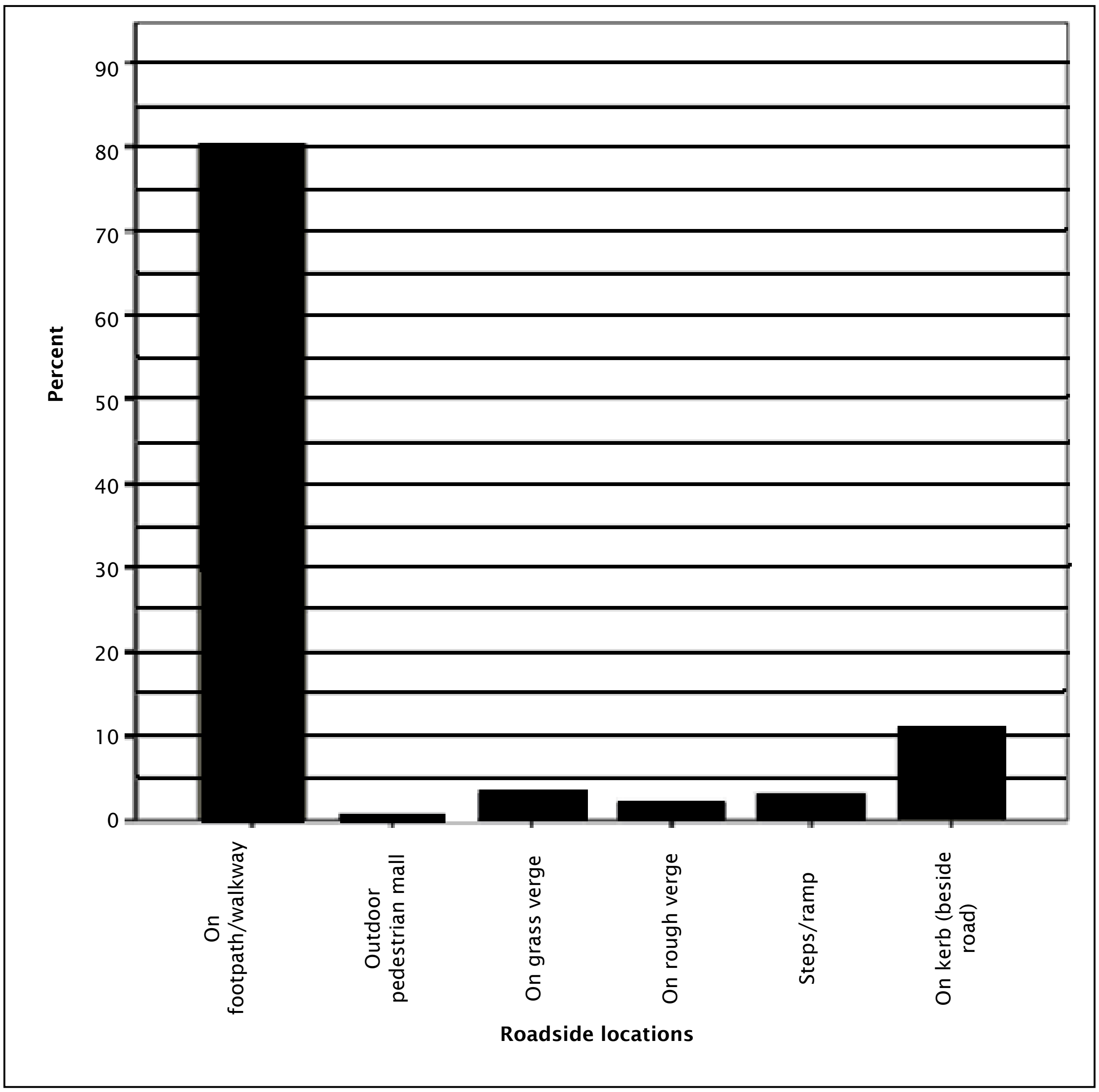
Figure 4.6 Percentage of accident types by location



Accidents occurred more often on the roadside (79.8%) than on the road (20.2%). Figure 4.7, which depicts the percentage of accidents that occurred in different roadside locations, shows that roadside accidents mainly occurred on the footpath (80.2%), with a further 13.8% of accidents occurring at a vertical change in the pedestrians' path (eg a kerb (10.7%) or a ramp/steps (3.1%)).

For people that considered themselves to be on the road at the time of the accident, the percentage citing the kerb as a factor was much higher at 36.1%. The kerb was, in fact, the most mentioned factor. This might indicate that stepping onto the kerb from the road might be more hazardous than the opposite manoeuvre. On-road accidents often occurred, unsurprisingly, at areas where the infrastructure was designed for pedestrians to cross (36.1%), including signalised crossings at intersections, non-signalled zebra crossings and pedestrian refuges. A further 27.8% of accidents occurred at non-specified road locations (presumably where no pedestrian-specific infrastructure was present).

Figure 4.7 Percentage of accidents that occurred in different roadside locations (*N* =384)



4.2.2 Participants' observations regarding remedial work at the site since their accident

The timing of the surveys in relation to the accidents varied, but was generally between two and six months after the accident. Exact accident locations were identified between January and June 2010 using Google Map Street View™ for approximately 86% (n = 421) of the participants. Where the image was clear enough (n = 305), the majority of participants (72.1%, n = 220) reported that the cause of the accident was still present. Most participants perceived from the image that the accident site had not changed (86.6%), with only 2.8% perceiving that the walking environment in the accident location had become worse (ie deteriorated) and 10.5% perceiving that the environment had improved (ie had been upgraded or had had maintenance work).

4.2.3 Primary obstacle

A wide variety of obstacles were present that contributed to an injury (figure 4.8). The rate of on-road accidents with no obstacle was slightly higher (19.2%) than that of roadside accidents with no obstacle (16.8%). Again, the kerb was a greater hazard for on-road users where they would be required to step up, compared with those stepping down on to the road. Uneven construction (eg a poorly laid surface) was the leading cause of the roadside accidents.

4.2.4 Walking surface – ratings for smoothness and potential to injure

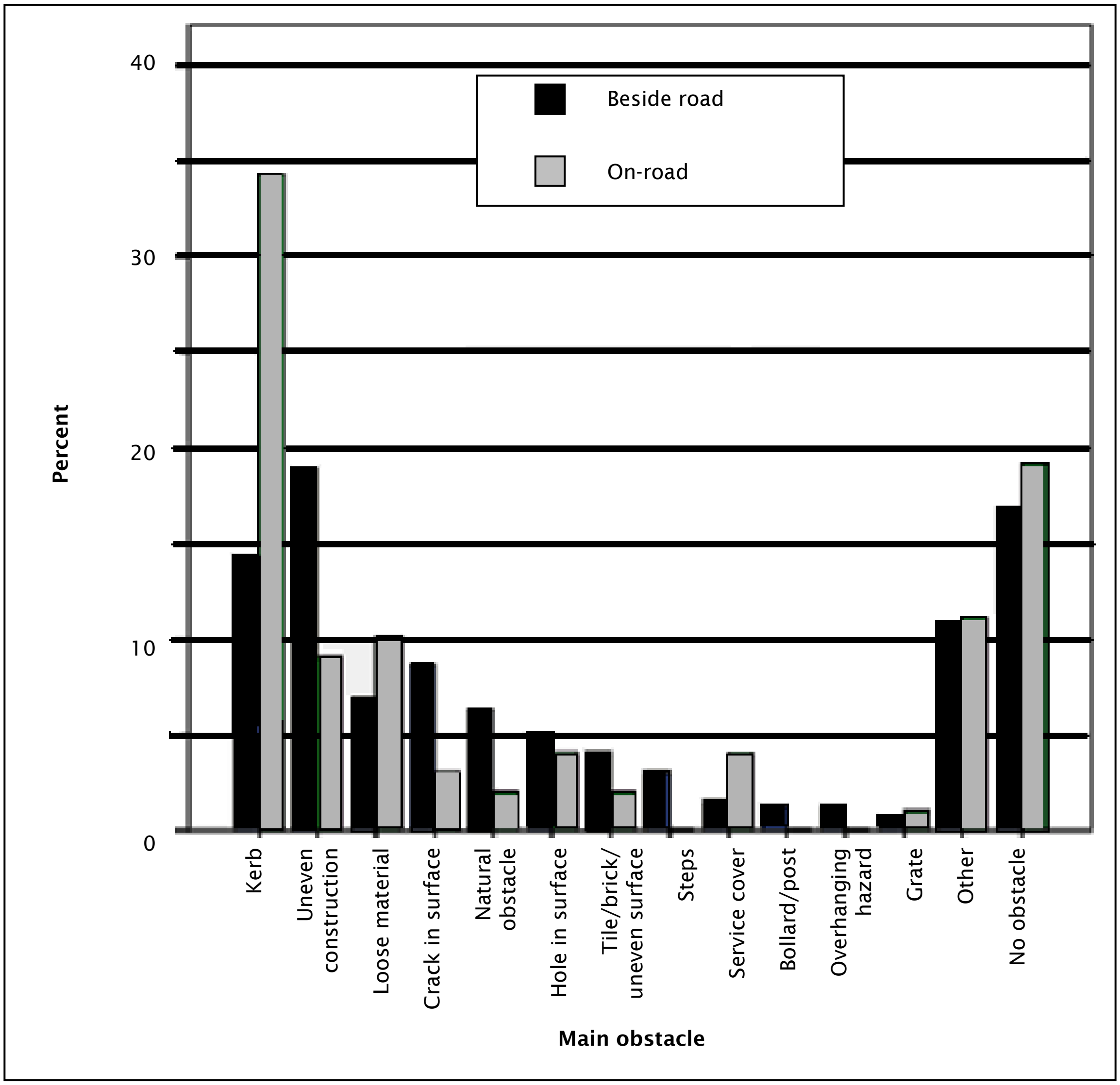
As shown in table 4.5, the most common surface type pedestrians slipped, tripped or fell from was asphalt/bitumen (37.1%) followed by concrete (34.2%), most probably because of a high exposure to these surface types. The surface material participants fell onto was the same material from which they slipped, tripped or fell from for 78% of participants.

Table 4.5 Frequency of accidents by the surface material they slipped, tripped or fell from.

Surface	Frequency*	Percent
Asphalt/bitumen	165	37.1
Concrete	152	34.2
Tiles/pavers/bricks	53	11.9
Chipseal	30	6.7
Loose gravel	19	4.3
Grass	14	3.2
Tactile pavers	3	0.7
Other	9	2
Total	491	100.0

*Excludes accidents not classified, for the purposes of this paper, as a slip, trip or fall. Not slipping, tripping or falling includes accidents such as hitting head on a tree, being knocked over by another person and accidents at change points such as the kerb.

Figure 4.8 Percentage of accidents caused by different obstacles on and beside the road



Participants rated the smoothness of the surface they slipped, tripped or fell from using an 11-point scale, where 0 = too rough (easy to trip on), 5 = about right and 10 = too smooth (slippery). Participants were asked whether the level of surface smoothness was adequate for themselves, for other typical New Zealand pedestrians, and for vulnerable pedestrians (such as a frail elderly person or a very young child). Table 4.6 shows the smoothness rating scores, from surfaces that were considered too smooth through to surfaces that were considered too rough.

The other category was partly comprised of metal surfaces (such as utility covers), which explains the high smoothness rating. Tiles, pavers and bricks came out as relatively neutral, but also had relatively high standard deviations, indicating that these surfaces can have characteristics that foster both slips and trips. Asphalt and concrete, the more common accident surfaces, were primarily rated as too rough.

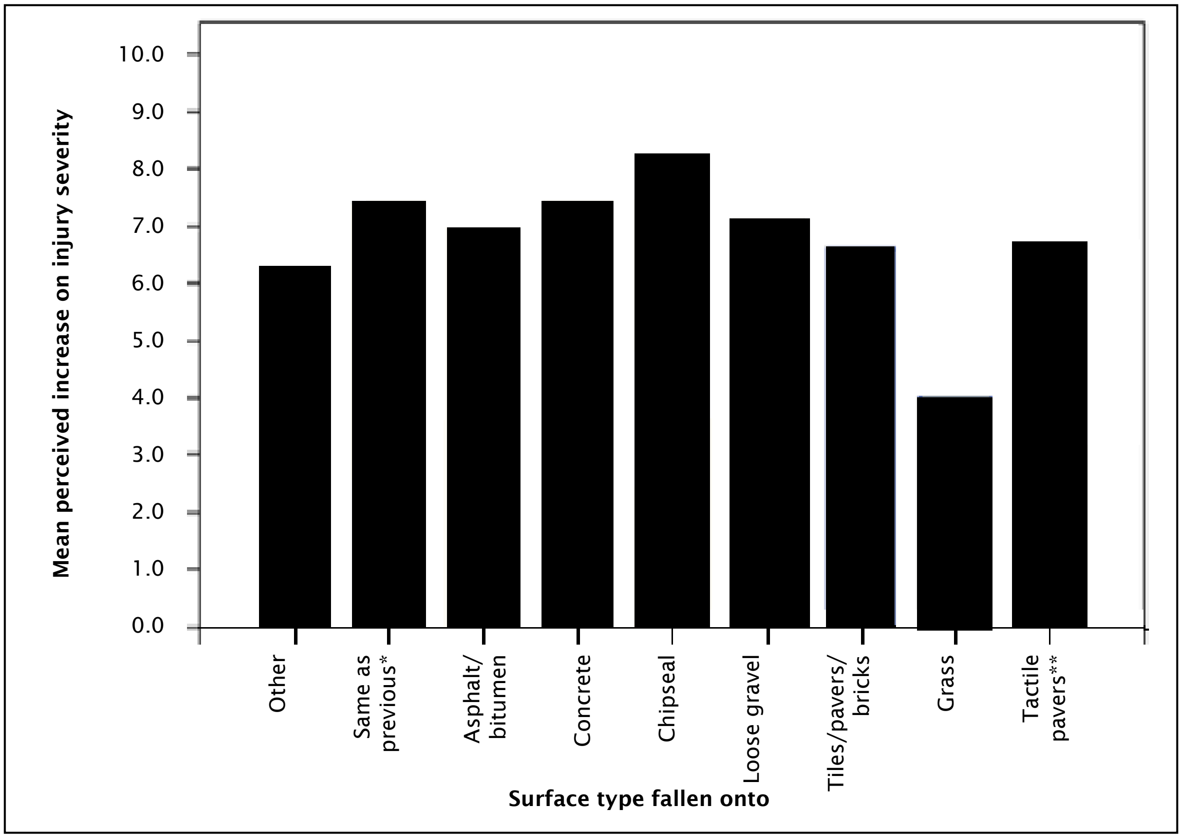
Table 4.6 The smoothness rating (0 = too rough; 10 = too smooth) of different walking surface materials for self, other 'typical' pedestrians and vulnerable pedestrians

Surface type	***N***	**Self**		**Other pedestrian**		**Vulnerable pedestrian**	
		M*	SD*	M	SD	M	SD
Grass	14	5.51	2.81	5.52	2.93	5.00	3.41
Tactile pavers	3	5.06	4.26	6.11	3.53	5.41	4.31
Tiles/pavers/bricks	53	5.00	2.08	5.10	2.03	4.90	2.46
Asphalt/bitumen	165	4.73	1.62	4.81	1.46	4.62	2.02
Concrete	152	4.33	1.65	4.44	1.52	4.00	2.01
Loose gravel	19	3.77	2.25	3.80	2.30	3.22	3.03
Chipseal	30	3.39	1.68	3.66	1.65	2.99	1.85
Other	9	6.44	1.87	6.08	1.79	6.47	2.37
Total	**445**	**4.58**	**1.85**	**4.68**	**1.72**	**4.33**	**2.24**

*M = mean, SD = standard deviation

The perceived influence on injury severity of the surface type fallen onto was measured and came up with unsurprising answers. Grass is perceived as significantly more likely to reduce the injury severity (figure 4.9). Chipseal is perceived as the surface type that would cause the most injury.

Figure 4.9 Perceived increase in injury severity by surface type fallen onto



* 'Same as previous' indicates that the surface the person fell onto was the same as the surface they fell from.

** Tactile pavers are used to warn blind pedestrians. They are often coloured yellow.

4.3 Injury type

4.3.1 Bodily location

Pedestrian injuries were aggregated by bodily injury location (table 4.7) and injury type (table 4.8) for the purposes of analysis.

Table 4.7 Body injury locations of pedestrian accidents

Injury location	*N*	%
Head		
Face	37	7.5%
Head (except face)	15	3.1%
Nose	8	1.6%
Neck (back of head vertebrae)	8	1.6%
Eye	5	1.0%
Sub-total for head	73	14.9%
Torso		
Shoulder (including clavicle/blade)	25	5.1%
Lower back/spine	24	4.9%
Chest	11	2.2%
Upper back/spine	2	0.4%
Abdomen/pelvis	2	0.4%
Sub-total for torso	64	13.0%
Upper limbs		
Hand/wrist	38	7.7%
Upper and lower arm	27	5.5%
Finger/thumb	13	2.7%
Elbow	4	0.8%
Sub-total for upper limbs	82	16.7%
Lower limbs		
Ankle	106	21.6%
Knee	70	14.3%
Foot	29	5.9%
Hip, upper leg or thigh	25	5.1%
Lower leg	16	3.3%
Toes	1	0.2%
Sub-total for lower limbs	247	50.3%
Other	11	2.2%
Missing	14	2.9%
TOTAL	491	100.0%

Table 4.8 Frequency of pedestrian injury types

Injury type	*N*	Percent
Sprain/strain	205	43.3%
Laceration/puncture	74	15.6%
Contusion	69	14.6%
Fracture/dislocation	59	12.5%
Other	67	14.1%
Total	**474**	**100%**

Pedestrian injuries were most commonly strains or sprains to the lower limbs (table 4.9).

No significant relationship was detected between the main obstacle and injury location (χ^2 (N = 353, 18) = 27.04; p = 0.08, NS) or the main obstacle and injury type (χ^2 (N = 317, 18) = 22.97; p = 0.19, NS). Similarly, no significant relationship was detected between geographical location and injury location (χ^2 (N = 466, 12) = 13.18; p = 0.36, NS) or injury type (χ^2 (N = 407, 12) = 11.42; p = 0.49, NS).

Table 4.9 Injury type by injury location on the body

Injury type	Injury location				
	Head	Body	Upper limbs	Lower limbs	Total
Contusion					
Observed count	17	7	19	26	69
Expected count	8.73	11.47	13.01	35.78	69
Adjusted residual*	3.29	-1.59	2.02	-2.59	–
Sprain/strain					
Observed count	0	51	7	147	205
Expected count	25.94	34.08	38.66	106.32	205
Adjusted residual	-7.78	4.53	-8.06	8.11	–
Laceration/puncture					
Observed count	33	0	17	20	70
Expected count	8.86	11.64	13.20	36.30	70
Adjusted residual	9.55	-4.11	1.28	-4.29	–
Fracture/dislocation					
Observed count	1	9	33	16	59
Expected count	7.47	9.81	11.13	30.60	59
Adjusted residual	-2.74	-0.31	7.88	-4.12	–
Total (observed count)	**51**	**67**	**76**	**209**	**403**

* The significant findings (those with adjusted residuals +/-1.96) are highlighted in grey fill.

An examination of injury location by age group reveals that head injuries are more common in the 65+ year-old age group and that lower limb injuries are more common in the 25–64-year-old age group (see table 4.10); χ^2 (N = 443, 9) = 74.40; $p < 0.001$).

Injury type by age group reveals that the 24–44-year-old age group is most likely to have sprain or strain injuries, whereas the 65+ year-old age group is more likely to have contusions, lacerations and fractures (see table 4.11; χ^2 (N = 391, 9) = 56.01; $p < 0.001$).

Table 4.10 Injury location on the body by age group

Age group	Injury location				
	Head	**Body**	**Upper limbs**	**Lower limbs**	**Total**
0–24 years					
Observed count	8	7	12	20	47
Expected count	6.47	7.43	7.96	25.14	47
Adjusted residual*	0.68	-0.18	1.66	-1.59	–
25–44 years					
Observed count	5	15	7	79	106
Expected count	14.60	16.75	17.95	56.71	106
Adjusted residual	-3.10	-0.53	-3.25	4.98	–
45–64 years					
Observed count	10	24	27	100	161
Expected count	22.17	25.44	27.26	86.13	161
Adjusted residual	-3.49	-0.39	-0.07	2.75	–
65+ years					
Observed count	38	24	29	38	129
Expected count	17.76	20.38	21.84	69.01	129
Adjusted residual	6.14	1.04	2.00	-6.50	
Total (observed count)	**61**	**70**	**75**	**237**	**443**

* The significant findings (those with adjusted residuals +/-1.96) are highlighted in grey fill.

No relationship was detected between the surface type fallen onto and either bodily injury location (χ^2 (N = 400, 9) = 16.19; $p = 0.06$, NS) or injury type (χ^2 (N = 346, 9) = 10.25; $p = 0.33$, NS).

Table 4.11 Injury type by age group

Age group	Injury type				
	Contusion	**Sprain/strain**	**Laceration/puncture**	**Fracture/dislocation**	**Total**
0–24 years					
Observed count	6	16	11	6	39
Expected count	6.78	19.85	6.88	5.49	39
Adjusted residual*	-0.35	-1.30	1.82	0.25	–
25–44 years					
Observed count	7	73	7	7	94
Expected count	16.35	47.84	16.59	13.22	94
Adjusted residual	-2.92	5.96	-2.98	-2.12	–
45–64 years					
Observed count	25	76	19	19	139
Expected count	24.17	70.74	24.53	19.55	139
Adjusted residual	0.23	1.11	-1.53	-0.17	–
65+ years					
Observed count	30	34	32	23	119
Expected count	20.70	60.57	21.00	16.74	119
Adjusted residual	2.70	-5.84	3.17	1.98	–
Total (observed count)	**68**	**199**	**69**	**55**	**391**

* The significant findings (those with adjusted residuals +/-1.96) are highlighted in grey fill.

4.3.2 Pedestrians' perceived environmental distraction

Only 3% of participants agreed that they were distracted by advertising and signage, while participants found other physical features and buildings slightly more distracting (12%). Motor vehicles were also slightly distracting for pedestrians (10%), especially for those pedestrians that were on the road at the time of their accident (20%).

4.3.3 Lighting

Accident locations were primarily well lit (86.2%), with sunlight as the typical light source (81.5%). At accident locations having artificial lighting at the time of the accident, the lighting was predominantly judged as poor by respondents (table 4.12).

Table 4.12 Accident frequency by lighting level and light source

Light source	Light level		
	Well lit	Poorly lit	Total
Sunlight (*N*)	386	14	400
Artificial light (*N*)	25	48	73
Total	**411**	**62**	**473**

The walking environment of well-lit areas (mean (M) = 5.96, standard deviation (SD) = 2.35) were rated as significantly better in terms of the design compared with those of poorly lit areas (M = 5.11, SD = 2.14 (t[17] (471) = -2.71, $P < 0.01$). People were also less likely to see hazards in poorly lit environments (t (87) = 4.76, $P < 0.001$). No lighting influence was detected in terms of likelihood to have raised hazard accidents (such as kerbs, steps, bollards or other furniture), as opposed to surface hazard accidents (such as cracks, utility covers or grates; χ^2 (N = 372, 1) = 0.18; P = 0.67, NS).

4.4 Individual characteristics of pedestrians

4.4.1 Overview

The individual characteristics of pedestrians outlined in table 4.13 indicates that people mostly wear appropriate footwear, are familiar with the environments in which they are walking, are physically fit and not typically looking at their feet as they walk.

[17] The *t*-test is used here and also in the following test, as the tests are of mean ratings on scales where the *t*-test is the appropriate test rather than the χ^2test.

Table 4.13 Likert scale* percentage responses and overall percentage agreement for the individual factors at the time of the accident (*N* = 491).

Individual factor	Strongly disagree	Disagree	Not sure/ neutral	Agree	Strongly agree	Total percent agree
Appropriate footwear	0.8	3.5	2.0	61.9	31.8	93.7
Familiar with environment	1.2	8.6	3.1	38.7	48.5	87.2
Physically fit	0.0	5.1	7.9	68.4	18.5	87.0
Not looking at feet	1.4	17.5	9.0	58.0	14.1	72.1
In a hurry	6.5	58.2	5.9	19.6	9.8	29.3
Travelling too fast	6.1	67.6	8.4	16.5	1.4	17.9
Often injured when fall	9.4	69.2	6.7	13.6	1.0	14.7
Very fatigued	6.7	75.2	4.7	11.8	1.6	13.4
Often fall over	13.4	71.5	5.7	7.9	1.4	9.4
Carrying objects	13.6	77.4	2.2	5.1	1.6	6.7
Previous medical condition	16.1	76.4	3.7	3.3	0.6	3.9
Temporary illness	15.9	78.2	2.6	2.6	0.6	3.3

*The Likert scale is a subjective scoring system that allows a person being surveyed to quantify likes and preferences on a five-point scale, with 1 being least important and 5 being most important.

4.4.2 Travelling speed

Pedestrians were mostly walking at the time of the accident (see figure 4.10), with the remaining 18% of participants travelling at faster speeds.

When participants were asked about their travelling speed, those travelling at walking speed were typically did not perceive themselves to be travelling too fast, whereas those that were jogging or running viewed themselves as travelling too fast at the time of the accident (figure 4.11). Again, this supports the concept that most individuals believe that walking environments are not designed for those travelling at faster speeds.

Figure 4.10 Proportion of sample group walking, jogging, running or other

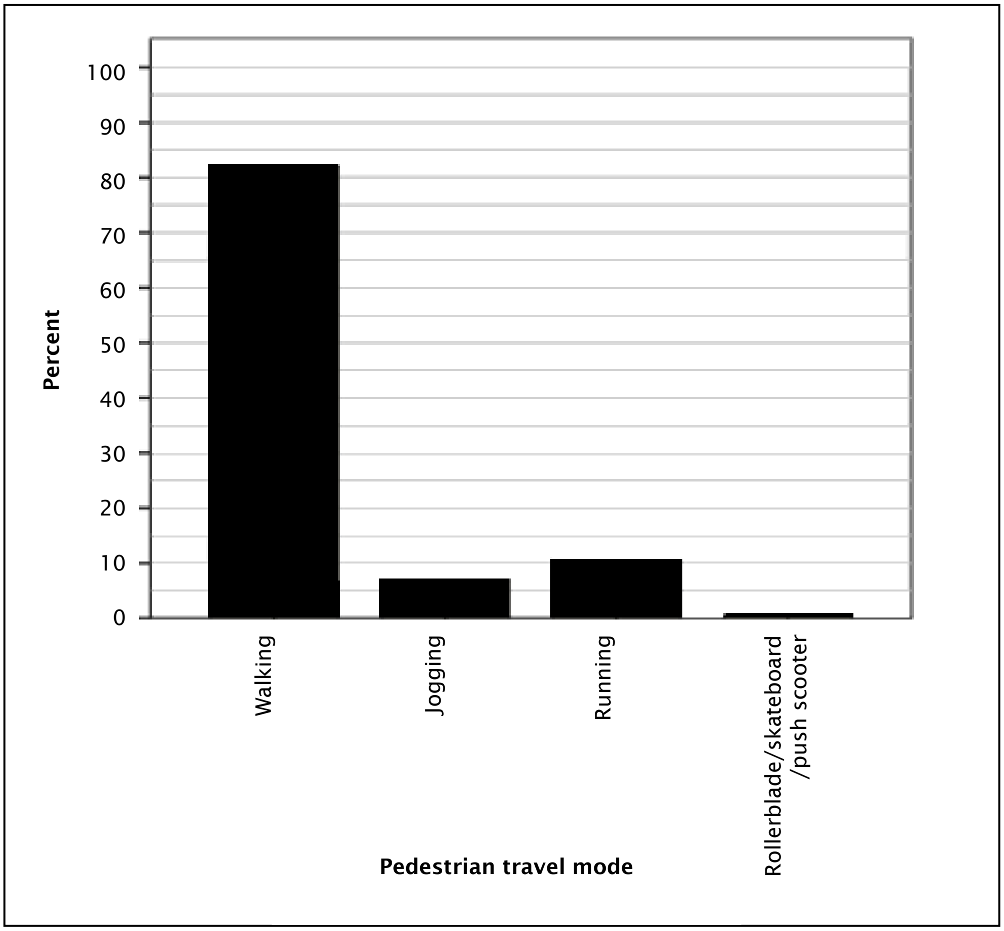
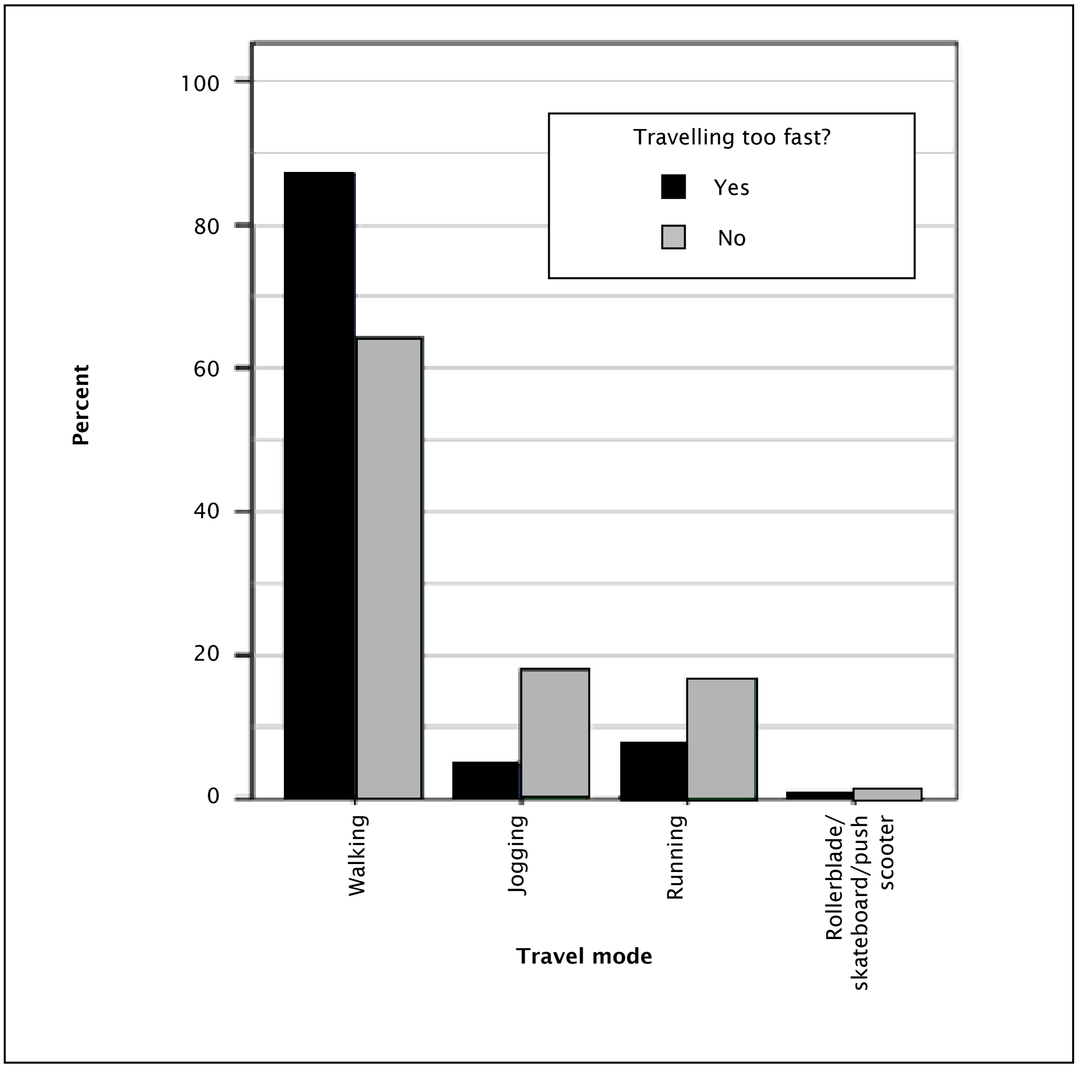


Figure 4.11 Accidents associated with different pedestrian travel modes by perceived travelling speed



4.4.3 Footwear

Perceptions of appropriate walking footwear are rather intuitive, although they do relate to the perception that walking environments are only designed for sport shoes or flat-soled shoes (see figure 4.12). This supports the idea that pedestrians take responsibility for negotiating through their walking environment. High-heeled footwear, jandals, sandals and bare feet were typically deemed to be inappropriate for their walking trip. Females were more likely to be wearing footwear with raised heels or jandals, and less likely to be wearing sports shoes ($\chi^2(6, N = 477) = 31.51$; $p < 0.001$). An examination of footwear by location (figure 4.13) reveals that less stable footwear, such as medium and high-heeled shoes, tends to be used in the CBD. People often use sports shoes in residential areas. High-heel wearers were more likely to report that they were travelling too fast for the walking surface when compared with those wearing flat-soled or running shoes ($F(4, 475) = 2.93$; $p < 0.05$).

Figure 4.12 Perceived appropriateness of different footwear types for walking.

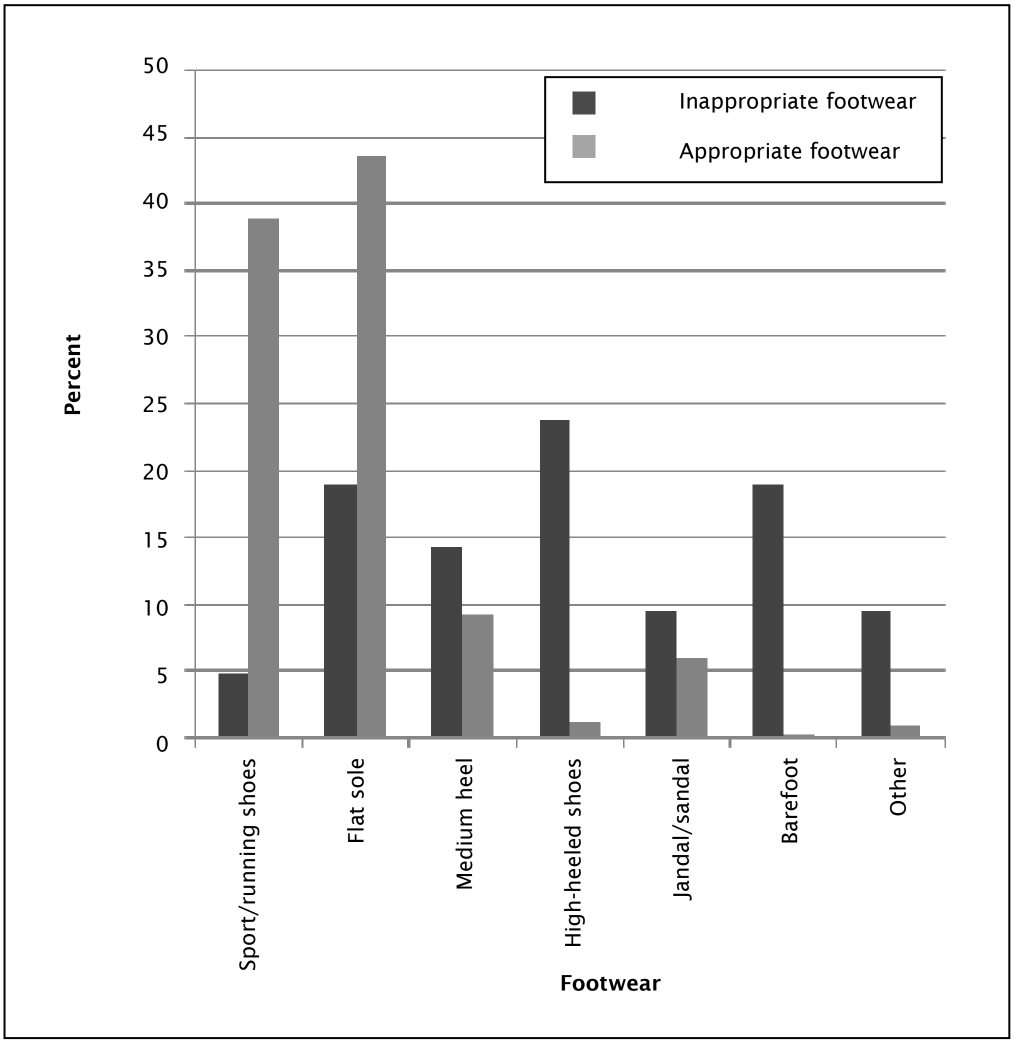
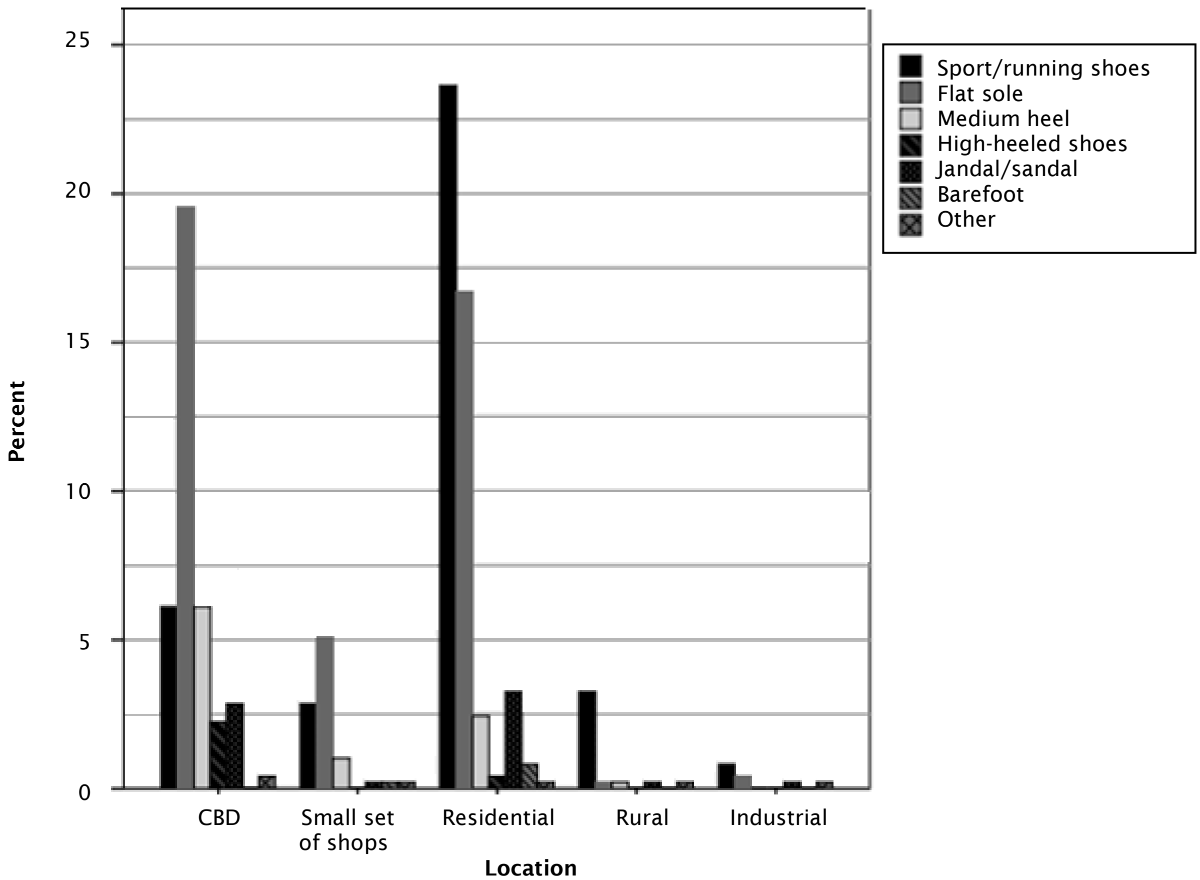


Figure 4.13 Type of footwear worn in different locations



4.4.4 Visual impairment

Only 1% of pedestrians had a permanent visual impairment and another 2% of pedestrians were not wearing their prescribed corrective lenses at the time. A further 2% had their view obstructed by items they were carrying and another 8% by poor lighting. The remaining 87% of pedestrians did not report being visually impaired at the time of their accident.

4.4.5 Fatigue, illness, frailty or previous injury

Pedestrians typically considered (87%) that they were physically fit, with only 3% reporting that they were suffering from an illness and 4% reporting that they were suffering from a previous condition (injury/frailty/sickness) at the time of the accident (see table 4.14). However, a number of pedestrians (13%) were very fatigued at the time of the accident, which may have been a contributing factor. About 9% of pedestrians stated they often fell over, with another 15% reporting they were often injured when they fell (15%). A correlation analysis revealed a positive relationship between those pedestrians that reported being frail (or prone to injury when they fell) and age (r (491) = 0.55; $p < 0.01$). No relationship was found between age and whether pedestrians reported they often fell over (r (491) = -0.02; $p > 0.05$, NS). Pedestrians that were fatigued at the time of the accident were also likely to report falling over regularly (r (491) = 0.10; $p < 0.05$), and fatigued pedestrians were more likely to be younger in age (r (491) = -0.14; $p < 0.01$).

4.5 Distraction characteristics

4.5.1 General level of distraction

Approximately 45% of participants agreed or strongly agreed they had some level of distraction at the time of their accident. A key reason for distraction was simply that people were ‘lost in thought’ at the time of their accident, with 23% of people agreeing that this was the case.

4.5.2 Distraction from other people

Thirty-eight percent of the participants were accompanying another person at the time of the accident. Table 4.14 shows that conversation was the largest distraction from other people.

Table 4.14 Level of distraction from other people (*N* = 491)

Distractions from other people	Strongly disagree	Disagree	Not sure/ neutral	Agree	Strongly agree	Total percent agree
Distracted by conversation	7.1%	76.4%	3.3%	11.4%	1.8%	13.2%
Collision with person/animal caused accident	10.4%	75.8%	2.2%	9.2%	2.4%	11.6%
Walking environment crowded with people	8.6%	79.8%	2.2%	6.7%	2.7%	9.4%
Watching other people	10.8%	83.9%	1.8%	1.8%	1.6%	3.5%

4.5.3 Activities

Most people (91%) were not engaged in another activity at the time of their accident. In this study, the most common other activities reported were listening to music and walking the dog (see table 4.15). While this is consistent with the findings of Weerdesteyn et al (2003; see section 2.4.3), it also indicates that the growing popularity of listening to music while walking may be having an effect on the number of pedestrians injured.

Table 4.15 Different activity types at the time of the accident

Activity	*N*	Percent
No additional activity	449	91.5
Music player	18	3.7
Walking dog	6	1.2
Cell phone – texting	3	0.6
Cell phone – talking	2	0.4
Reading	1	0.2
Drinking (non-alcoholic)	2	0.4
Delivering pamphlets	2	0.4
Other	8	1.6
Total	**491**	**100**

4.6 Responsibility and prevention

In questions 73 and 74 of the survey, questionnaire participants were separately asked for the main contributing factor with the best chance of preventing the accident and the person who the respondent believed was mainly responsible for the accident. The results of these questions, disaggregated by on-road and on roadside, are depicted in figures 4.14 and 4.15. Participants primarily had an internal locus of control, placing the responsibility for the cause of the accident and accident prevention on themselves (table 4.16). More than half of the sample (249 or 51%) considered themselves to have had the best chance of preventing the accident and 185 (38%) considered they were the main factor responsible for the accident. Another inference from this is that the public are less likely to make complaints regarding this type of accident.

Seventy-six people took personal responsibility for accidents when they actually believed the main mechanism of prevention for the accident related to better maintenance ($N = 36$), better design ($N = 30$) or another person ($N = 10$). A further 12 people believed they could possibly have prevented the accident, but also blamed the maintenance ($N = 6$), design ($N = 3$) or another person ($N = 3$) as other factors increasing their risk.

Figure 4.14 Respondents' perceptions of the most important factor for preventing the accident

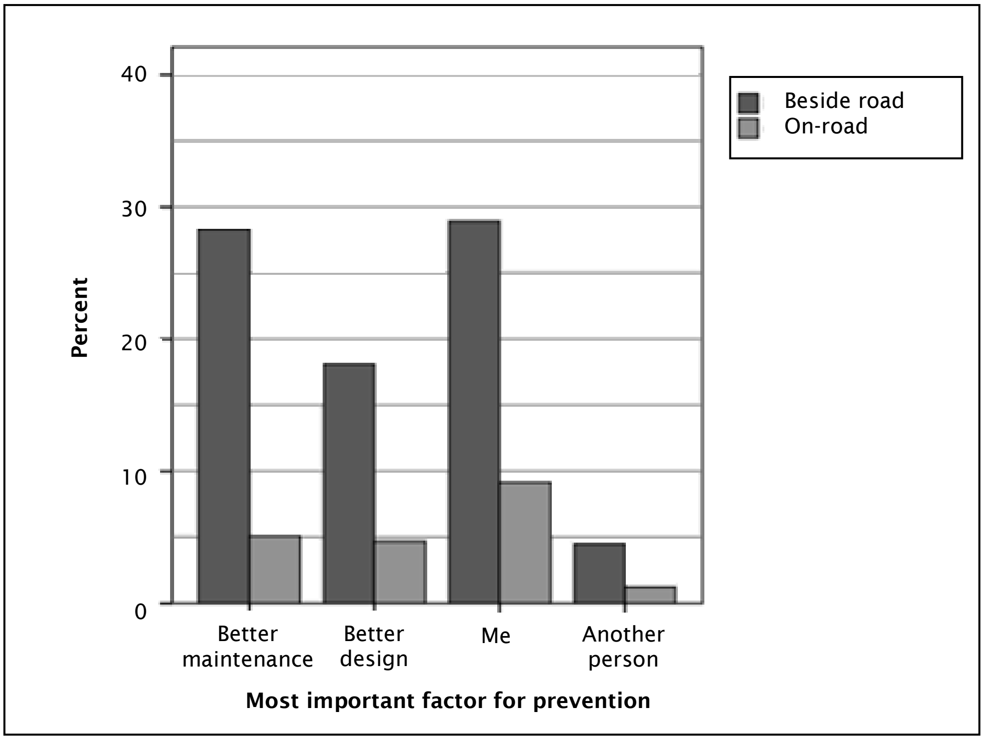
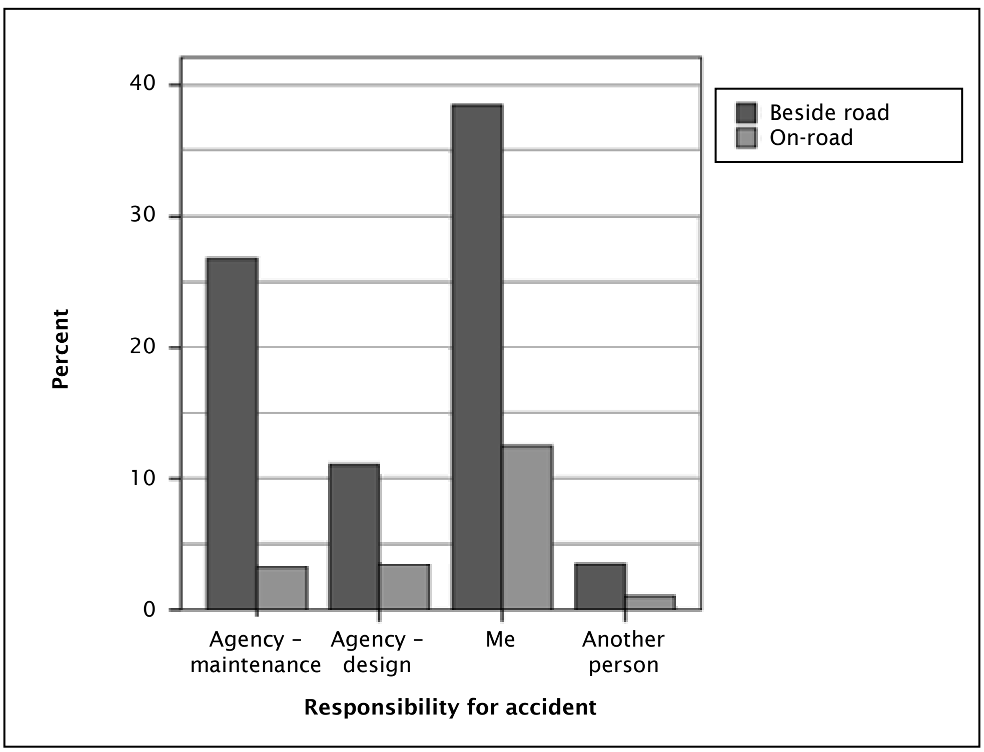


Figure 4.15 Respondents' perceptions of who is responsible for the accident



People that believed they were travelling too fast were 2.39 times more likely to take responsibility for their accident (χ^2(1, N = 491) = 13.22; p< 0.001) than others.

Table 4.15 Respondents' perceptions of the factor most responsible for the accident

Responsible for accident	Travelling too fast		
	Yes	No	Total
Other	203	29	232
Me	193	66	259
Total	**396**	**95**	**491**

4.7 Accident site examinations

A small sample of 14 accident sites was visited to examine whether the sites complied with basic pedestrian level of service criteria. The 14 sites were selected to represent the primary types of accident by area type (ie urban, residential, small shops, rural) and by obstacle type.

Twelve subjective quality criteria, such as pavement quality, slope and trip hazards were adopted based on similar criteria used by previous pedestrian level of service studies (Borsta et al 2008; Hunt-Sturman and Jackson 2009). See appendix E for the site evaluation form. The criteria for evaluating the accident sites were:

- quality of pavement
- slip resistance
- slope/gradient
- trip hazards
- obstructions
- collision potential
- contaminants, including litter, fallen leaves, etc
- disabled/impaired access (ramps, etc)
- good footpath width (for peak traffic)
- pathway continuity (eg feature continuity, desire lines (ie an informal pathway or 'beaten track' in a grassy area))
- hazard conspicuity (including use of lighting, paint marking etc)
- level of design features for making a pleasant walking environment, eg paving, bollards, gardens or statues.

The criteria used scales ranging from 0 = excellent characteristic to 10 = poor characteristic, so that high scores indicated particularly problematic sites. Three site examiners – a road safety expert, a civil engineer and a human factors psychologist – visited each of the sites and scored them against the 12 subjective quality criteria. The scores quoted here are the means of the three scores of the examiners.

The *Pedestrian planning guide* (NZTA 2009) was also used to help determine site standard compliance, as it outlined some key maintenance criteria regarding vegetation encroaching on the path and localised changes in vertical levels (over 6mm and over 13mm).

Table 4.16 provides a summary of the 14 sites visited, with location type, nature of problem, whether the problem was still present at the time of the visit and whether the site complies with New Zealand standards vis-à-vis the aspect of the site that related to the accident.

Table 4.16 Location and problems of 12 footpath accident sites

Site number	Location	Nature of problem	Problem still present	Compliance
1	Residential	Loose gravel	No	Yes
2	Residential	Uneven surface	Yes	No 28mm elevation
3	Residential	Uneven construction	Yes	No Multiple elevation issues
4	Residential	Uneven construction	Yes	No 18mm elevation
5	Residential	Kerb	Yes	No 14mm elevation by kerb
6	CBD	Uneven construction	Yes	No 16mm elevation
7	CBD	Uneven construction	Yes	Yes 2mm elevation
8	CBD	Tiled surface	Yes	Yes
9	CBD	Crack in surface	Yes	No 26mm elevation
10	CBD	Service cover	Yes	Yes 3mm elevation
11	CBD	Kerb	No	Yes
12	CBD	Tiled surface	Yes	Yes Hole (30mm ×30mm ×16mm deep)
13	CBD	Kerb	Yes	Yes
14	Residential	Crack in surface	Yes	No Hole (700mm × 500mm × 44mm deep)

Site descriptions, site photographs and site quality scores with regard to these 12 site characteristics related to walking are detailed in appendix B. One can see from table 4.16 that seven of the 14 sites did not comply with the standards of the NZTA (2009). With regard to the expert quality scores, all of the sites had at least one score of 5 or more, nine had at least one score of 6 or more, and four had at least one score of 8 or more. Some sites had multiple unsatisfactory scores.

The conclusion from this data is that all sites had infrastructural characteristics related to the accident that were unsatisfactory both by expert opinion and, in seven cases, in relation to the NZTA *Pedestrian planning guide*.

5 Discussion

5.1 Overview

A combination of factors often contribute to a pedestrian accident, be it travel speed, stability of footwear or level of distraction. The following sections discuss these factors in summary.

5.2 Complexity of pedestrian accidents

The cause of a pedestrian slip, trip or fall is not typically one-dimensional, and certainly not solely a function of the environment. People have strategies to compensate and adjust to walking through untenable walking environments. Even when people encounter obstacles as high as a bath tub while they are wearing low-traction footwear, they can ably negotiate the obstacle without falling, as they are attentive to this difficult walking environment (Decker et al 2009).

For most people, walking through an environment is a relatively simple task, but additional factors can often increase the complexity of this task. The survey indicates that people carry loads, engage in other activities (9%) or hurry through their walking environment (29%). These factors can block their vision, distract them from their task and alter their gait. Therefore, environments that are not forgiving to pedestrians that may be fatigued, visually impaired or distracted are more likely to cause accidents than those that are more forgiving.

The complexity of pedestrian accidents is heightened when cognitive factors are included, such as a relatively low perception of risk and low attentiveness. In this study, about 45% of pedestrians reported some level of distraction at the time of their accident. Leclercq and Thouy (2004) also conclude that accidents do not happen in isolation of other factors, such as preoccupation with events not related to walking.

5.3 Environment

5.3.1 The footpath as a hazard

Walking environments must be designed to account for the fact that pedestrians are often obstructed visually, physically impaired, fatigued or simply distracted. Fothergill et al (1995) found that two-thirds of falls in public places occurred on pavements, and that about 50% of falls involve uneven surfaces underfoot or inadequate street lighting. About 8% of pedestrians reported poor lighting as a contributing factor in their accident, whereas vertical changes and uneven surfaces were more commonly reported as hazards.

5.3.2 Vertical changes

Vertical changes, particularly kerbs, are a key cause of pedestrian trips and falls. These accident types are particularly problematic when stepping up (as opposed to stepping down). Figure 4.7 indicates that the kerb featured in 34% of the accidents where pedestrians were originally on the road but in only 14% of the accidents where pedestrians were stepping down from the roadside.

Misjudging the kerb height when stepping down is likely to be more forgiving than tripping on the edge of the kerb when stepping up. Also, pedestrians are more likely to pause before stepping down from a kerb onto the road. Whatever the explanation, a design solution to make the vertical change more visually obvious would be beneficial, as would a move to improve the consistency of kerb heights.

5.3.3 Uneven construction

Uneven construction is the most commonly reported hazard type in roadside pedestrian accidents.

5.3.4 Maintenance

A need for maintenance was identified as the most important factor in accident prevention.

5.3.5 Environmental consistency

It is particularly problematic to negotiate a walking environment when the perceived predictability of the environment and the actual continuity of the environment do no match. For example, when pedestrians negotiate steps, they predict that each step will be evenly spaced unless visually indicated otherwise[18].

Ayres and Kelkar (2006) suggest that the key reasons we fail to recognise trip points include:

- a narrow gaze direction
- distraction (eg mentally distracted or engaged in an activity)
- attention impairment (eg alcohol, fatigue)
- underestimation of risk
- ‘change blindness’

The theory of change blindness suggests that pedestrians do not detect large changes in their environment unless they are actively attending to them (Jovancevic et al 2006).

5.4 Footwear

In the sample group, pedestrians wearing high-heeled shoes at the time of the accident reported they were travelling too fast for the conditions. Evidence that higher heels do not reduce women’s walking speeds in New Zealand has already been found. These pedestrians are often in the CBD, wearing work clothing and walking for work purposes, which has been shown to relate to higher walking speeds than, say, walking for other activities, such as leisure or shopping (not including joggers/power walkers) (Finnis and Walton 2008). The combination of faster walking speeds in less stable footwear should be taken into account when designing high pedestrian traffic CBDs.

18 This is a similar concept to a self-explaining road.

5.5 Summary of issues

5.5.1 Infrastructural

- Kerbs (vertical changes) are a major contributory factor in pedestrian trips, falls and injuries, particularly when stepping up (as opposed to down).
- Maintenance is more of an issue than initial design and construction.
- The site visits suggest that places where accidents occur tend to be rated unfavourably by experts vis-à-vis the part of the infrastructure associated with the accident. They also tend to have one or more faults that violate design standards in the relevant NZTA guide[19].
- Environments that are not forgiving to pedestrians, who may be fatigued, visually impaired or distracted, are more likely to cause accidents.
- Uneven construction is the most commonly reported hazard type in roadside pedestrian accidents.
- Environments ought to be predictable to the pedestrian (ie have no surprises).
- The combination of faster walking speeds in less stable footwear (eg high-heeled shoes) should be taken into account when designing high pedestrian traffic areas. This is in accordance with safe system principles.

5.5.2 Person-related

- People primarily internalise the responsibility for walking accidents rather than finding fault with the infrastructure, even when the infrastructure is clearly a large contributing factor to the accident.
- People who believed they were travelling too fast were also more likely to take responsibility for their accident than other people, even when the infrastructure had played an important role in the accident.
- These views on the part of pedestrians could compromise the reporting of infrastructure defects to the authorities.
- Accident rates per hour walked increase markedly with the age of the victim.

5.5.3 Future-related

With predicted increases in the older population, vulnerable older pedestrians will be more numerous, which is likely to increase pedestrian injury, all other things being equal.

19 No controlled study was done to show that accident sites are worse than non-accident sites in similar areas. This might be a subject of subsequent research.

6 Conclusions

- The safe system approach to road safety demands that RCAs have a responsibility to minimise injury on their road networks (including areas near the roadway used by pedestrians), irrespective of whether or not the injury involves a motor vehicle.
- This research, and previous cited research, shows that pedestrian injuries that are not related to motor vehicles contribute significantly to road network trauma numbers. However, carrying out systematic work to improve the situation has been seriously impeded.
- These impediments relate to the fact that the types of pedestrian injury sampled in this study do not feature in our database of road crashes, which includes only motor vehicle-related crashes. This has the effect of placing them generally below the radar of those engaged in road safety work, either locally or centrally.
- The absence of this information from the crash database also makes monitoring their incidence and setting performance measures more difficult. These data problems have no ‘quick fixes’, but the relevant national health statistics and insurance data for monitoring purposes could be used to help fill the gap.
- In New Zealand, the main publication where these pedestrian injury incidents are highlighted is the Pedestrian planning and design guide (Land Transport New Zealand 2007), which would arguably have lower than optimal penetration into the road safety community.
- In order to achieve better levels of penetration, these injury incidents should be recognised as an integral and important part of road safety, and their prevention should be consciously and deliberately brought into the road safety mainstream as an area for targeting by countermeasures under the safe system approach.
- The first steps in this approach could be the promulgation of a policy that, at local, regional and national levels, all road safety strategies, safety management systems and associated action plans should specifically have regard to these injury events, on a level playing field with motor vehicle crashes.
- The promulgation of such a policy would have the inevitable consequence of stimulating a demand for improved analysis tools to prioritise such countermeasures vis-à-vis other uses of road safety funds and improved data for input into these analysis tools.
- It is to be expected that the major focus of such countermeasures would relate to the direct infrastructure issues described in this paper, although some scope may remain for behavioural countermeasures in conjunction with the wider injury prevention community.

7 Recommendations

It is recommended that road safety decision makers:

- formally recognise the prevention and mitigation of non-motor vehicle pedestrian injury as an integral and important part of road safety
- bring the prevention and mitigation of pedestrian accidents consciously and deliberately into mainstream road safety activities and funding.
- promulgate a policy that, at local, regional and national levels, all road safety strategies, safety management systems and associated action plans should specifically have regard to these pedestrian injury events
- instigate research to provide improved data and analysis tools to prioritise such countermeasures vis-à-vis other uses of road safety funds and improved data for input into these analysis tools
- commission a guide for pedestrian road safety auditing and inspection, covering both motor vehicle and non-motor vehicle risk.

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Appendix A Survey instrument (paper version – post-pilot)

The following is a copy of the paper version of the survey form used during this research. It has not been altered from the original, apart from minor details to conform to NZTA usage.

Road and roadside pedestrian accidents

- Participants should already have received a letter telling them the purpose of this research, but feel free to remind them:

The purpose of this research is to assess the mechanisms and types of non-motor vehicle injuries to pedestrians (for instance falls or collisions with fixed objects) and use this to evolve cost-effective infrastructural measures to prevent such injuries. This research has been funded by the NZ Transport Agency (www.nzta.govt.nz).

- Please advise participants of the following important points:
- Your answers are entirely confidential and anonymous. We only use the ACC data to identify you as a potential participant. Your details will not be linked to your responses, so please answer honestly and openly.
- Please feel free to skip any question you do not feel comfortable answering.
- You are free to withdraw your participation at any time.

Accident information

• Interviewer to insert time, date and location of accident from the ACC data prior to interview:		
Date of accident in ACC file:	/ /	(eg 21/03/09)
1. Time of day:	am/pm	(eg 4:06pm)
2. Accident location:		(eg Taupo)

• Prompt the participant with the time and date of the accident above.		
3. Do you recall having an accident while you were walking on *[Insert date and time from above]*?	☐ Yes	☐ No
• If they answer ‘No’ prompt with all available accident information and repeat question. • [If still ‘No’ discontinue interview]	☐ Yes	☐ No

4. In what town/city did this accident happen?		
5. In what suburb did this accident happen?		
CHECK: Does this answer match the location above?	☐ Yes	☐ No

6. Did the accident involve a motor vehicle/cyclist?
☐ No
☐ Yes, I was distracted by a moving motor vehicle/cyclist
☐ Yes, I needed to avoid or actually collided with a motor vehicle/cyclist [Please discontinue interview]

7. Did the accident happen beside or on a road?		
☐ Beside road (eg footpath or grass verge)	☐ On road	☐ Other ……………………………………………… [If nowhere near a road, eg in the middle of a large park or enclosed mall, then please discontinue interview]

8. On what specific part of the road network did the injury happen? [Please tick only one box]	
Roadside options…	On road options…
☐ On footpath/walkway	☐ No specific road location
☐ Outdoor pedestrian mall (eg Manners Mall)	☐ At signalised pedestrian road crossing at intersection
☐ On grass verge	☐ On zebra pedestrian crossing
☐ On rough verge	☐ On cycleway/edge of road
☐ Steps/ramp	☐ Crossing road at roundabout
☐ On shared cycleway/walkway	☐ On central pedestrian refuge (or traffic island)
☐ On kerb (beside road)	☐ On kerb (beside roadside area, eg gutter)
☐ Other roadside location [specify] ……………………………………………..	☐ Other road location [please specify] ……………………………………………......

9. How were you travelling at the time of the accident? [Please tick only one box]	
☐ Walking (ie slow speed)	☐ Roller blading/skateboarding/push scooter
☐ Jogging (ie medium speed)	☐ Mobility scooter (motorised)
☐ Running (ie fast speed)	☐ Other……………………………………………
• [Please note: If the participant is travelling using a device to travel you will need to alter the wording of some of the following questions referring to walking.]	

10. Would you describe your accident as a slip (eg slipping on a surface), a trip (eg tripping over an obstacle), a fall (eg simply falling because you were imbalanced), a collision (colliding into an obstacle without falling), or were you knocked over by someone? [Please tick only one box]					
☐ Slip	☐ Trip	☐ Fall	☐ Collision	☐ Knocked over	☐ Other …………………………

11. How much impact do you believe your injuries had on your life after the accident? (eg think about how long before you could walk comfortably again and how the injury prevented you from common activities in your day-to-day life)		
0 1 2 3 4 5 6 7 8 9 10		
No impact (no impact upon my day-to-day life)	Moderate impact (some negative impact upon my day-to-day life)	Serious impact (a large negative impact upon my day-to-day life)

• Load Google Maps on your laptop to identify the exact location of your accident. *http://maps.google.co.nz* [see instruction sheet if you are having difficulties]			
12. What is the name of the <u>main</u> road you were travelling on or beside when the accident occurred?	………………………………………………		
13. What is the name of the <u>secondary</u>, or next nearest road to the accident?	……………………………………………… ☐ There was no secondary road nearby ☐ Does not remember the name of the nearby road		
14. Were you successfully able to locate the scene of the accident?		☐ Yes	☐ No
15. Has the walking environment in this image become better or worse from when your accident occurred? (eg upgrades to or deterioration of the walking surface).			
☐ Worse	☐ No change	☐ Better	☐ Could not get an image
16. Is the cause of your accident still present based on this image?			
☐ Yes	☐ No	☐ I could not tell from the image	☐ Could not get an image
Other location comments: ……………………………………………………………………………. ……			

Environmental characteristics

- This section of the questionnaire examines the condition of the environment at the time of the accident.

17. Was the lighting primarily sunlight or artificial light?			
☐ Sunlight	☐ Artificial lighting (eg street lights)	☐ Both sunlight and artificial light	☐ Not sure

18. Was the area you were in well lit or poorly lit?	☐ Well lit	☐ Poorly lit

19. How would you describe the weather conditions at the time of your accident?			
☐ Warm/sunny/dry	☐ Overcast/dry	☐ Light showers, off and on	☐ Raining
☐ Other...			

20. What best describes the location of the walking environment? [Please tick only one box]				
☐ Central business district	☐ Small set of shops	☐ Residential	☐ Rural	☐ Industrial

21. Please rate the level of design features in the general location of your accident to make it a pleasant walking environment, such as paving, bollards, gardens, statues etc.

0	1	2	3	4	5	6	7	8	9	10

No design to encourage pedestrians (eg grass verge on side of road)	Neutral (eg basic footpath)	Heavily designed walking area to encourage pedestrians

• Please rate your level of agreement with the following statements thinking about the exact location of your accident	Strongly disagree	Disagree	Not sure/ neutral	Agree	Strongly agree
22. The surface I was on was slippery	☐	☐	☐	☐	☐
23. I expected a better environment than what was provided	☐	☐	☐	☐	☐
24. I could not see all of the physical hazards in my pathway (eg they may have been partially blocked from view by other objects or people)	☐	☐	☐	☐	☐
25. There were strong winds that made walking difficult	☐	☐	☐	☐	☐
26. The walking environment was very cluttered with objects (eg seats, bollards, signs)	☐	☐	☐	☐	☐

27. I was aware of all the physical hazards in my pathway	☐	☐	☐	☐	☐

28. Please describe the type of surface material that you slipped/tripped/fell FROM [Tick only one box]:	
☐ I did not slip, trip or fall [go to item 34]	☐ Grass
☐ Asphalt/bitumen	☐ Tiles/pavers/bricks
☐ Chipseal (a surface with stone chips in it, commonly used as a road surface)	☐ Tactile pavers (used to warn blind pedestrians – often yellow in colour)
☐ Concrete	☐ Loose gravel
☐ Other surface..	

29. Would you say that this surface was too smooth (slippery) or too rough (easy to trip on) or about right for YOU to walk on? On a scale of 0-10 where 0 = Too rough, 5 = About right and 10 = Too smooth.

0 1 2 3 4 5 6 7 8 9 10

☐ NA

Too rough (easy to trip on) About right Too smooth (slippery)

30. Asking the same question again, but this time think about whether this surface was too smooth, too rough or about right for a VULNERABLE walker (such as an elderly person who is quite frail, or a very young child)

0 1 2 3 4 5 6 7 8 9 10

☐ NA

Too rough (easy to trip on) About right Too smooth (slippery)

31. Asking the same question again, but this time think about whether this surface was too smooth, too rough or about right for a TYPICAL New Zealand walker.

0 1 2 3 4 5 6 7 8 9 10

☐ NA

Too rough (easy to trip on) About right Too smooth (slippery)

32. Please describe the type of surface material you slipped/tripped/fell ONTO [Tick only one box]:	
☐ I did not slip, trip or fall	☐ Grass
☐ Asphalt/bitumen	☐ Tiles/pavers/bricks
☐ Chipseal (a surface with stone chips in it, commonly used as a road surface)	☐ Tactile pavers (used to warn blind pedestrians – often yellow in colour)
☐ Concrete	☐ Loose gravel
☐ Other surface…………………………………………………………………………………………	

33. How would you describe the main physical obstacle that contributed to your injury (eg something you tripped over)? [Please tick only one box]:	
☐ No obstacles contributed to my accident	☐ Loose material (eg rubbish)
☐ Service cover	☐ Bollard/post
☐ Grate (eg drainage grate)	☐ Steps
☐ Seating/signs (eg café seating or shop signs)	☐ Kerb
☐ Uneven construction (eg poorly laid surface)	☐ Tiled/bricked/uneven surface material
☐ Crack in surface	☐ Overhanging hazard (eg plant/sign)
☐ Hole in surface	☐ Natural obstacle (eg tree root)
☐ Other obstacle [please specify]………………………………………………………………	

34. How did the nature of the surface you slipped/tripped/fell onto, or the object you collided into influence the potential severity of your injury?

0	1	2	3	4	5	6	7	8	9	10

☐ NA

Reduced the severity of the injury (eg a forgiving environment or soft landing)	Neutral	Increased the severity of the injury (eg an unforgiving environment or hard landing)

35. Was it the collision with an obstacle or the surface you fell onto that caused your injury?			
☐ Collision	☐ Surface	☐ A combination of both	☐ Neither

36. How visible was this hazard at the time of the accident?
0 1 2 3 4 5 6 7 8 9 10
Completely obscured Partially obscured Highly visible

• Please rate your level of agreement with the following statements thinking about the surface you were walking on at the time of your accident…	Strongly disagree	Disagree	Not sure/ Neutral	Agree	Strongly agree
37. Too rough	☐	☐	☐	☐	☐
38. Temporarily deteriorated by road works or other construction/maintenance	☐	☐	☐	☐	☐
39. Too slippery	☐	☐	☐	☐	☐
40. High quality	☐	☐	☐	☐	☐
41. Too uneven	☐	☐	☐	☐	☐
42. In need of maintenance [due to damage over time]	☐	☐	☐	☐	☐
43. Dry	☐	☐	☐	☐	☐

Personal characteristics

- This section of the questionnaire examines factors related your behaviour at the time of the accident.

44. What type of footwear were you wearing at the time of your accident?	
☐ Sport/running shoe	☐ High-heeled shoe
☐ Flat soled shoe	☐ Jandal/sandal
☐ Medium-heeled shoe	☐ Barefoot
☐ Other..	

45. Did you have any health issue or injury at the time of your accident that made it more difficult for you to walk, or that caused you to fatigue more quickly?	
☐ No, I had excellent health at the time	☐ I had a serious health issue
☐ I had poor health, but this did not affect my ability to walk at all	☐ I had a minor injury (eg sprain)
☐ I had a minor health issue (eg cold)	☐ I had a major injury (eg on crutches)
☐ Other..	

46. Was your vision impaired in any way at the time of the accident?	
☐ No	☐ My view was partially blocked by objects I was carrying (eg large parcels)
☐ I was not wearing my corrective glasses/lenses	☐ My vision is permanently poor (beyond the help of corrective glasses)
☐ The poor lighting restricted my vision	☐ I am blind
☐ Other..	

• Please rate your level of agreement with the following statements thinking about your situation at the time of your accident	Strongly disagree	Disagree	Not sure/ Neutral	Agree	Strongly agree
47. I was fatigued	☐	☐	☐	☐	☐
48. My footwear was appropriate for this walking journey	☐	☐	☐	☐	☐
49. I had not been drinking alcohol prior to the accident (or using any other intoxicating substances)	☐	☐	☐	☐	☐
50. I often fall over	☐	☐	☐	☐	☐

51. I was in a hurry to get to my destination	☐	☐	☐	☐	☐
52. I was carrying large/heavy objects that made walking difficult	☐	☐	☐	☐	☐
53. I was familiar with the walking environment (eg I walk there most weeks)	☐	☐	☐	☐	☐
54. I fell over because of a previous injury/frailty/sickness	☐	☐	☐	☐	☐
55. I often injure myself when I do fall over	☐	☐	☐	☐	☐
56. I was physically fit	☐	☐	☐	☐	☐
57. I was travelling too fast	☐	☐	☐	☐	☐

Other people or distractions

• This section of the questionnaire examines the influence of external distractions at the time of the accident.		
58. Were you accompanying another person at the time of the accident?	☐ Yes	☐ No

59. Were you performing any activity, such as using your cell phone, reading a book or listening to music at the time of your accident?	
☐ No activity	☐ Reading a book or other material
☐ Cell phone (conversation)	☐ Music player
☐ Cell phone (texting)	☐ Other item

60. Was your accident caused by colliding with another person?	
☐ No	☐ Yes, a roller blader/skateboarder/push scooter
☐ Yes, another pedestrian	☐ Yes, a person on a mobility scooter (motorised)
☐ Yes, a cyclist	☐ Other item

• Please rate your level of agreement with the following statements thinking about your situation at the time of your accident	Strongly disagree	Disagree	Not sure/ Neutral	Agree	Strongly agree
61. I was distracted by watching other people	☐	☐	☐	☐	☐
62. A collision with (or the need to avoid) an animal caused my accident	☐	☐	☐	☐	☐
63. A collision with (or the need to avoid) another person caused my accident	☐	☐	☐	☐	☐
64. I was distracted by conversation with another person	☐	☐	☐	☐	☐

65. I was distracted by looking at buildings or other physical features of the environment	☐	☐	☐	☐	☐
66. I was distracted by nearby motor vehicles	☐	☐	☐	☐	☐
67. I was lost in my own thoughts (eg daydreaming)	☐	☐	☐	☐	☐
68. The walking environment was crowded with people	☐	☐	☐	☐	☐
69. I was distracted by signs in the environment (eg advertising/billboards)	☐	☐	☐	☐	☐
70. I was using a cell phone	☐	☐	☐	☐	☐
71. I was listening to a personal music device (such as a walkman or iPod)	☐	☐	☐	☐	☐
72. I was not distracted at all	☐	☐	☐	☐	☐

73. After considering all of the factors associated with your accident, what <u>one</u> contributing factor would have had the best chance of preventing your accident? [Please tick only one box]			
☐ Better maintenance	☐ Better design	☐ Me (eg paying more attention, being less hasty)	☐ Another person (eg paying more attention, being less hasty)
Please elaborate			

74. Who do you believe is mainly responsible for your accident? [Please tick only one box]	
☐ An agency in control of the <u>maintenance</u> of the space	☐ Me
☐ An agency in control of the <u>design</u> of the space	☐ A private individual (eg another walker)
☐ Other [please specify]………………………………………...	

75. [INTERVIEWER ONLY] • The data was good, the participant's responses were appropriate and the accident fit our requirements (ie pedestrian accident that involved infrastructure in some way, even if this was just falling or landing on infrastructure)
☐ Yes
☐ No. Please explain the problem with the accident or data: ……… ……………………………………………………………………………………………

Appendix B Descriptions and quality scores of accident sites visited

B1 Site 1: loose gravel (residential)

The subject tripped on the road, catching his foot on the lip or joint between the gutter and the chipseal.

Table B1 Characteristics of accident site 1 (loose gravel))

Site characteristic	Mean*
Pavement quality	4.33
Slip resistance	2.17
Slope/gradient	3.33
Trip hazards	5.33
Obstructions	1.00
Collision potential	1.67
Contaminants (eg litter)	1.67
Disabled/impaired access	3.33
Footpath width	1.00
Pathway continuity	1.67
Hazard conspicuity	1.67
Pedestrian design	4.33

* The mean when referring to site characteristics is the mean of the quality scores of the three assessors who visited the sites. The assessment criteria are discussed in section 4.6.

Figure B1 Long-shot view of accident site 1

Figure B2 Close-up view of accident site 1

B2 Site 2: uneven surface (residential)

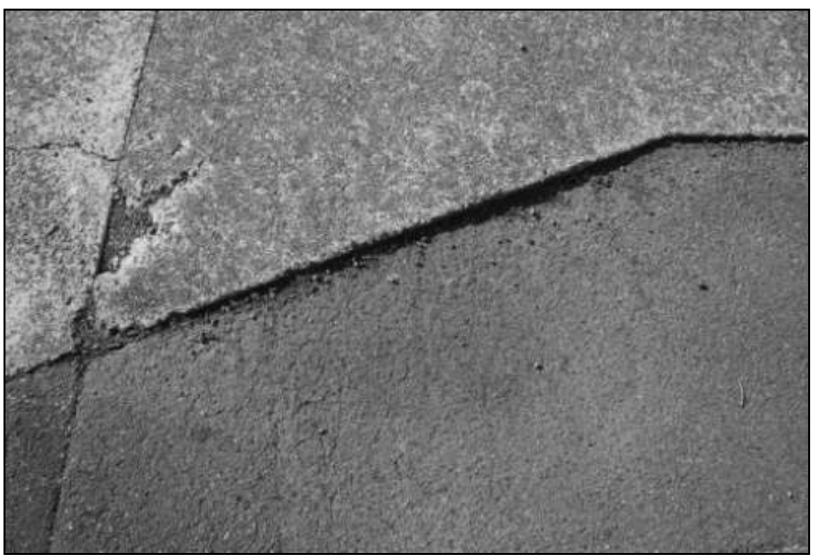
This was a classic case of deteriorated footpath, where the asphalt developed a hole and the concrete driveway maintained its design, creating an obstacle. This hole was also apparently marked for repair with yellow paint. It had been 18 months since the accident, and the hazard had not been fixed. Special mention needs to be made that the person was preoccupied with carrying a jacket, which was not heavy or bulky, but just prevented protection in the fall.

Table B2 Characteristics of accident site 2

Site characteristic	Mean
Pavement quality	6.67
Slip resistance	2.00
Slope/gradient	2.00
Trip hazards	9.00
Obstructions	1.00
Collision potential	0.67
Contaminants (eg litter)	1.33
Disabled/impaired access	3.17
Footpath width	0.33
Pathway continuity	1.67
Hazard conspicuity	8.50
Pedestrian design	5.50

Figure B3 Long-shot view of accident site 2

Figure B4 Close-up view of accident site 2



B3 Site 3: uneven construction (residential)

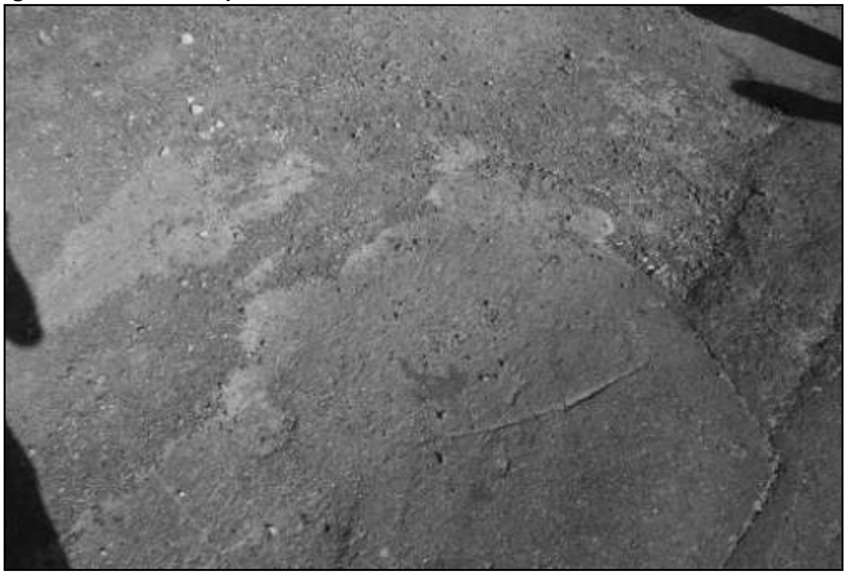
This path had a rocky surface with gravel. The path needs an upgrade, as it is well used.

Table B3 Characteristics of accident site 3

Site characteristic	Mean
Pavement quality	9.33
Slip resistance	8.67
Slope/gradient	3.33
Trip hazards	4.33
Obstructions	3.00
Collision potential	3.00
Contaminants (eg litter)	5.83
Disabled/impaired access	6.17
Footpath width	5.17
Pathway continuity	8.50
Hazard conspicuity	7.33
Pedestrian design	4.00

Figure B5 Long-shot view of accident site 3

Figure B6 Close-up view of accident site 3



B4 Site 4: uneven construction (residential)

The uneven footpath contributed to this accident.

Table B4 Characteristics of accident site 4

Site characteristic	Mean
Pavement quality	2.17
Slip resistance	3.83
Slope/gradient	2.00
Trip hazards	6.00
Obstructions	2.00
Collision potential	0.33
Contaminants (eg litter)	0.17
Disabled/impaired access	1.17
Footpath width	1.17
Pathway continuity	2.67
Hazard conspicuity	3.50
Pedestrian design	3.83

Figure B7 Long-shot view of accident site 4

Figure B8 Close-up view of accident site 4

B5 Site 5: kerb (residential)

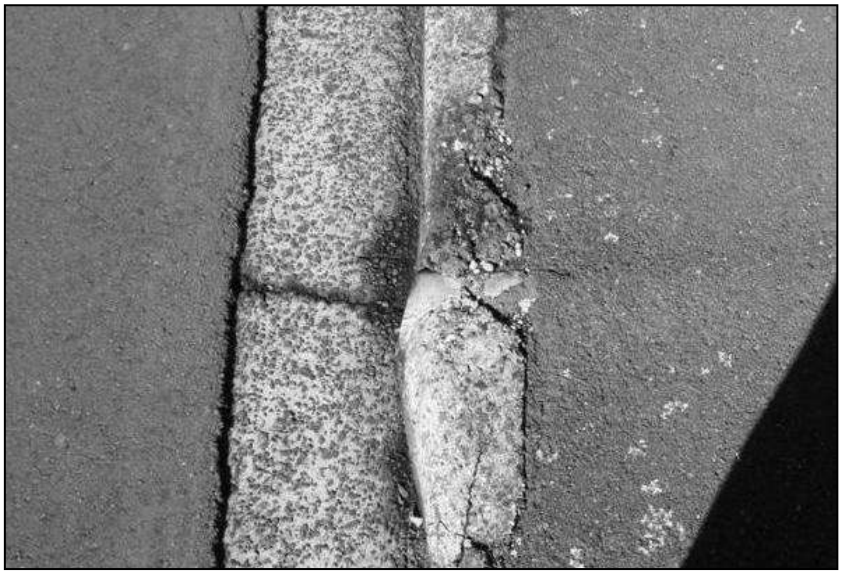
While rushing to the bus stop in light rain, the subject slipped off the kerb. The person was rushing because of the weather.

Table B5 Characteristics of accident site 5

Site characteristic	Mean
Pavement quality	4.00
Slip resistance	3.33
Slope/gradient	5.00
Trip hazards	5.67
Obstructions	5.00
Collision potential	2.67
Contaminants (eg litter)	1.83
Disabled/impaired access	5.33
Footpath width	5.33
Pathway continuity	4.00
Hazard conspicuity	6.33
Pedestrian design	5.50

Figure B9 Long-shot view of accident site 5

Figure B10 Close-up view of accident site 5



B6 Site 6: uneven construction (CBD)

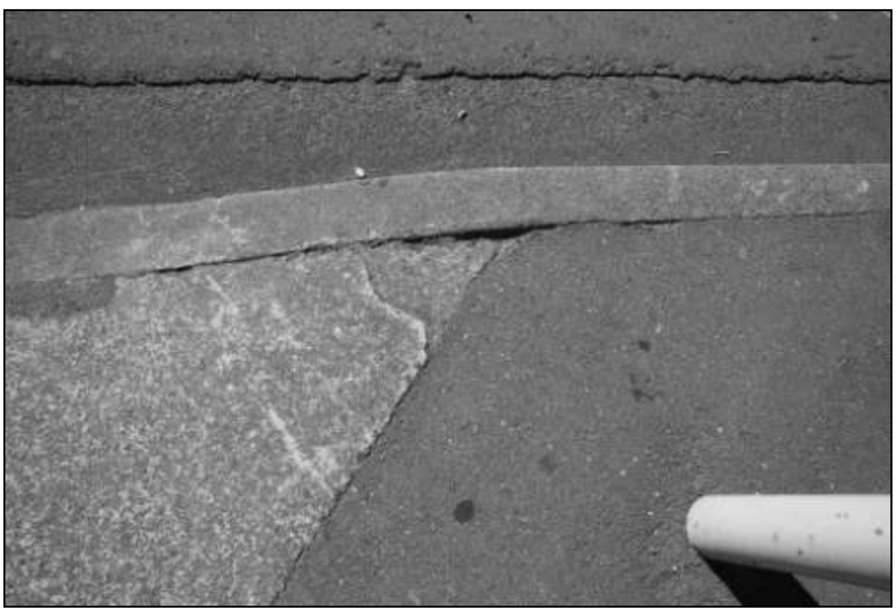
While the subject was crossing the road, the signal 'red man' started flashing. The subject picked up his pack and rolled his ankle on the deformed footpath.

Table B6 Characteristics of accident site 6

Site characteristic	Mean
Pavement quality	2.33
Slip resistance	1.83
Slope/gradient	3.33
Trip hazards	5.33
Obstructions	6.67
Collision potential	4.67
Contaminants (eg litter)	0.67
Disabled/impaired access	2.83
Footpath width	3.00
Pathway continuity	3.67
Hazard conspicuity	5.17
Pedestrian design	3.50

Figure B11 Long-shot view of accident site 6

Figure B12 Close-up view of accident site 6



B7 Site 7: uneven construction (CBD)

The footpath and parking lot are at different levels. The subject tripped on this hazard.

Table B7 Characteristics of accident site 7

Site characteristic	Mean
Pavement quality	5.33
Slip resistance	2.17
Slope/gradient	2.67
Trip hazards	3.67
Obstructions	4.00
Collision potential	3.33
Contaminants (eg litter)	0.33
Disabled/impaired access	2.67
Footpath width	2.67
Pathway continuity	4.67
Hazard conspicuity	5.33
Pedestrian design	4.33

Figure B13 Long-shot view of accident site 7

Figure B14 Close-up view of accident site 7

B8 Site 8: tiled surface (CBD)

The subject slipped on paving bricks on the footpath near the train station; it was poorly lit, raining and the footpath had heavy pedestrian traffic.

Table B8 Characteristics of accident site 8

Site characteristic	Mean
Pavement quality	0.67
Slip resistance	7.50
Slope/gradient	0.33
Trip hazards	0.67
Obstructions	2.67
Collision potential	2.67
Contaminants (eg litter)	0.67
Disabled/impaired access	0.33
Footpath width	1.33
Pathway continuity	0.67
Hazard conspicuity	4.67
Pedestrian design	3.00

Figure B15 Long-shot view of accident site 8

Figure B16 Close-up view of accident site 8

B9 Site 9: crack in surface (CBD)

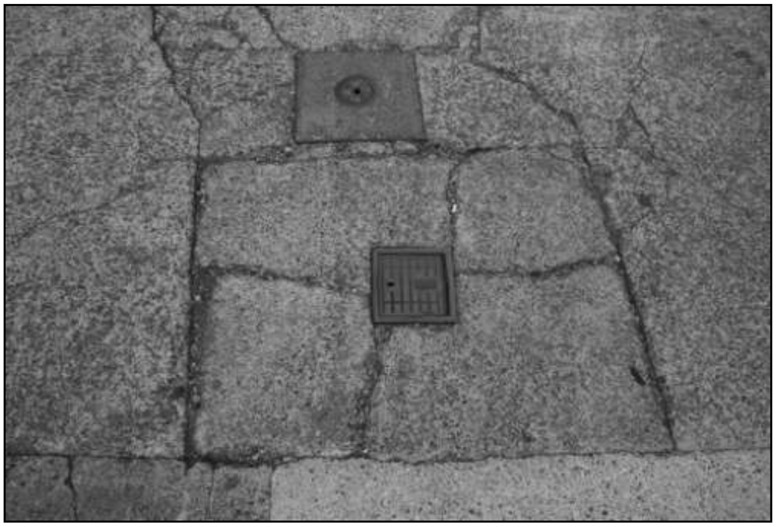
While looking for a particular building, the subject did not see the hazard on the footpath and tripped.

Table B9 Characteristics of accident site 9

Site characteristic	Mean
Pavement quality	7.67
Slip resistance	2.00
Slope/gradient	4.17
Trip hazards	8.50
Obstructions	0.67
Collision potential	1.33
Contaminants (eg litter)	1.00
Disabled/impaired access	4.00
Footpath width	0.50
Pathway continuity	3.33
Hazard conspicuity	6.67
Pedestrian design	4.83

Figure B17 Long-shot view of accident site 9

Figure B18 Close-up view of accident site 9



B10 Site 10: service cover (CBD)

The subject's shoe grip was 'not great'. The person walked over the slippery surface and fell over on their ankle. A non-slip surface is needed on the cover.

Table B10 Characteristics of accident site 10

Site characteristic	Mean
Pavement quality	0.50
Slip resistance	6.00
Slope/gradient	0.00
Trip hazards	2.83
Obstructions	2.67
Collision potential	3.00
Contaminants (eg litter)	0.67
Disabled/impaired access	1.00
Footpath width	0.33
Pathway continuity	2.00
Hazard conspicuity	1.67
Pedestrian design	1.33

Figure B19 Long-shot view of accident site 10

Figure B20 Close-up view of accident site 10

B11 Site 11: kerb (CBD)

The subject was having a night out, and took a step backward, tripping on the gutter and hitting their head.

Table B11 Characteristics of accident site 11

Site characteristic	Mean
Pavement quality	0.67
Slip resistance	5.83
Slope/gradient	0.00
Trip hazards	1.67
Obstructions	2.33
Collision potential	2.50
Contaminants (eg litter)	0.33
Disabled/impaired access	1.33
Footpath width	0.50
Pathway continuity	1.00
Hazard conspicuity	2.00
Pedestrian design	2.00

Figure B21 Long-shot view of accident site 11

Figure B22 Close-up view of accident site 11

B12 Site 12: tiled surface (CBD)

The details of how this accident occurred have not been recorded or are missing.

Table B12 Characteristics of accident site 12

Site characteristic	Mean
Pavement quality	4.00
Slip resistance	4.67
Slope/gradient	0.90
Trip hazards	3.60
Obstructions	3.00
Collision potential	2.67
contaminants (eg litter)	0.07
Disabled/impaired access	1.00
Footpath width	1.00
Pathway continuity	1.50
Hazard conspicuity	5.93
Pedestrian design	2.97

Figure B23 Long-shot view of accident site 12

Figure B24 Close-up view of accident site 12

B13 Site 13: kerb (CBD)

The subject was running by Te Papa on the walkway beside the drop-off zone. A poorly designed kerb transition occurs in that area, with a convex kerb and two different levels that do not stand out from each other. The combination of these two designs led to the subject to roll his ankle.

Table B13 Characteristics of accident site 13

Site characteristic	Mean
Pavement quality	1.50
Slip resistance	4.33
Slope/gradient	4.00
Trip hazards	4.33
Obstructions	5.00
Collision potential	4.00
Contaminants (eg litter)	0.33
Disabled/impaired access	1.83
Footpath width	1.00
Pathway continuity	4.83
Hazard conspicuity	3.17
Pedestrian design	2.33

Figure B25 Long-shot view of accident site 13

Figure C26 Close-up view of accident site 13

B14 Site 14: crack in surface (residential)

The footpath has been in poor condition at this point for some time. The subject stated that 'I could have been watching my step more in poor lighting.'

Table B14 Characteristics of accident site 14

Site characteristic	Mean
Pavement quality	8.17
Slip resistance	2.17
Slope/gradient	4.67
Trip hazards	9.00
Obstructions	1.33
Collision potential	1.00
Contaminants (eg litter)	1.50
Disabled/impaired access	6.00
Footpath width	2.23
Pathway continuity	3.83
Hazard conspicuity	7.13
Pedestrian design	5.67

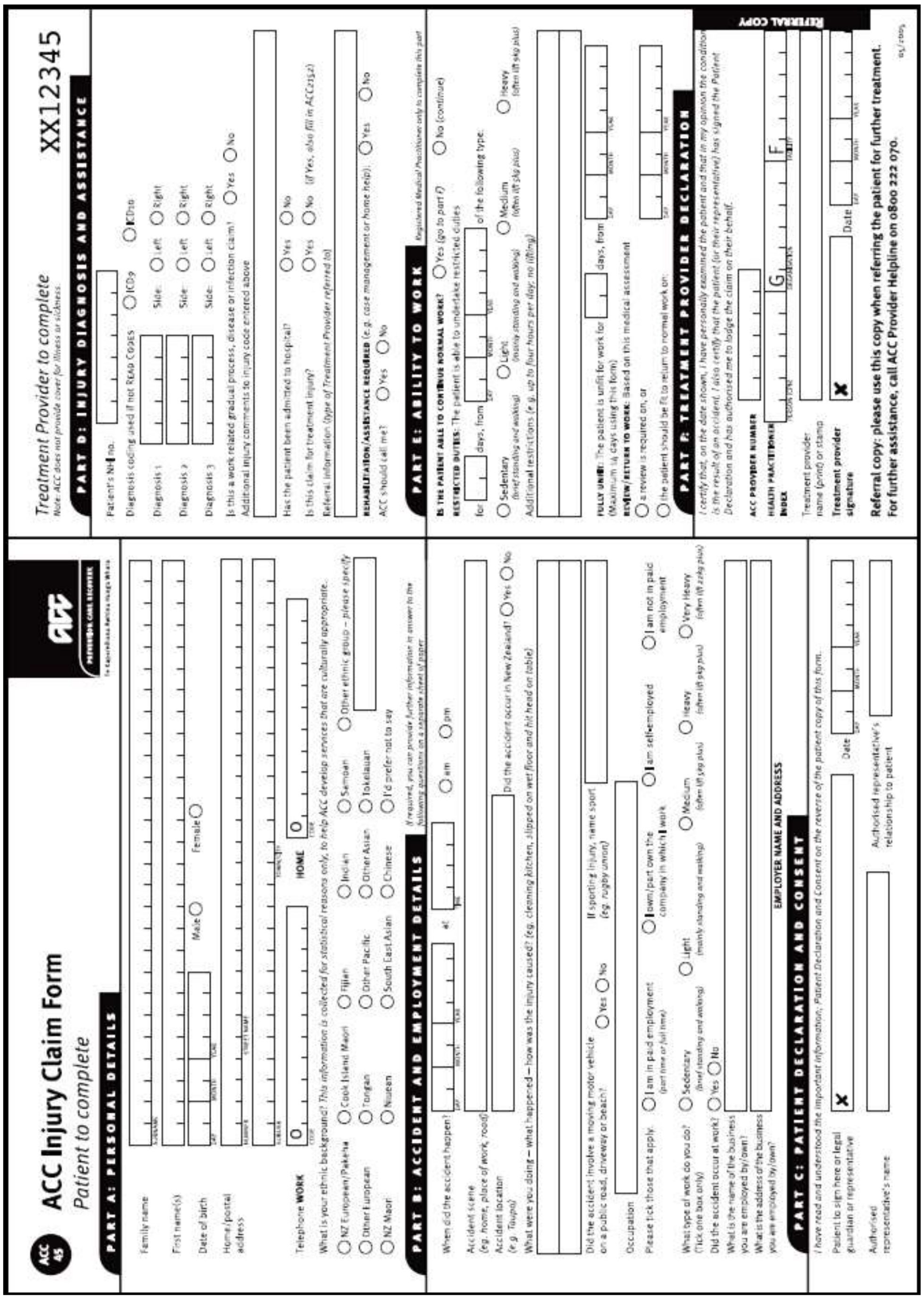
Figure B27 Long-shot view of accident site 14

Figure B28 Close-up view of accident site 14

Appendix C ACC45 accidental injury claim form

Figure C1 (overleaf) shows the ACC45 claim form used to extract data for this survey.

Figure C1 The ACC45 claim form



Appendix D Approach letter and consent form sent out by ACC

D1 Approach letter

Figure D1 is a replica of the letter sent by the ACC to claimants who were potential interviewees for this research. It has not been edited or altered from the original.

Figure E1 Letter from the ACC to potential interviewees

Research study – Non-motor vehicle Pedestrian Injury Project
A research study by Opus International Consultants Ltd

ACC is supporting researchers at Opus International Consultants Ltd in a study on causes of accidents to pedestrians which do not involve motor vehicles. ACC has identified you from their records as a possible research participant.

As an active mode, walking is being encouraged by the Government as part of its push towards safe sustainable transport. It is important for the future growth of walking that the public has confidence in its ability to do so safely on the network. This means putting effort into identifying under what circumstances injury events occur and developing ways to reduce these accidents. Most pedestrian injuries involve no motor vehicle and are not reported as part of traffic crash data. Indeed, for all ACC pedestrian claims (around 30,000 p.a.) about 90% do not involve a motor vehicle. For the more serious entitlement claims (around 2,600 p.a.) about 80% do not involve a motor vehicle.

At present there is little knowledge about the circumstances and mechanisms of non-motor vehicle related pedestrian injuries on and near roads, and in particular how they relate to infrastructure.

To remedy this lack of knowledge, the New Zealand Transport Agency (NZTA) has commissioned Opus International Consultants to interview a sample of ACC clients who have been injured on the road or in the road environs such as footpaths, grass verges or berms, kerb crossings traffic islands, pedestrian refuges etc. ***without the involvement of a motor vehicle.***

ACC understands from our claim records that you have recently been injured, on or near the road, in an accident not involving a motor vehicle.

This letter is to offer you the chance to take part in a survey of such people. This involves an interviewer from Opus International Consultants visiting you and asking you some questions about the circumstances of your injury. This interview, which is entirely voluntary, could take place at your home or at some other agreed venue. Opus will arrange the interview with you beforehand and the interviewer will be clearly identified.

These interviews will provide information, additional to that on your claim form, necessary to allow Road Controlling Authorities to ensure that walking environments are constructed and maintained in a safe manner. This will be of benefit to all of us. The information will also assist the ACC in providing input to local road controlling authorities regarding the appropriateness of their walking infrastructure from the injury prevention viewpoint.

As a member of New Zealand's National Road Safety Committee, ACC supports this initiative.

Your participation is completely voluntary. Whether or not you decide to take part has no affect on the status of your claim, or your relationship with ACC. If you do take part, all information you give will be kept confidential by the researchers and will not be shared with ACC or anyone else. ACC will only receive a summary report which will not identify any individuals.

In order to ensure people that might benefit from this project are given an opportunity to take part, ACC intends to give the researchers your name, address and telephone number on April 24th so that a researcher can phone you to discuss the study further and ask if you wish to take part. This will take about five minutes of your time.

If you do not want a researcher to phone you to discuss the study, please ring 0800 956 125 by Tuesday April 21st and leave your name, address and study reference number (printed on the top right hand side of this letter) on the answer-phone and your details will not be passed to the researchers.

If you have any questions about the survey please contact Bill Frith (Research Leader, Road Safety for Opus International Consultants) on phone (04 587 0690). Alternatively you can contact Cliff Studman at ACC on phone (04) 9187149.

Thank you for taking the time to read this letter. It is only with the assistance of people like you that ACC can improve our services and the outcomes for our claimants, and your contribution will be a valuable part of this work.

Thank you very much for your assistance with this important road safety project.

Yours sincerely

C T Studman

Cliff Studman
Senior Research Programme Manager
ACC

D2 Consent form

This consent form (figure D2) was carried by interviewers and required to be signed by interviewee before the interview began.

Figure D2 Consent form used for this survey

OPUS
INTERNATIONAL CONSULTANTS

1. **The mechanisms and types of non-motor vehicle injuries to pedestrians in the transport system and indicated infrastructure implications**

CONSENT TO PARTICIPATE IN RESEARCH

2. The purpose of this research is to assess the mechanisms and types of non-motor vehicle injuries to pedestrians (for instance falls or collisions with fixed objects) using ACC data and use this to evolve cost-effective infrastructural measures to prevent such injuries
3. This research has been funded by the NZ Transport Agency (www.nzta.govt.nz).

CONSENT TO PARTICIPATION IN RESEARCH

- I have been given and have understood an explanation of this research project and what is involved
- I have had an opportunity to ask questions and have them answered to my satisfaction
- I understand that I may withdraw myself from this research at any stage

4. I ____ have read and understood the information above, and agree to take part in this research.

Appendix E Site evaluation form

Table E1 Form used to evaluate the accident site characteristics

Site number:		
Location name:		
Area type:		
Surface type:		
Apparent problem still present?	Yes	No
Subjective measures	**Observer rating**	
1. Quality of pavement	0 1 2 3 4 5 6 7 8 9 10 Good Moderate Poor	
2. Slip resistance	0 1 2 3 4 5 6 7 8 9 10 Good Moderate Poor	
3. Slope gradient	0 1 2 3 4 5 6 7 8 9 10 Good Moderate Poor	
4. Trip hazards	0 1 2 3 4 5 6 7 8 9 10 Good Moderate Poor	
5. Obstructions	0 1 2 3 4 5 6 7 8 9 10 Good Moderate Poor	
6. Collision potential	0 1 2 3 4 5 6 7 8 9 10 Good Moderate Poor	
7. Contaminants (including litter)	0 1 2 3 4 5 6 7 8 9 10 Good Moderate Poor	

Table E1 (cont.) Form used to evaluate the accident site characteristics

8. Disabled/impaired access (ramps, etc)	0 1 2 3 4 5 6 7 8 9 10 Good Moderate Poor
9. Good footpath width (for peak traffic)	0 1 2 3 4 5 6 7 8 9 10 Good Moderate Poor
10. Pathway continuity (feature consistency, desire lines, etc)	0 1 2 3 4 5 6 7 8 9 10 Good Moderate Poor
11. Hazard conspicuity (including use of lighting, paint marking, etc)	0 1 2 3 4 5 6 7 8 9 10 Good Moderate Poor

12. Please rate the level of design features in the general location of your accident to make it a pleasant walking environment, such as paving, bollards, gardens and statues.

0 1 2 3 4 5 6 7 8 9 10

No design to encourage pedestrians (eg grass verge on side of road | Neutral (eg basic footpath) | Heavily designed walking area to encourage pedestrians

Physical compliance measures	Measure	Comply (yes/no)
Height of the worst surface defect causing a vertical change in the surface (under 6mm height)		
Footpath width		
Gradient		
Overhang		
Other		