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Unintentional falls at home among young and middle-aged adults: the influence of alcohol

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Abstract

Aim

To investigate the epidemiology of unintentional fall-related injuries at home among young and middle-aged adults (25 to 59 years) and to investigate the contribution of alcohol to these injuries.

Methods

Routinely collected national fall injury data were analysed to describe the incidence and characteristics of falls at home resulting in death or hospital inpatient treatment among this age group in New Zealand.

A systematic review of the published literature evaluated the epidemiological evidence quantifying the risk of falls associated with acute and usual alcohol consumption in this age group.

A population-based case-control study was conducted in Auckland, New Zealand over a 12-month period. Cases were 335 people aged 25 to 59 years who were admitted to hospital or died as a result of unintentional non-occupational falls at home. Controls were 352 people randomly selected from the electoral roll from the same age group as the cases. The participants or next-of-kin completed a structured interview to ascertain data on personal and lifestyle factors including alcohol consumption.

Findings

The review of national injury data found that almost a third of unintentional falls resulting in an in-patient admission among working-age people were recorded as occurring at home. For every death there were about 150 in-patient hospital admissions.

The systematic review identified only a small number of studies but showed an increased risk of unintentional falls in this age group with increasing exposure to alcohol use. The magnitude of this risk varied considerably across studies with most estimates being relatively imprecise. There was modest evidence of a dose-response relationship with acute alcohol use. The association between usual alcohol use and fall risk was inconclusive.

The case-control study revealed that after controlling for confounding, the consumption of two or more standard alcoholic drinks in the preceding six hours relative to none is associated with a significantly increased risk of fall-related injury. Approximately 21% of unintentional non-occupational falls at home in this population was attributed to this risk.

No association between hazardous drinking as a usual pattern and falls was found when the analyses were adjusted for confounders.

Conclusion

A significant proportion of unintentional fall-related injuries among the working-aged New Zealanders occur at home. Consuming two or more drinks in the previous six hours was strongly associated with unintentional non-occupational falls at home that result in admission to hospital or death in this age group. This largely unrecognised problem should be addressed in further research and in falls prevention programmes.

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List of Abbreviations

ACC	Accident Compensation Corporation
ACCIS	Auckland Car Crash Injury Study
AUDIT	Alcohol Use Disorders Identification Test
BAC	Blood Alcohol Concentration
BMI	Body Mass Index
CI	Confidence Interval
DALY	Disability Adjusted Life Year
ED	Emergency Department
ICD	International Classification of Diseases
IPRU	Injury Prevention Research Unit
ISS	Injury Severity Score
MeSH	Medical Subject Headings
NICE	National Institute for Clinical Excellence
NIQS	National Injury Query System
NMDS	National Minimum Dataset
NZHIS	New Zealand Health Information Service
NZIPS	New Zealand Injury Prevention Strategy
OR	Odds Ratio
PAR	Population-Attributable Risk
ProFaNE	Prevention of Falls Network Europe
RR	Relative Risk
SD	Standard Deviation
TLA	Territorial Local Authority
UK	United Kingdom
US	United States
Vs.	Versus
WHO	World Health Organisation

CHAPTER ONE: INTRODUCTION

1.1 Fall-related injury is an important public health issue

Globally, falls are a leading source of injury-related morbidity and a significant contributor to injury-related mortality.¹⁻⁷ Falls are the primary cause of traumatic brain injury⁸ and the second leading cause of spinal cord injury.⁹ After road traffic crashes, falls are estimated to be the world's second leading cause of the burden of unintentional injury as measured by Disability-Adjusted Life Years (DALYs), a metric that integrates years lived with a disability of specified duration and severity with years of life lost to premature death.¹⁰ ¹¹ The social and economic costs to individuals, and society from fall related injury is substantial. In the United States (US) falls are estimated to account for 42% (US\$90.5 billion inflation adjusted to 2000 dollars) of the total societal costs associated with unintentional home injury across all ages resulting in death, hospital admission or other medical treatment.¹²

In New Zealand falls are the leading cause of injury hospitalisation among all age groups,¹³ responsible for 40% of unintentional injury hospitalisations for the 2000 to 2003 period.¹⁴ Falls are also a major cause of injury death in New Zealand, accounting for 17% of unintentional injury deaths during the 2000 to 2001 period.¹⁴ In New Zealand across all age groups for every unintentional fall fatality there are around 68 people hospitalised with moderate injuries.¹⁵ New Zealand's age standardised DALY for unintentional fall death per 100,000 population is 122, higher than that of Australia (112), the United States (106), and the United Kingdom (112).¹¹

1.2 Unintentional falls among young and middle-aged adults at home

Traditionally the focus of epidemiological research on falls has been the very young or the very old as the incidence of falls is greatest amongst these age groups.¹⁶⁻²⁸ Far less is known about falls among young and middle-aged adults for whom the impact of injury has significant implications for both work productivity and family life.^{28 29}

Internationally, falls in the 15 to 44 year age group are the second leading cause of unintentional injury DALYs and third in the 45 to 59 year age group.¹¹ In New Zealand, a review of injury hospital admissions for a minimum overnight stay among 40 to 59 year olds found falls were the leading reason for injury admission for Māori, Pacific, and New Zealand European/Other ethnicities, accounting for 23%, 21% and 28% of hospital admissions

respectively.³⁰ Twenty-six percent of injury hospitalisation costs in New Zealand among 24 to 65 year olds are as a result of unintentional falls.¹⁴

Home is the most common location for injury hospitalisations and second to roads as the location for injury deaths across all ages.^{1 3-6 31} In the US, falls account for more than 40% of all nonfatal unintentional home injuries, and one third of unintentional home injury deaths.⁶ Almost 40% of all adult injury emergency department (ED) presentations in Queensland, Australia occur at home.³² A New Zealand study of injury cases presenting to ED found among three quarters (15/19) of those with alcohol-related injuries occurring at home, the "place of last drink" was home (own or other).³³

A high proportion of hospitalisations or deaths from injury among young and middle-aged adults are the result of unintentional falls at home. A Norwegian review of injury data among 25 to 64 year olds found falls accounted for 44% of injuries sustained inside the home, and 29% outside the home.³ Driscoll *et al.* in an Australian study of fatal unintentional injuries arising from unpaid work at home among adults found falls from a height to be the leading mechanism of injury in the 55 to 74 year age group and the second leading mechanism of injury in the 35 to 54 year old age group.¹ Around 30% of adult home injury ED presentations are as a result of falls.³² More than 25% of unintentional falls among New Zealanders aged 15 to 64 years to occur at home.³⁴

Falls at home among young and middle-aged adults, account for a large proportion of serious injury and are therefore likely to be associated with high healthcare costs. A study in the United Kingdom (UK) examining serious home accidents (inpatient stay of three days or more) reported 45 to 64 years olds accounted for over 60% of the most serious home accidents, 80% of these involved falls.³⁵ An Australian study of falls from heights reported patients injured at home had significantly (p= 0.003) longer lengths of stay in hospital (mean three days, range 0 to 54 days) than those injured at work (mean two days, range 0-35 days).³⁶

Gender differences exist for unintentional fall injury incidence among young and middleaged adults. A review of Victorian State (Australia) fatality and hospitalisation data found home fall admission rates from age 50 years on were higher for females than males.² US national health survey data indicates residential non-fatal injury rates are higher among females than males after age 20.⁶ However, a Scandinavian study that took into account the amount of time spent at home found incidence rates for falls on stairs to be higher for males than females (6.3 vs. 5.9 per 10 million person-hours) and for other falls (14.0 vs. 12.7 per 10 million person-hours).³ Overall, the study found for all unintentional home injuries among 25 to 64 year olds, males had significantly higher exposure-specific incidence rates than females (6.0 vs. 4.1 per million person-hours, P < 0.01).³ Rates for fatal falls in the home among young and middle-aged adults appear to be higher for males than females. An Australian study reported home fall death rates were highest for males in all 5-year age groups from 30 years of age on.² In the US home fall death rates in males exceed female death rates across all age groups.⁶

There is no published detailed analysis of routinely collected New Zealand data describing the characteristics of unintentional falls at home among young and middle-aged adults. Therefore an important aim of this thesis was to undertake such a review and publish the findings in a peer reviewed journal (Chapter 2).

1.3 Addressing the burden of falls

The published fall-related literature is dominated by studies examining risk factors and prevention strategies among older people. In contrast, falls among young and middle-aged adults have received little research attention. We know from falls research among older adults that the causes of these events are multi-factorial. The injury prevention framework posed by Haddon in 1980 to target traffic safety provides a conceptual model that applies the principles of public health to injury prevention activities.³⁷ Haddon suggests that the modification of any of the components of the injury triad - host-agent-environment - have the potential to interrupt the causal pathway. The framework consists of a matrix that combines the targets of host-agent-environment with primary, secondary, and tertiary prevention concepts. Since Haddon first developed the model it has been adapted as an injury prevention tool for a range of injury causes.³⁸⁻⁴¹

Central to the control of injury in the first instance is the identification of those most at risk (the *host*) and the factors that place them more at risk (the *agent* and the *environment*) and secondly to determine the most appropriate evidence-based interventions to employ. Epidemiological research is critical in assisting with the identification of those most at risk, to identify injury risk factors, and in the development and monitoring of targeted prevention activities.

The New Zealand Injury Prevention Strategy (NZIPS) was launched in 2003.⁴² The purpose of the Strategy is to establish a framework for injury prevention activities in New Zealand addressing the needs of government and non-government agencies, local government, communities and individuals. The Strategy's vision is that New Zealanders "..*can live free of injury while continuing to lead active and challenging lives*". Six national priority areas are highlighted in the Strategy: falls, drowning, motor vehicle traffic accidents, workplace injuries, and assault. Collectively these six areas account for around 80% of serious injuries and injury deaths in New Zealand.⁴²

In 2005 *Preventing Injury from Falls: The National Strategy 2005-2015* was released signalling the commitment of the New Zealand government and other agencies to reduce the rate and impact of fall injury in the community.⁴³ The home is acknowledged as one of the priority settings in the Strategy. The two long-term goals identified in the Strategy are 1) to reduce the incidence and severity of injury from falls; and 2) to reduce the social, psychological and economic impact of fall-related injuries on individuals, families (whanau) and the community. The research undertaken in this thesis directly addresses the second of five objectives developed to achieve the strategy goals. Objective Two focuses on improving the collection and dissemination of knowledge that can contribute to the prevention of injury from falls. The National Falls Strategy highlights and aims to address a number of issues that are particularly relevant to analysing fall injuries. Included in these issues are:

- A lack of information on interventions for 15 to 64 years olds
- That hazardous drinking may lead to an increase in alcohol-related falls

In the past decade increasing attention has been given to the role alcohol plays on the burden of injury. Alcohol is estimated to be implicated in between 20 to 30% of all injuries.⁴⁴ Seven percent of the worldwide disability and death related to falls has been estimated to be attributed to alcohol.⁴⁵ Acute drinking is estimated to be involved in 21% to 77% of non-fatal fall injuries and 18 to 53% of fatal fall injuries.⁴⁶ For this reason investigating the relationship between alcohol and unintentional falls at home among young and middle-aged adults is worthy of further investigation and will be the major focus of this thesis.

1.4 Alcohol use and falls

Alcohol is the most commonly used drug in New Zealand.⁴⁷ As a nation we rank 20th in the world in terms of per capita alcohol consumption, one place ahead of the UK and one behind Australia.⁴⁷ In the late 1990's the downward trend in per head consumption of alcohol that had continued for almost 20 years plateaued. Factors identified as contributing to the plateau include the almost doubling of liquor licence outlets following the introduction of the Sale of Liquor Act (1989), the removal of restrictions on opening hours for licensed premises, sale of alcohol on Sundays, sale of beer and wine in supermarkets, increased availability of ready-to-drink combinations of spirits and mixers, and lowering of the drinking age to 18 years.⁴⁷

Despite the decline in total consumption in recent decades, considerable variation in patterns of consumption among New Zealanders exists.⁴⁸⁻⁵¹ Findings from the 2006/07 New Zealand Health Survey indicate that around 84% of adults consume alcohol.⁴⁹ Just over one fifth (21%) of adult drinkers have a potentially hazardous drinking pattern; with males twice as likely to have this drinking pattern compared with females (28% vs. 12%). The findings of a nationwide survey looking at New Zealanders' drinking patterns conducted by ALAC in 2003 found almost 10% of New Zealand adults drink to get drunk.⁵² In New Zealand, alcohol is estimated to be a factor in around 35% of injury cases presenting to ED.³³

Observational studies indicate *acute* alcohol use (within four to six hours of the injury event) is common among young and middle-aged adults who have a fall resulting in medical treatment.^{53 54} A New Zealand study investigating the role of alcohol in fall-related injury hospitalisations among 16 to 29 years olds found alcohol was involved in 23% of falls.⁵⁵ Studies reporting the prevalence of hazardous drinking patterns among young and middle-aged fallers are less common.⁵⁶

The mechanisms by which alcohol can increase the risk of injury are varied and include biological effects and indirect effects. Biological effects include impairment of performance such as reduced visual acuity, longer reaction time, altered perceptions, and impaired attention. Indirect effects include loss of self-control, increased sense of confidence, reduced response to hazards, and increased risk-taking and impulsivity.⁵⁷⁻⁶⁰ All of these factors could increase an individual's risk for serious or fatal injury. Alcohol may also specifically contribute to fall injury through the effects on gait, postural control and balance.⁶¹

As well as being a potential risk factor for injury in general, consumption of alcohol also appears to play a role in severity and pattern of injury. ^{62 63} Excessive alcohol is a risk factor for poor skeletal health,⁶⁴⁻⁶⁶ with higher intakes associated with increased fracture risk.⁶⁶⁻⁶⁸ In

addition heavy drinkers have been shown to have low dietary intake of calcium, protein, and vitamin D that are necessary for the health development of bones.⁶⁴

Only one published systematic review has examined the evidence on alcohol use and risk of unintentional falls.⁴⁶ No reviews have systematically and critically reviewed the literature with respect to risks associated with falls and alcohol use among young and middle-aged adults. In light of this a systematic review of the epidemiological literature was conducted (Chapter 3) to establish the role of alcohol in unintentional falls among young and middle-aged adults. A systematic review uses explicit and objective inclusion and exclusion criteria in an attempt to identify all the relevant literature, and employs rigorous methods to assess the quality of included studies to ensure the limitations and biases of reviewed studies are identified.⁶⁹

A preliminary review of this literature had identified a dearth of studies examining the relationship between alcohol consumption and falls in the home environment. At the time of this preliminary review, the applicant was given the opportunity to undertake a case-control study of risk factors for falls in the home among young and middle-aged people. This case-control study represents the primary research undertaken for this thesis (Chapters 4 to 6).

The burden of disease and disability and the economic and social consequences placed on populations by the overuse of alcohol has led to international and national policies to reduce harmful consumption levels.^{47 70-72} In 1988 the New Zealand government released a national policy statement on alcohol as part of the 1998 National Drug Policy.⁷³ The policy aimed to minimise the harm associated with alcohol use. In 2001 the Alcohol Advisory Council of New Zealand and the Ministry of Health jointly released the National Alcohol Strategy (2000-2003) which complemented and extended the National Drug Policy.⁴⁷

The National Alcohol Strategy provides a framework for action on alcohol issues.⁴⁷ The priority injury areas specifically highlighted in the strategy include: workplace injury, road crashes, and drowning. Priority groups include young people and Māori. A recent review of the National Alcohol Strategy undertaken in 2007⁷⁴ highlighted the need for an Alcohol Action Plan to be developed to convey a strategic direction drawing on existing activities, policies and interventions, and to inform future directions. The National Alcohol Action Plan: Consultation Document released in 2008 identifies five goals in the "framework for action" (Figure 1).⁷⁵

Figure 1: Framework for action to reduce alcohol-related harm



Source: Ministry of Health. National Alcohol Plan: Consultation document (2008)75

The current research is aligned with goal five of the framework which focuses on improving the collection and communication of research relating to alcohol consumption and related harm.

In order to target injury prevention interventions and to monitor their effectiveness it is essential that the appropriate epidemiological data is collected. The research presented in this thesis including the review of routinely collected data (Chapter 2), the systematic review of the role alcohol plays in unintentional falls (Chapter 3) and the case-control study findings (Chapter 5) will add to the limited existing body of knowledge relating to the epidemiology of, and specifically the role of alcohol in, unintentional non-occupational falls at home among young and middle-aged adults.

1.5 Context and aims of the thesis

The principle aim of the research presented in this thesis was to investigate the epidemiology of unintentional non-occupational falls at home among young and middle-aged adults (25 to 60 years of age) resulting in serious injury using routinely collected data, a review of the literature examining the role of alcohol in falls, and a population-based case-control study with a primary emphasis on the role of alcohol in unintentional non-occupational falls at home. The overall goal of the research was to inform fall prevention strategies to reduce the incidence and severity of injury resulting from falls of this nature among young and middle-aged adults.

The research presented is based on a review of routinely collected New Zealand health data, a systematic review of the published literature relating to alcohol use and falls, and an estimation of the relative and population-attributable risks associated with alcohol use and other factors in falls based on data collected in the Auckland Falls Study – a population-based case-control study. The latter was conducted over a one-year period commencing in July 2005 in the greater Auckland region of New Zealand. Participants in the study were people aged 25 to 59 years who died or were admitted to hospital as the result of an unintentional non-occupational fall at home in the Auckland region (cases) and a representative sample of the general population for the region (controls). The overall objective of the Auckland Falls Study was to determine the relative and attributable risks of factors associated with unintentional non-occupational falls at home compational falls at home resulting in hospitalisation or death among young and middle-aged adults.

For the purposes of this thesis and the Auckland Falls Study the definition of *fall* developed by the Prevention of Falls Network Europe (ProFaNE)⁷⁶ and used in the New Zealand National Falls Strategy⁷⁷ has been adopted:

An unexpected event in which the person comes to rest on the ground, floor, or lower level.⁷⁶

The Auckland Falls Study was funded by the Accident Compensation Corporation (ACC).

1.6 Roles of the study investigators

The investigators involved in the design and conduct of the Auckland Falls Study were Associate Professor Shanthi Ameratunga¹ (Principal Investigator), Bridget Kool ²(Lead Researcher), Professor Rod Jackson³, Elizabeth Robinson⁴, Dr Sue Crengle⁵, Mr Alex Ng⁶, Mr John Cullen⁷, and Dr Wayne Hazell⁸. Dr Jennie Connor provided input into the methodology at the commencement of the project.

A study advisory group was established to ensure the findings could usefully inform endusers and the stakeholders in the field. Advisory group members included representation from the Accident Compensation Corporation (ACC), Māori and Pacific groups, a lay representative, a senior researcher with expertise in falls in elderly people, a health and housing researcher, a city council representative, and a representative from the disability sector. Advisory group members were kept up to date with the study progress through regular email updates.

The candidate's main roles in the Auckland Falls Study included:

- Assisting with the development of the study methodology
- Developing and piloting the data collection instruments
- Recruiting and training study staff
- Preparing the study manual
- Establishing the recruitment processes for cases in each of the three recruiting hospitals
- Establishing the recruitment processes for controls
- Obtaining ethical and hospital research board approval for the study
- Liaising with the study funding agency
- Coordinating the day-to-day running of the study including supervision of study staff
- Undertaking the analyses presented in this thesis, with advice and guidance from Elizabeth Robinson and my supervisors.

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⁸ Emergency Care Physician, Middlemore Hospital

1.7 Structure of the thesis

In this first chapter an overview of the significance of unintentional falls among young and middle–aged adults in the home setting as a public health issue has been given, the role of alcohol in falls of this nature has been introduced, and the rationale for the thesis established.

Chapter 2 provides a focused review of routinely collected national data on unintentional falls to describe the incidence and characteristics, of unintentional falls at home among this age group in New Zealand.

Chapter 3 is in two parts, the first part systematically reviews the published literature examining the role of alcohol in falls among young and middle-aged adults. The second part of the chapter provides a brief summary of the literature regarding other factors that may influence the relationship between alcohol and falls.

In Chapter 4 the design and methodology of the Auckland Falls (case-control) Study is outlined.

Chapter 5 presents the results of the case-control analyses, quantifying the contribution of risk factors to fall injury risk with particular emphasis on the role of alcohol.

In the final chapter (6) the main findings of the research are summarised, the strengths and limitations of the current investigation are discussed, implications for future epidemiological research in the field are presented, the research findings are reviewed in light of other published research in the field, and finally implications for public health policy are discussed.

CHAPTER TWO: A REVIEW OF NATIONAL ROUTINELY COLLECTED DATA ON UNINTENTIONAL FALLS AT HOME AMONG YOUNG AND MIDDLE-AGED ADULTS

2.1 Introduction

This chapter presents a review of routinely collected national data on unintentional falls in the home in New Zealand. The aim of the review was to describe the incidence and characteristics of unintentional fall-related injuries at home resulting in death or hospital inpatient treatment among young and middle-aged New Zealanders. The rationale for the review is described first, followed by the methods used, the results, and a discussion of the review findings.

2.2 Sources of routinely collected injury data in New Zealand

In the public health setting "surveillance" is the activity of systematically collecting, analysing, interpreting, and disseminating health-related information on an ongoing basis. These data are essential for identifying trends in the prevalence of disease and disability, and for the planning, implementation and evaluation of health care and public health interventions.⁷⁸ A public health approach to injury prevention requires information about the numbers and types of injuries taking place and the circumstances in which those injuries occur. This information can help to determine how serious the injury problem is, and where to target and prioritise prevention measures.⁷⁹

The New Zealand Health Information Service (NZHIS) is the section within the Ministry of Health responsible for the collection and dissemination of health-related data. NZHIS manage a number of data collections; the two most relevant for injury prevention purposes are the Mortality Collection and the National Minimum Dataset (NMDS). The Mortality Collection contains data on all deaths registered in New Zealand and includes information on demographics, place of death, and the underlying cause of death. The NMDS contains data on all public discharges and records information on a range of demographic data, processes of care (e.g. length of stay, referral source, discharge destination, procedures etc), and diagnoses. Data elements that are specifically relevant to injury prevention and control in the NMDS include: external cause of injury, activity at the time of injury, and the place of injury. Injury events that result in an in-patient hospital admission are more commonly at the moderate to serious end of the severity spectrum and provide valuable insights into not only injuries that result in a threat to life but also a threat to long term disability.⁸⁰

A commonly cited limitation of using routinely collected data for injury surveillance purposes is coding errors.^{79 81} A recent review of the accuracy of injury coding (ICD-10-CM) of New Zealand Hospital discharge data found an incorrect coding level of 14% for principal diagnosis and 26% for external cause codes.⁸² In addition 22% of the place of occurrence codes and 29% of the activity codes were incorrect. These error rates are three to five times higher than those reported in an earlier study by Langley et al that assessed ICD-9CM-A coding errors in New Zealand.⁸³ Another study by Langley et al. reported significant variation in estimates of injury incidence in New Zealand NMDS data depending on how the injury was operationally defined.⁸⁰ In light of this they recommend that researchers using these data to determine injury incidence should use the following criteria to select cases: injury as the principal diagnosis, primary admission only, and hospital stay of one day or more.

2.3 Rationale for a review of unintentional falls data

The incidence and circumstances of unintentional falls at home among young and middleaged adults in New Zealand has not been well described. Therefore, a focused review of routinely collected national surveillance data was conducted. The research questions this review addressed were:

- What is the incidence of unintentional fall-related injuries at home resulting in death or inpatient treatment among young and middle-aged adults (25 – 59 years inclusive)?
- 2. What are the characteristics of these falls?

The candidate's role in this review included:

- Obtaining ethical approval for the review as a component of the ethical approval for the Auckland Falls Study
- Analysis of the data (guided by Elizabeth Robinson biostatistician and co-investigator on the Auckland Falls Study)
- Interpretation of the findings
- Lead author on a paper describing the study findings⁸⁴(Appendix One)
- Lead author on a fact sheet describing the findings⁸⁵(Appendix Two)

A paper detailing the findings of this review has been published in the international peer reviewed journal *Injury* (Appendix One).⁸⁴ In addition an Injury Prevention Research Centre fact sheet has been produced (Appendix Two)⁸⁵, and an item published in the Injury Control Bulletin (Appendix Three).

2.4 Methods

Data on all people aged 25 to 59 years with a primary in-patient admission to hospital for a fall-related injury occurring at home during 1993 to 2004 or who died as a result of a fall-related injury at home in New Zealand between 1993 and 2002 was obtained from the national mortality and morbidity databases complied by the NZHIS. A minimum hospital in-patient stay of 'overnight' was selected to give a more reliable estimate of moderately severe and serious injury incidence.⁸⁰ Cases were identified by the International Classification of Diseases (ICD) external cause of injury code for falls ICD-9-AM⁸⁶ E880-888 (1993 to 2000 data), and ICD-10-AM⁸⁷ W00-19 (2001 to 2004 data). Cases with the external cause ICD-9-AM E887 (fracture, cause unspecified) were excluded as in ICD-10-AM this external cause is no longer included in the Falls (W00 – W19) category and instead appears in the Accidental Exposure to Other and Unspecified Factors (X59 exposure to unspecified factor) category. Cases with no injury diagnosis or where "late effect of injuries" was recorded in the principal diagnosis field were also excluded. The ICD place of injury code "home" was used to identify falls that had occurred at home ("home" includes driveway to home, garage, garden to home, yard to home, swimming pool in private house/garden).

The statistical programme STATA Version 8⁸⁸ was used for all analyses. Rates and means were calculated with 95% confidence intervals. Chi-squared tests were used to test for differences in proportions and Poisson regressions for analysis of trends over time.

Ethical approval for the study was obtained from the Northern Regional Ethics Committee.

2.5 Results

2.5.1 Fatalities

During the ten-year period 1993 to 2002, 281 people aged 25 to 59 years died in New Zealand from unintentional fall-related injury, 26% (n=73) of these falls were classified as occurring at home. In a further 15% of unintentional fall fatalities, the place where the event occurred was not recorded. During the study period between two and nine deaths per annum were attributed to unintentional falls at home, corresponding to an average annual rate of 0.41 per 100,000 (95% CI 0.32 to 0.51). The mean age of decedents was 47.6 years (95% CI 45.5 to 49.8), with half (51%) being 50 years or older. The death rate increased with age, with people in the 55 to 59 year old age band having nearly a three times higher rate than people aged 25 to 29 years (Figure 2). The fatality rate for males was three times that for females. There were insufficient deaths to examine ethnic differences.

Figure 2: Frequency and rate (per 100,000) of unintentional fatal falls at home, by age band: New Zealand, 25 to 59 year olds, 1993 – 2002 (n= 73)



* Rate per 100,000

The most common type of unintentional fatal fall occurring in the home environs was *falls from buildings or structures* (n=19) followed by *falls involving stairs or steps* (n=14). In 25% (n=18) of fatal events the type of fall was not specified. Men were most likely to die as a result of a fall from a building or structure (17/55 males vs. 2/18 females). Females were most likely to die as a result of a fall involving stairs or steps (7/18 vs. 7/55).

2.5.2 Hospitalisations

During the twelve-year period 1993 to 2004, 40,370 people aged 25 to 59 years had a hospital admission for an injury caused by an unintentional fall. In 31% (n=12,529) of cases, the location of the injury event was not specified. In 28% (n=11,236) of cases, the falls were coded as having occurred at home, representing an average annual rate of hospitalisation of 52.0 per 100 000 (95% CI 51.1 to 53.0). Fifty-four (4.8/1000 cases hospitalised) of these cases died in hospital.

The mean age of hospitalised cases was 44.9 years (95% CI 44.7 to 45.1). The incidence of fall hospitalisations increased with age, the 55 to 59 year age group incidence rate (110.2 per 100,000, 95% CI 105.8 – 114.6) was more than three times the 25 to 29 year age group rate (30.3 per 100,000, 95% CI 28.4 – 32.2), p < 0.0005.

Amongst admissions that were coded as a fall at home, 12% and 3% were classified to people of Māori and Pacific ethnicity, respectively.

Fifty three percent of admissions were females. Male rates were higher than female rates until age 45 years when the pattern reversed. As age increased, the difference between

rates by gender also increased, the rate for 55 to 59 year old women was 1.5 times the male rate (Figure 3).



Figure 3: Number and overall average rate of hospitalisations for unintentional falls at home by age group: among 25 to 59 year olds, New Zealand, 1993 – 2004 (n= 11,236)

* Rates per 100,000 with 95% confidence intervals

Falls occurring on the same level were responsible for almost a third of hospitalisations, and falls involving 'stairs or steps' accounted for a further 19%. Males were four times more likely to fall from a 'building or structure' than females and to fall from a 'ladder or scaffolding'. In contrast females were almost twice as likely to fall 'on the same level' as males and to have a fall involving 'stairs or steps'. In 12.9% of cases the type of fall was unspecified.

The mean length of stay was 4.97 days (SD 7.14 days). Among the hospitalised patients, the principal injury diagnosis at discharge was lower limb fracture (38%), followed by upper limb fracture (16%). Eleven percent of cases had a principal injury diagnosis at discharge of intracranial injury (including skull fracture) and 9% had a neck or trunk fracture. Collectively, skull, neck or trunk factures were more likely to have been sustained by males than females (26.6% compared with 14.8%). Females were more likely to have sustained a lower or upper limb fracture than males (62.1% compared with 45.4%).

2.6 Discussion

In New Zealand, at least one third of unintentional falls resulting in-patient admission or death among working-age people occur at home. This is almost certainly an underestimate due to the number of cases where the place of the fall was not specified (31% of hospitalisations and 15% of fatal, unintentional falls). Deaths from falls at home are

uncommon in this age group (in contrast to the high case fatality rate seen in older adults) but for every death there were approximately 150 hospital admissions, broadly consistent with the "injury pyramid" for New Zealand.¹⁵ During the time period reviewed, a small increase in the rate of fall-related injuries at home resulting in hospitalisations was apparent. The steady increase in rates of injury from about 45 years of age onwards suggests that consideration should be given to commencing fall prevention initiatives at an earlier age than has traditionally been the case. Males experienced higher rates of fatal falls than females, with the reverse pattern seen with hospitalisations. This may be due to differences in context and type of fall, co-morbidities, and quantitative and qualitative differences in the exposure to hazards in the home environment.

The strengths of this study are the use of national population-based data over a substantial period (10 to 12 years) providing reasonably reliable estimates of the burden of serious fall-related injury at home; the ability to identify broad categories in terms of the circumstances surrounding serious falls; and the opportunity to identify characteristics of subgroups at increased risk of these injuries. The reliability of New Zealand hospital inpatient external cause of injury data is higher than the United States (US) experience.⁸³

It was acknowledged, a priori, by the researchers that the well-recognised under-reporting of Māori in mortality statistics, was likely to result in an under-representation of Māori in these data.⁸⁹ In addition, as a result of changes to the 1996 census definition of ethnicity mean the denominator for Māori during the period 1996 to 2002 differs from earlier years.⁹⁰

The limitations of using hospitalisations as an indicator of non-fatal injury are wellrecognised as numerous extraneous factors influence admission to hospital.^{80 91 92} Research by Langley et al. on the reliability of routinely collected data suggest that the method of case selection used in the current review (principal diagnosis of injury, hospitals stay \geq 1 day, primary admission only), may result in an overestimate of incidence as high as 3%.⁸⁰ Nevertheless Langley et al recommend this approach to case selection. In addition, a focus on more serious injury does not take into account minor injuries some of which may result in significant longer-term disability at the population level.

The main limitation of this review is the absence of relevant contextual or exposure information (e.g. amount of time spent at home) and postulated or known risk factors (e.g. co-morbidities, alcohol use) which limits the ability to make inferences about aetiology. The risk factors in this population may differ from risk factors identified for falls in older populations. Such differences could relate to their lower levels of morbidity but more active lifestyles as well as reduced exposure (especially for men) to the home environment.

2.7 Summary

This review of routinely collected national injury data has described characteristics of unintentional falls at home among young and middle-aged New Zealanders. The review indicates that at least one third of unintentional falls resulting in inpatient admission or death in this age group occurs at home. For every fall-related death at home there are approximately 150 in-patient admissions. Females in this age group experience higher rates of hospitalisation for falls at home than males, but the reverse pattern was observed for fatal falls.

This chapter highlights the burden of falls at home among young and middle-aged adults and provides the most comprehensive description of New Zealand data to date. Further analytical studies are required to establish causal aetiology for falls among this relatively young and productive age group to identify factors such as alcohol which may place them at increased risk of unintentional falls at home resulting in moderate to severe injury.

CHAPTER THREE: SYSTEMATIC REVIEW OF EPIDEMIOLOGICAL STUDIES OF THE ROLE OF ALCOHOL IN UNINTENTIONAL FALLS AMONG YOUNG AND MIDDLE-AGED ADULTS

3 Introduction

Risk factors can be described as characteristics or situations found significantly more often among individuals who sustain a certain event than individuals not sustaining the event.⁹³ To maximise the effectiveness of prevention interventions it is essential to identify risk factors for fall injury.

This chapter is in two parts, part one (Section 3.2) presents a systematic review of the epidemiological literature undertaken to quantify the magnitude of fall risk associated with both acute and usual alcohol consumption among young and middle-aged adults. The second part of the chapter (Section 3.3) summarises factors identified from the literature that may have a relationship with alcohol.

The role of these and other putative risk factors in unintentional falls in this population helped inform the methodology of the population-based case-control study (the Auckland Falls Study) described in Chapter 4 of this thesis.

3.1 Systematic review of epidemiological studies of the role of alcohol in unintentional falls among young and middle-aged adults

3.1.1 Aim and objectives

A number of major reviews have examined the role of alcohol in non-traffic injuries.^{44 94-96} However, only one review published by Hingson and Howland in 1987 has specifically examined the link between alcohol and falls.⁴⁶ This review found an association with acute alcohol use and risk of fall, but concluded that more case-control studies were required to establish the magnitude of the risk. Over a decade later, Smith et al. found alcohol was an important contributor to serious falls in a review of non-traffic fatal injuries.⁹⁷ The aggregated proportion of fall cases determined to be intoxicated was 32.2% comparable to 32.8% of motor vehicle crash victims. These authors also noted a lack of case-control and prospective cohort studies investigating the relationship between alcohol use and fatal non-traffic injuries.

The aim of this review was to quantify the magnitude of fall risk associated with both acute and usual alcohol use among young and middle-aged adults including the research published in the 20 years since the paper by Hingson and Howland.

The findings of this review have been submitted for publication to the international journal *Injury Prevention* (Appendix Four).

3.1.2 Methods

3.1.2.1 Inclusion criteria

Epidemiological studies examining the association between alcohol use and the occurrence of unintentional non-occupational falls or fall-related injury were included in the review. The exposure of interest was defined as either usual alcohol use, or the acute consumption of alcohol in a defined period immediately prior to the event (or reference period). Study inclusion required the following criteria to be met: 1) study population to include young and middle-aged adults defined for the purposes of this study as 25 to 60 years (or a sub-group within this age range), 2) information regarding alcohol use, and 3) an English language abstract. Studies including subjects in residential care, work-related falls, or studies of injuries limited to a specific body region (e.g. hip fracture, traumatic brain injury, maxillofacial injuries) were excluded. Given the focus of the review, data specific to unintentional falls were extracted from studies focusing on injury more generally, where this was not possible the study was excluded.

3.1.2.2 Data sources and search terms

Research published from 1983 to 2007 was reviewed. The review period covered 25 years and included the only case-control study⁹⁸ in the Hingson and Howland review. Bibliographic computerised searches using the Ovid search engine of the following databases were undertaken: Medline, EMBASE, CINAHL, PsycINFO, and Scopus. Main Medical Subject Heading (MeSH) and text words search terms included: accidental falls; accidents, home; alcohol, ethyl; BAC; and alcohol drinking.

Additional strategies utilised to identify any potentially relevant studies included: examination of reference lists of retrieved articles and proceedings of applicable conferences; hand-searching of the table of contents of the following journals – *Injury*, *Injury Prevention*, *Journal of Safety Research*, *Journal of Trauma*, *Journal of Trauma*, *Injury*, *Infection and Critical Care*, *Alcohol and Alcoholism*, and *Alcohol;* electronic media searches of internet sources, websites of institutions involved in research and policy in the areas of falls or alcohol, particularly focusing on publication lists; and contact with key researchers in the field.

3.1.2.3 Quality assessment

The quality of studies fulfilling the inclusion criteria was assessed using the GATE LITE[™] critical appraisal form (<u>www.epiq.co.nz</u>).⁹⁹ Evidence tables for included studies were developed including information regarding participants, comparison group, exposure, confounders considered, outcomes, results, and appraisals of study quality and biases of the research. The identified studies were heterogeneous in many respects and were not considered sufficiently robust to combine quantitatively.

3.1.3 Results

Out of the 106 studies identified from the search strategy, 54 were considered potentially relevant based on the title or abstract and the full-text retrieved for detailed evaluation. Eight studies from the US,¹⁰⁰⁻¹⁰³ Finland,^{98 104} Sweden,¹⁰⁵ and Canada,¹⁰⁶ published between 1983 and January 2005, fulfilled the review inclusion criteria (Figure 4).





3.1.3.1 Study characteristics

The primary focus of four of the studies was falls,^{98 102 104 106} the remaining four were general injury studies where data on falls could be identified as a sub-group (Table 1).^{100 101 103 105} Three studies were explicitly population-based.^{101 104 105} Participants in the other studies were identified from selected emergency departments (ED) and hospitals in four,^{98 100 102 103} and a medical clinic in one.¹⁰⁶ The research designs included four case-control studies,^{98 100-102} three cohort studies,¹⁰⁴⁻¹⁰⁶ and a case-crossover study.¹⁰³ The individual sample sizes ranged from 118 to 19,582. The overall mean age for the four studies providing information was 47.4 years.

The proportion of fall subjects who had been drinking within 6-hours of the event (where data were reported) ranged from 14% to 53%.^{98 100 103}

Study	Participants	Relevant exposures	Fall-related outcomes	Confounders considered	Results OR ^{ŧv} /RR ^ŧ (95% CI)	Comments
1. Honkanen (1983), Finland, case-control ⁹⁸	Cases: 313 adults (≥ 15 years) fall injury in a public place between 3 – 11P.M. and admitted to ED* Controls: 626, randomly selected from the accident sites 1 week after the event	Acute alcohol: • cases: BAC** • controls: breath samples	Unintentional fall requiring an ED* visit	Slippery road, disease, age, use of psychotropic medications, shoe sole, social class Matched on: gender, location of fall, day of week, hour of day	 Mean age of cases was 44.9 yrs Mean age of controls was 37.4 yrs 92% of cases treated as outpatients 53% of cases and 15% of controls had acute alcohol involvement RR^t of injury compared with BAC** of 0: RR^t=3 for BAC** 60 – 100mg/100ml, RR^t=10 for BAC** 100- 150mg/100ml RR=60 for BAC** ≥160 mg/100ml No Confidence Intervals (CI) or p values given 	 Response rates : cases = 96%, controls= 96.4% No exclusion criteria reported Cases were older than controls (mean age 44.9 and 37.4 respectively) "falls" not operationalised Matching limited ability to look at temporal factors. Analyses done on discordant pairs only – matched analysis gave 2-3 times higher risk estimates than unmatched analysis Selection bias: interviewed on evening shifts only Misclassification bias: self report for some exposures Raw data not given therefore unable to establish the precision or significance of the risk estimates
2. Malmivaara (1993), Finland, population- based cohort ¹⁰⁴	19,518 adults (20 - 92 years) from 4 regions of Finland (8-11 year follow-up) Falls = 628 injuries/ 187,405 person years	Usual frequency of alcohol consumption: gms/month	Hospitalisation/death for fall injury	Age, sex education, martial status, smoking, physical exercise, Body Mass Index (BMI), use of psychopharmacologic agents, Cardio vascular disease (CVD), diabetes, musculoskeletal disorder, previous history of severe injury, other chronic diseases	 Mean age 45 years Monthly alcohol intake (gm/month) vs. abstainers: 100-499g RR^t = 1.43 (1.13, 1.82) 500-999g RR^t=2.32 (1.71, 3.17) ≥1000g RR^t=3.05(2.05,4.55) Gender differences: 20-44: 500-999g vs. abstainers Men RR^t=3.00 (1.45,6.19) Women RR^t=0.77 (0.10, 6.03) 	 Response rate 83% "fall" operationalised using ICD 8 codes Misclassification bias: Alcohol consumption recorded at baseline, outcomes measured 8- 11 years later. Drinking habits could have changed affecting the alcohol estimates

Table 1: Alcohol consumption and the risk of fall injury among young and middle-aged adults: summary of epidemiological evidence

Study	Participants	Relevant exposures	Fall-related outcomes	Confounders considered	Results OR ^ŧ /RR ^ŧ (95% CI)	Comments
3. Borges (1994), USA, case-control ¹⁰⁰	Cases 274, ≥ 15 years, injury (fall, assault/fight, MVC ⁺ , home injury) resulting in presentation to hospital Falls= 73/214 34% Controls 115, ≥ 15 years, injury (recreational, animal bite, workplace injury) resulting in presentation to hospital	 Breath alcohol Self report: Previous 6 hrs Usual alcohol consumption 	Injury (fall, assault, MVC [●] , home) requiring an ED* visit	Gender, day of accident, schooling, place of residence, age and occupation	 Mean age – not reported 26% of falls consumed alcohol prior to the event 11% of controls consumed alcohol prior to the event OR^t for fall injury: Breathalyser: OR^{t#}=3.45 (1.23, 9.66) for ≥10mg/100ml vs. ≤9 mg/100 Previous 6 hours OR^{t#} = 2.09 (0.66,6.56) for ≤100nl vs. abstainer Previous 6 hours OR^{t#} = 6.73 (1.54,29.34) for 101- 2001 ml vs. abstainer Self report of drunkenness OR^{t#} = 5.70 (1.96,16.56) for yes vs. abstainer Habitual use non-significant 	 Response rate 94% for both cases and controls "fall" operationalised Measurement bias: Alcohol consumption recorded by BAC** for cases and breath analysis for controls Misclassification bias: Unusual comparison group
4. Vinson (1995), USA, case-crossover ¹⁰³	350 acutely injured adults (≥18 years) presenting at ED*s of 2 hospitals for the region Falls = 87/350 27% Excluded: head injury or life- threatening trauma , presentations ≥48 hours after injury	 Acute alcohol: Self report number of drinks Alcohol use: Previous 30 hours (hour by hour) Previous 6 hours on the same day of the week for the preceding 28 days 	Injury requiring an ED* visit Injury Severity	Age, sex , weight, severity of injury, socio-economic status, day of the week, hospital type	 Mean age 37 years 13.5% consumed alcohol in the previous 6 hours For falls: Alcohol in previous 6 hours vs. with no alcohol OR[#]=3.0 (0.54, 30.0) 	 Response rate 87% Period of recruitment not stated Some interviews face-to-face some via telephone "falls" not operationalised Selection bias: interviewed evening only recruitment late spring & early summer days of week selected to have equal probability of enrolment Misclassification bias: self report for exposures Analysis on discordant pairs only. Excluded 16 cases who drank on both the day and previous day – may underestimate effect of alcohol

Study	Participants	Relevant exposures	Fall-related outcomes	Confounders considered	Results OR ^ŧ /RR ^ŧ (95% CI)	Comments
5. Gray (2000), Canada, cohort ¹⁰⁶	118 randomly selected Parkinson's clinic patients (≥40 years) (3 month follow-up) ≥ 1 falls = 70 No falls = 48 Exclusions: unable to stand / walk a short distance unaided, unable to complete a diary, conditions that could further predispose to fall e.g. epilepsy	Daily intake of alcohol (not stated how this was obtained)	Self-reported fall (injurious and non- injurious falls)	None reported	 Mean age not reported 70% who had ≥ 1 drink per day fell- not significant 56% who had < 1 drink per day fell <i>p</i> 0.002 ≥ 1 drink/day vs. < 1 drink/day OR[#]= 1.85 (0.73, 4.67) Peak time for falls was 2 hours after meals and medication 	 Response rate not reported "falls" not operationalised Included non-injurious falls Misclassification bias: self reported fall data (daily diary and interviews) Potential for under reporting of alcohol consumption Did not control for relevant confounders e.g. age, gender, stage of disease, use of walking aid, required assistance with activities of daily living etc. No effect estimates reported
6. Stenbacka (2002), Sweden, Population- based cohort ¹⁰⁵	4,023 randomly selected adults (20 – 89 years). (12 year follow-up) Falls = 330 Men= 1,828 falls/20,782 person years Women = 2,195 falls/ 25,231 person years	Usual alcohol consumption per month: • Low: 0.001- 100g • Moderate: 100- 500g • Moderately high: 500-1000g	Fall resulting in hospitalisation or death	Living alone, poor/rather poor health, earlier injuries	 Mean age not reported 8% died/hospitalised because of falls during the 12-year period RR^t for falls among 20 to 89 yr olds: ≥500g/month 1 fall RR^t=2.27 (1.45,3.57) ≥2 falls RR^t=2.08 (1.23,3.53) Gender differences 1 fall or 2 or more falls ≥500g/month vs.0 g/month: Women (20-59 yr olds): RR=3.65 (1.48,8.99) Men: RR^t=2.49 (0.96,6.45) 	 Response rate 65%. Higher rate of female non-participation Postal questionnaire Included all injurious falls a subject had potential for over estimation of alcohol associated risk Selection bias: no data on injury rates among non-responders subjects may have had more than one fall potentially overestimating some exposures Misclassification bias: exposures only measured at baseline, but outcome period 12 years effects may be underestimated if changes in alcohol consumption occurred since baseline

Study	Participants	Relevant exposures	Fall-related outcomes	Confounders considered	Results OR [#] /RR ^t (95% CI)	Comments
7. Keegan (2004) USA, case-control ¹⁰²	Cases= 2348 (≥45 years) fracture as a result of a fall to the ground/floor or attributed their injury to a fall Exclusions: pathological fractures, non- English/Spanish speakers Controls= 512 (≥45 years) medical centre members Exclusions: non- English/Spanish speakers, fracture since age of 45,	Acute alcohol: self report (number of drinks) Usual alcohol: number of drinks per week	Fall resulting in fracture identified from inpatient and outpatient hospital records	Age, gender, ethnicity	 Mean age 62.8 years Consuming alcohol in past year no increase in risk for foot , distal forearm, proximal humerus, pelvic or shaft of tib/fib fractures in multivariable adjusted model Alcohol use in the previous 4 hours increased risk of foot fracture in multivariable adjusted model OR[#]=3.1 (1.6, 6.0) but not for other fracture sites 	 Response rate cases = 73%, controls: 66%. Selection bias: Kaiser patients may differ systematically from non-Kaiser patients Misclassification bias: index time for acute alcohol use was fall/time of interview may have resulted in under / overestimate of exposure with temporal component e.g. meds and alcohol use recall bias: mean time from fall to interview was 3.9 months
8. Chen (2005), USA, Population- based case- control ¹⁰¹	Cases= 5549 (≥ 15 years) persons who died from injury NB: Falls as a component not stated Controls= 42,698 from the National Longitudinal Alcohol Study	Current drinkers= ≥12 drinks in last year of life	Fatal unintentional falls	Age, sex, race/ethnicity, education, marital status, working status, and drug use	 Mean age not reported Risk of dying from unintentional falls for current drinkers vs. abstainers and prior drinkers OR[#] 1.38 (1.05-1.82) males: OR[#]=1.39 (0.94, 2.05) females: OR[#]=1.35 (0.91, 1.99 	 Response rates: case proxies=83% controls=92% "abstainers" and "prior drinkers" not operationalised Selection bias: Two surveys covered different time period and locations 1993 national survey used for case information but 1994 national survey used for control information Misclassification bias: Alcohol consumption information: Cases- from proxies Controls-self report

Abbreviations: *ED: emergency department **BAC: blood alcohol concentration

^tRR: relative risk [#]OR: odds ratio

[•]MVC: motor vehicle crash

Footnote: In general injury studies, only those reporting fall-related outcomes have been included
The outcome measures included self-reported falls (injurious and non-injurious),¹⁰⁶ ED visit or admission to hospital for a fall-related injury,^{98 100 103-105} death as a result of a fall-related injury,¹⁰¹ ¹⁰⁵ and fractures as a result of falls.¹⁰² While two studies described the circumstances of the falls in limited detail,^{102 104} neither reported if the association with alcohol varied in different contexts.

3.1.3.2 Selection biases

The identification and recruitment of study cases from hospital ED and admission records may have introduced selection biases due to the unreliability of the coding of fall injury^{107 108} and to referral patterns and access issues that result in some cases attending ED whilst others seek care from alternative providers or not at all.^{109 110} Moreover, trauma studies based only on admitted patients may be more likely to include intoxicated minor injury cases due to the difficulty of initial clinical assessment among intoxicated patients which can result in biased estimates of association between alcohol and injury risk.¹¹⁰

In the seven studies reporting response rates, these ranged from 65% to 96%.^{98 100-105} Studies with unreported or low response rates are more likely to yield biased effect estimates as respondents may be systematically different from non-responders with regard to exposure measures. A cohort study of individuals with traumatic brain injury, found subjects lost to follow-up were more likely to be those who were intoxicated at the time of injury and those with a history of substance abuse.¹¹¹

The selection of non-injured patients¹⁰² and patients injured by other mechanisms¹⁰⁰ as controls in two studies meant that controls may not have represented the same populations generating the cases.^{109 112 113} Previous studies have found non-injured patients to be more frequent heavy drinkers than the general population¹¹⁴ potentially resulting in conservative estimates of the effect of alcohol on injury.

3.1.3.3 Information biases

The measurement of exposures and outcomes commonly relied on self-report raising the possibility of recall bias and socially desirable responses. The latter may have resulted in an underestimate of effect in some studies.¹¹⁵ Exposures measured at baseline in cohort studies, if not updated, may not reflect the exposure status of participants when outcomes are measured.^{109 112} As follow-up periods for two of the cohort studies exceeded ten years,^{104 105} it is likely that drinking patterns changed within that period.

The alcohol use measures investigated were self-reported volume of alcohol consumption in preceding four to six hours,¹⁰⁰ ¹⁰² ¹⁰³ blood alcohol concentration (BAC),⁹⁸ breath alcohol concentration,⁹⁸ ¹⁰⁰ self-reported level of drunkenness¹⁰⁰ and usual alcohol consumption.¹⁰⁰⁻¹⁰² ¹⁰⁴⁻¹⁰⁶ Emergency department records were used in two studies to identify BAC.⁹⁸ ¹⁰⁰ These data

are commonly incomplete,^{108 116 117} potentially resulting in missing exposure or confounder information.

3.1.3.4 Confounding

The effect of recreational drug use and fatigue on the relationship between alcohol and falls appears to have been considered in only two studies.¹⁰⁵ ¹⁰⁶ These variables may have a relationship with both alcohol use and risk of fall, and could have distorted the risk estimates due to alcohol.¹¹⁵ Previous research has found the association between acute alcohol consumption and injury risk can be confounded by usual patterns of drinking, risk-taking behaviours and the use of other substances.¹¹⁸ Although age, gender, and socio-economic status could have an association with both alcohol use and risk of fall,¹¹⁸ it was unclear if the potential confounding effects of age, gender, and socio-economic status were adequately considered in one study.¹⁰⁶

3.1.3.5 Effect estimates

Two⁹⁸ ¹⁰⁰ ¹⁰² of the four studies⁹⁸ ¹⁰⁰ ¹⁰² ¹⁰³ investigating the association between acute use of alcohol and fall risk found statistically significant increases in risk. The first of these, a case-control study examining ED presentations for falls compared with presentations for injuries from animal bites, recreational "accidents" or workplace "accidents" reported odds ratios (OR) of 3.45 (95% CI; 1.23, 9.66) for breathalyser readings of 10 or more mg/100ml compared with nine or less; OR=6.73 (95% CI; 1.54, 29.34) for self-reported consumption of 101 to 2001 ml of alcohol in the previous six hours compared with abstainers; and OR=5.70 (95% CI; 1.96 ,16.56) for those self-identifying as "drunk" compared with abstainers.¹⁰⁰ These estimates may have been biased as alcohol could have also been a factor in these injuries. As alcohol could also have influenced the injuries experienced by the control group, these estimates may be biased and result in an underestimation of the risk.

The subsequent case-control study of hospital presentations (inpatient or outpatient) for fractures attributed to falls compared with presentations for other conditions, found the foot fracture group had a three-fold greater risk of exposure to alcohol use in the previous four hours (OR=3.1; 95% CI 1.6, 6.0).¹⁰² However, the generalisability of these findings is limited by the particular type of fall injury investigated.

The remaining two studies that examined acute alcohol use both found an increased fall risk but the precision of these estimates was of concern.^{98 103} The first of these was a case-control study examining BAC levels among ED presentations following a fall in a public place compared with controls randomly selected from the incident site.⁹⁸ The study found increased risk associated with BAC of 60mg/100ml and greater but information regarding the precision of these estimates was not reported. The second was a case-crossover study of ED fall injury presentations which

found alcohol use in the preceding six hours was associated with an OR=3.0 (95% CI; 0.54,30).¹⁰³ These findings are equivocal as the confidence interval was extremely wide.

There was some evidence of a dose-response relationship with acute alcohol use and fall risk reported in two of the studies reviewed.⁹⁸ ¹⁰⁰ The case-control study by Honkanen et al. reported relative risks (RR) of around 3 for BAC of 60 – 100mg/100m ml, RR=10 for BAC 100 – 150mg/100ml and RR=60 for BAC of 160mg/100ml or more compared with BAC of 0 mg/100ml.⁹⁸ While this study indicates a dose-response relationship, information regarding the precision of estimates was not reported. Another case-control study of fall-injury requiring hospitalisation reported an OR of 2.09 (95% CI, 0.66 - 6.56) for breath alcohol levels of 100mg/ml or less compared with abstainers, increasing to OR 6.73 (95% CI, 1.54 – 29.34) for 101 – 2000 mg/ml.¹⁰⁰ Despite the imprecision of the estimates in this study, the direction of the relationship is clear.

While three^{101 104 105} out of six studies found that usual alcohol use increased fall risk, others did not find a significant association.^{100 102 106} Two cohort studies^{104 105} examining usual alcohol intake per month compared with abstainers reported statistically significant relative risks of around 2.0 for consumption of 500gm or more of alcohol per month. The more robust of these two studies demonstrated a dose-response relationship with increased usual alcohol consumption correlating with an increase in risk of fall.¹⁰⁴ Compared with abstainers, relative risks increased from 1.43 (95% Cl, 1.13,1.82) for those consuming 100 to 499 gms of alcohol per month to RR 3.05 (95% Cl, 2.05 – 4.55) for consumption of 1000gm per month or more. A case-control study investigating drinking history and risk of fatal injury found current drinkers were at increased risk of death from falls compared with abstainers and prior drinkers (OR=1.38; 95% Cl 1.05,1.82).¹⁰¹

Two case-control studies examining usual alcohol consumption and fall risk found no significant relationship.^{100 102} Gray et al. in a cohort study of self-reported falls found a non-significant increase in fall risk associated with the consumption of one or more drinks pre day compared with less than one drink (OR=1.85; 95%CI 0.73,4.67).¹⁰⁶

No studies reported statistically significant gender differences in fall risk associated with acute alcohol use, and the evidence relating to usual alcohol consumption was inconsistent. One study found a significantly increased risk for women (aged 20-59 years) with high usual alcohol consumption (500gm/month or more) of fall-related hospitalisation or death, after controlling for confounders, while the risk was only marginally significant for males of the same age.¹⁰⁵ However, another study using similar cut points but examining consumption by age group found males aged 20 to 44 years consuming 500-999gms/month had a three-fold increase in risk (RR=3.00; 95%CI 1.45, 6.19) of hospitalisation or death resulting from falls, after controlling

for confounders, compared with women of the same age (RR=0.77, 05%CI 0.10, 6.03). This pattern was reversed in the older age group (45 to 64 years) with women consuming 500 gm/month or more having almost the double risk of their male counterparts (RR=4.57; 95% CI 1.68, 12.45 vs. RR=2.75; 95%CI 1.58, 4.79). A study investigating fatal falls found similar risks among male and females who were current drinkers compared with abstainers.¹⁰¹

3.1.4 Discussion

Several studies have investigated the association between alcohol consumption and fall since the last substantive review by Hingson and Howland in 1987.⁹ Studies examining associations between acute alcohol use and increased risk of unintentional falls among young and middleaged adults have found a consistent relationship although the estimates of risk varied with respect to magnitude and precision. There was some evidence of a dose-response relationship with acute alcohol use though again the estimates lack precision. Evidence of any gender difference is inconsistent.

There is inconclusive evidence of an association between usual alcohol use and fall risk among young and middle-aged adults. Confounding was not adequately considered in a number of studies. Some studies were compromised by the delay between measurement of alcohol consumption and measurement of outcomes, resulting in potential recall and other measurement biases. The wide range of measures used to characterise usual alcohol consumption highlights the need for a consistent measure that can be used across countries.

With these caveats, the findings of this review are consistent with those from Hingson and Howland's review and provide additional support for the contention that acute alcohol use increases the risk of non-fatal unintentional falls.⁴⁶ However, the magnitude of this risk among young and middle-aged adults remains subject to several sources of systematic error and imprecision. Moreover, there is insufficient evidence to conclude that there is an important association between usual alcohol use and fall risk in this age group.

A systematic review of the literature using a comprehensive reproducible search strategy is expected to provide a less biased view of the total evidence on a topic compared with narrative reviews or individual studies. However, publication bias can be an important threat to the validity of systematic reviews.¹¹⁹ The latter may arise as a result of a number of factors including studies with significant findings being more likely to be published;^{119 120} and computerised data bases less likely to index non-English language published research, research undertaken by low-income countries, or research in the grey literature.^{121 122} Threats to the validity of this review from publication bias and language bias was reduced by implementing a broad and comprehensive search strategy and by making contact with experts in the field. Acknowledging these strengths and limitations, it is worthy to note that all eligible studies were conducted in high income countries in North America and Europe. Yet, as with most types on injury, the

burden of falls is disproportionately borne by low and middle-income countries,¹²³ indicating an important gap in context-based research.

Although meta-analyses of pooled data can improve the precision of estimates in systematic reviews, the heterogeneity in research designs, variable definitions and study context made this approach inappropriate in the present review. Instead, recommended criteria were used to synthesise the evidence.^{99 124 125}

The primary focus of this review was to use well recognised criteria to evaluate and synthesise the evidence regarding the magnitude of unintentional fall risk associated with both acute and usual alcohol consumption among young and middle-aged adults. Therefore we did not include studies limited to study populations with injuries in specific regions of the body (e.g. traumatic brain injury, maxillofacial injuries, and hip fracture). These studies may have provided insights regarding the role of alcohol in these particular types of injuries, not all of which may be generalisable to falls.

The studies selected for this review were either case-control, case-crossover or cohort studies, methodological designs suited to investigate the aetiology of injury.¹⁰⁹ ¹¹² ¹¹³ ¹²⁶ While our inclusion criteria were relatively strict with regard to eligible study designs, the quality of the included studies was quite variable. The lack of analytical studies with a population focus is a major limitation identified in this review. A number of studies drew participants from specific emergency departments, hospitals or clinics, introducing a number of selection biases.⁸¹ ¹⁰⁷ ¹⁰⁸ ¹²⁷

The use of non-population based controls was a limitation in a number of the studies reviewed. The selection of population-based controls ensures the controls are drawn from the same population source as the cases. This has the advantage of minimising differential ascertainment of exposure among cases and controls.^{109 113 128}

Several studies were compromised by the lack of objective measures of acute alcohol exposure. This is consistent with research by Cherpitel *et al.* indicating that only about 50% of US trauma centres routinely obtain blood alcohol on injury patients.¹²⁹ In addition, clinician detection of acute alcohol intoxication is unreliable and screening for alcohol intoxication is inconsistently undertaken.¹³⁰⁻¹³² Those with severe injuries may be less likely to have BAC estimated in a timely fashion due to other clinical management priorities.¹¹⁵ ¹³³ In some situations the consumption of alcohol may have taken place after the injury-event, an argument for complementing BAC levels with self-report data on when – in relation to the injury – alcohol was consumed.¹¹⁵

The use of abstainers as the reference group for the calculation of risk estimates for alcohol use was common.^{101 104} Concerns previously identified regarding the use of self-identified abstainers

as a control group include their potential heterogeneity, measurement error, and representativeness of the underlying study populations.¹³⁴ ¹³⁵ Abstainers may be life-time abstainers, long-term abstainers, or former drinkers. This latter group will include those who have stopped drinking for health reasons ("sick quitters"). Rehm et al. estimate that inconsistencies in self-report of lifetime abstention from alcohol can result in the underestimation of alcohol-attributable all-cause mortality by 2% to 17%.¹³⁴

Other factors with a transient effect on fall risk, such as recreational drugs and fatigue were seldom considered as potential confounders in the studies reviewed. Information on the type and circumstances of falls was not reported in most studies. This information is required to identify whether the relationship differs in different contexts e.g. home, public places and by type of fall e.g. stairs, ladder, slips and trips.

In conclusion, this review suggests that acute alcohol use increases the risk of unintentional falls among young and middle-aged adults, although the magnitude of this risk remains uncertain. Sufficiently powered population-based studies conducted in settings that encompass a range of economic contexts are required to enable estimation of the fall burden attributable to alcohol. The multifactorial nature of falls requires the consideration of other potential contributing causes, confounders, and consideration of interactions between alcohol and other factors such as fatigue and recreational drug use.

3.2 Other factors which may influence the relationship between alcohol and falls among young and middle-aged adults

This section will provide a brief summary of factors identified from the published falls literature which may influence the relationship between alcohol and falls among young and middle-aged adults. The section begins with a brief overview of what is known about risk factors for falls among older age adults. Following this, factors identified from the literature as potentially relevant to falls among young and middle-aged adults will be discussed.

3.2.1 Introduction

The causes of falls are well recognised as multi-factorial, with a number of intrinsic and extrinsic factors at play. While non-injurious falls are likely to be much more common than injurious falls the available evidence suggests, the risk factors for non-injurious and injurious falls do not differ greatly.¹³⁶⁻¹³⁸ Intrinsic or personal risk factors which place older adults at increased risk of falls are summarised in Table 2 adapted from a systematic review of cohort studies undertaken by the National Institute for Clinical Excellence (NICE).¹³⁹ The table identifies those risk factors which were found to be statistically significant in cohort studies.

Risk factor	OR range	N=studies included in the NICE review reporting statistically significant results
Diabetes	3.8 – 4.1	2
Visual impairment	2.6 – 5.8	5
Falls history	2.4 - 4.6	11
Mental status	2.2 – 6.7	4
Multiple medications	2.0 – 3.2	Meta-analysis of 14 studies
Mobility impairment	2.0 - 3.0	8
Low body mass index	1.8 – 4.1	3
Balance deficit	1.8 – 3.9	5
Incontinence	1.8 – 2.3	2
Gait deficit	1.8 – 2.2	4
Fear of falling	1.7 – 2.8	3
Functional dependence	1.7	4
Psychotropic medications	1.66	Meta-analysis of 11 studies
Anti-arrhythmic medications	1.59	Meta-analysis of 10 studies
Depression	1.5 – 2.2	3

Table 2: Factors found to be associated with falls in community dwelling older aged adults

Source: NICE. Clinical practice guideline for the assessment and prevention of falls in older adults (2004). Royal College of Nursing: London.¹³⁹

Some intrinsic factors have been identified as being associated with both increased and decreased risk of falls in older adults. These factors include: physical activity,¹³⁷ ¹⁴⁰⁻¹⁴⁴ and alcohol consumption.^{46 137} ¹⁴¹⁻¹⁴³ ¹⁴⁵ ¹⁴⁶

Little is known about the extent of the role that extrinsic (or external) risk factors play on falls among older adults. Extrinsic factors identified as playing a potential role in falls include footwear, inappropriate walking aids, and environmental hazards such as poor lighting, and uneven of slippery surfaces. Due to the methodological challenges of measuring exposure to extrinsic or behavioural factors epidemiological studies quantifying their contribution to falls are scant.⁹³ However, environmental factors are estimated to feature in about a third to half of all home falls.¹⁴⁰ ¹⁴⁷ ¹⁴⁸ There is evidence to support the notion that as the number or risk factors present increase so does fall risk.¹⁴⁰ ¹⁴¹ ¹⁴⁹ ¹⁴⁹ ¹⁴¹ ¹⁴⁹ ¹⁴⁹ ¹⁴¹

Falls in elderly people have been extensively characterised in the literature and have been the focus of a number of systematic reviews of both risk factors and prevention strategies (a listing of key publications are noted in Appendix Five).^{16 18 46 136 139 152-160} In contrast, the identification of risk factors for unintentional falls among young and middle-aged adults has received less research attention. The following is a brief summary of the limited information located in the published literature regarding risk factors that may have a relationship with alcohol use and unintentional home fall risk among young and middle-aged adults.

3.2.2 General health

Chronic diseases identified as risk factors for injurious falls in a cohort of adults (\geq 20 years) included: history of myocardial infarction (RR=1.53; 95% CI 1.14-2.07), non-insulin treated Diabetes Mellitus (RR=1.62; 95% CI 1.08-2.43), and insulin treated Diabetes Mellitus (RR=3.71; 95% CI 1.53-8.99).¹⁰⁴ *Poor or rather poor health* has been shown to increase the risk of two or more injurious falls among adults by over two and half times (RR=2.67; 95% CI 1.65-4.34).¹⁰⁵

Risk factors identified for falls among people aged 45 years or older with multiple sclerosis include being male, occasional use of a wheelchair, fear of falling, and bladder incontinence.¹⁶¹ Another study of multiple sclerosis suffers (aged 25 to 65 years) reported 54% had fallen within the past two months, fallers were more likely to have lower scores on ambulation and balance tests than non-fallers.¹⁶²

After adjustment for confounders, six or more physical difficulties place middle-aged and older adults at increased risk (OR 4.23; 95% CI 2.14-8.38) of having an indoor fall compared with people with no physical difficulties.¹⁴²

A history of previous falls has been identified as a risk factor for falls among older adults. An American study investigating the risk of re-injury in relation to time since first fall injury found 56% of people aged 15 to 64 years of age who had been hospitalised as a result of fall, were hospitalised or died as a result of a subsequent fall in the next five years. This compares with only 34% of people injured in motor vehicle crashes who were reinjured as a result on another crash.¹⁶³ Stenbacka *et al.* in a population-based cohort study reported both males and females aged 30 to 59 years were at increased risk of injurious falls (hospitalisation or death) if they

reported previous injuries, compared with those aged 20 to 29 years. The relative risks were 2.06 (95% CI 1.14-3.77) and 2.11 (95% CI 1.08-4.14) respectively.¹⁰⁵

The daily use of hypnotics or sedatives among women aged 60 years or younger has been shown to increase fall risk (RR=1.50; 95% CI 1.03-2.19).¹⁰⁵ Benzodiazepine use among adult ED presentations for falls has been reported as 9.5% for males and 2.4% for females.⁵³

3.2.3 *Physical activity*

Higher levels of leisure time activity among middle-aged and older adults have been identified as an independent predictor of outdoor falls with a dose response relationship evident.¹⁴² Following adjustment for confounders, people in the 5th quintile (\geq 185) of metabolic equivalents of leisure-time physical activity per month had more than double the risk (OR 2.15; 95% CI 1.36-3.41) of an outdoor fall compared with people in the 1st quintile. Similarly, a cohort study examining risk factors for injurious falls among adults resulting in hospitalisation reported a nonsignificant increase in risk associated with regular vigorous physical exercise (RR 1.45;95% CI 0.71-2.99).¹⁰⁴

3.2.4 Fatigue

Frequent sleeping problems were associated with an increased risk of two or more injurious falls in a cohort of 4,023 Swedish adults (OR= 3.67; 95% CI 2.56-5.25).¹⁰⁵ A strong dose-response relationship was found between hours worked and fall risk in a study of fall-related injuries among agricultural households.¹⁶⁴

3.2.5 Living alone

Living alone significantly increased the risk (RR=2.69; 95% CI 1.56-4.64) of sustaining two or more injurious falls in a Swedish population-based cohort study of adults aged 20 years and older.¹⁰⁵ In multivariable analyses the risk was twice as high for males (RR=2.69; 95% CI 1.56-4.64) compared with females (RR=1.22; 95% CI 0.62-2.39) in those aged 60 years or less.

3.3 Summary

Few studies have examined the role of alcohol in unintentional falls among young and middleaged adults. Evidence found in the systematic review discussed in Section 3.2 suggests that acute alcohol use increases the risk of unintentional falls among young and middle-aged adults. There is some evidence of a dose-response relationship with acute alcohol use. Evidence of any gender difference is inconsistent. There is inconclusive evidence of an association between usual alcohol use and fall risk in this age group. These findings provide compelling rationale for studying this relationship further. The use of community-based controls, adequately powered population-based studies, consideration of confounding effects, and valid measures of acute and chronic alcohol consumption are considered necessary improvements for future aetiological studies. The multifactorial nature of falls requires consideration of potential factors which may operate as confounders in the relationship between alcohol and falls such as fatigue, and recreational drug use.

CHAPTER FOUR: AIMS AND METHODS OF CASE-CONTROL STUDY

4.1 Introduction

This primary research reported in this thesis focuses on an investigation of the role of alcohol as a risk factor for unintentional falls. This research was conducted as part of the Auckland Falls Study, which aimed to identify and measure the contribution of a range of modifiable risk factors for unintentional falls at home resulting in hospitalisation or death among young and middle-aged adults. Recruitment of subjects for the study was carried out in the Auckland region from July 2005 to July 2006, and was funded by ACC. The role of the candidate in the conduct of the study has been described in Section 1.6.

Findings from the review of routinely collected data (Chapter 2) and the systematic review of the published literature (Chapter 3) helped inform decisions regarding the scope, study population and methodology for the Auckland Falls Study.

This chapter describes the conduct of the Auckland Falls Study with particular emphasis on the relationship between alcohol use and unintentional falls at home resulting in injury or death.

4.2 **Research objectives and hypotheses**

The main objective of the primary research presented in this thesis was to investigate the role of alcohol in unintentional non-occupational falls at home, and to quantify the contribution of alcohol and its determinants to the burden of unintentional fall–related injury among young and middle-aged adults. The overall purpose of this was to inform the development and targeting of injury prevention interventions.

The specific aims of this study were to determine the odds ratios and attributable risks for unintentional non-occupational falls at home resulting in death and hospitalisation associated with alcohol use.

The hypothesis being tested was:

Acute and usual alcohol use is associated with an increased risk of an unintentional fall at home among young and middle-aged adults resulting in hospitalisation or death.

4.3 Rationale for undertaking a case-control study

It would not be ethical to randomly assign individuals to drinking and non-drinking groups, and then measure their fall injury rate.¹⁰³ Therefore, a population-based case-control design was

chosen as the most appropriate design for addressing the aims of this research for several reasons. A population-based study enables measurement of the prevalence of exposures and the estimation of population-attributable risk. Unintentional fall injury is a rare event and is therefore suited to a case-control design.^{115 165} In addition the case-control methodology allows for the investigation of injury-related risk factors that are transient or have a short induction periods such as alcohol, fatigue and recreational drug use.¹¹²

The Auckland region has a number of characteristics that provide an environment suited to a population-based case-control study of injury. The region includes the largest concentration of the population of interest in the country, and all major ethnic groups are represented. Complete case ascertainment is achievable as inpatient trauma care for adults is exclusively provided by three general hospitals in the region, and individuals who die as a result of injury are notified to a single regional coroner's office.

The case-crossover study design would also have been a suitable methodology to examine the role of acute alcohol use in this study. The case-crossover methodology is suited to examining the effects of transient exposures which vary from time-to-time within a person (e.g. drug or alcohol use, fatigue, exercise etc) on the risk of acute-onset diseases and injuries.^{113 166 167} In case-crossover studies the case acts as their own control, thus controlling for between subject confounders.¹⁶⁸ The Auckland Falls study was designed to have a case-crossover component to investigate the role of acute alcohol use and fatigue on the risk of unintentional falls. Regrettably, a skip question was inadvertently placed in the questionnaire which meant that case-crossover analyses were not possible.

Cohort studies are an alternative design for investigating injury causality. In cohort studies a sample of the population is followed at intervals and postulated exposures (e.g. alcohol use) and outcomes (e.g. unintentional falls) are assessed.¹¹³ The design is most suited to investigating exposures that are stable over time¹⁰⁹ but not for short-term exposure associations and was therefore not suitable for the current study given the specific interest in acute alcohol use. In addition, the outcome of interest (unintentional non-occupational fall hospitalisations or deaths) has a low occurrence rate and therefore the numbers required for a cohort study and the length of time for follow-up would involve a prohibitively expensive study.

The main disadvantages of employing a case-control design are the additional threats to the study validity over and above those common in cohort studies, in particular as the result of selection bias and various information biases.¹¹² ¹¹³ ¹²⁶ Biases due to the selection of controls that do not accurately represent the source population, low response rates, and information biases arising from differential recall of information by cases and controls (recall bias) are the main concerns, along with confounding which ia a potential problem in all observational studies. The approaches used to minimise potential biases in this study are detailed in the following

description of the methods. The potential impact of biases is considered in the discussion of the study findings (Chapter 6).

4.4 Study design

4.4.1 Study base

The study base comprised young and middle-aged adults (25 to 59 years), residing in the Auckland region and registered on the New Zealand General and Māori electoral rolls for the region. Recruitment took place over a 12 month period between July 2005 and July 2006. The Auckland region comprises seven local territorial authorities (Rodney District, North Shore City, Waitakere City, Auckland City, Manukau City, Papakura District, and Franklin District). The Auckland region was a suitable setting for the study because it includes urban, suburban and rural settings; all major ethnic groups are represented; and it contains approximately 25% of the national population, approximately 600,000 of whom are aged 25 to 59 years.¹⁶⁹

4.4.2 Selection and recruitment of controls

In a case-control study, controls are used to estimate the prevalence of exposures in the population from which the cases have arisen.¹⁷⁰ The aim of control selection was to obtain a sample of the study base (people aged 25 to 59 years residing in the Auckland region, registered on the General and Māori electoral rolls for the region) to ensure an estimate of the exposure distribution in the population from which the cases came ("study base") could be obtained. The electoral roll is a comprehensive and up-to-date publicly available database of New Zealand citizens that contains identifying information. In New Zealand, 98% of people in the 25 to 59 year age group who are eligible to vote are on the electoral roll.¹⁷¹ Matching of controls to cases was not considered to be necessary and the advantages of matching – it precludes analysis of any matched factors¹⁷² – would almost likely outweigh any efficiency gains, which is the main benefit of matching. The principles outlined by Wacholder and Rothman were used to guide the selection of controls for this study.¹¹³ ¹²⁸ ¹⁷² ¹⁷³ A paper detailing the control selection process and results has been published in the *Australasian Epidemiologist* (Appendix Six),¹⁷⁴ the key points from this paper have been included in the Methods and Discussion chapters of this thesis.

Population-based controls aged 25 to 59 years were randomly selected from the electoral rolls for the Auckland Regional Council constituency (this included people on both the Māori and General rolls) during the 12-month study period July 2005 to July 2006. Controls were required to be able to complete the interview in English, or have a family member who could assist them with this. We sampled controls at a steady rate throughout the study period and measured exposures and history at the time of sampling to ensure the probability of selection as a control was independent of exposure status and proportional to the time contributed to the study base.¹⁷⁵ Controls were eligible to become a case, and in the event that this happened they

would be included in the study as both a case and a control.¹⁷⁵ ¹¹³ There were no offers of any financial or material incentives for participation in this study.

A letter was sent to potential controls inviting them to participate in the study. The letter included a brief introduction to the study and the research team and was accompanied by a participant information sheet, a consent form, an ACC falls prevention brochure, and a freepost return envelope.

Controls who returned a positive consent form were approached via telephone by study personnel to arrange a time at their convenience to be interviewed via telephone. If no postal response was received a follow-up phone call was made to establish if the person received the study letter and to inquire if they would like to participate in the study. Phone numbers were obtained from a telephone matching service. Three attempted phone calls were made and if all were unsuccessful the person was allocated "non-responder" status. If no response to the invitation to participate was received and no phone number was available then a study nurse visited their home to determine their responder status. If no-one was home a participant information sheet and note inviting the person to ring the study nurse was left in the mail box. If the person no longer lived at the property and there was a forwarding address available, the study information was resent, if not then the person was allocated "non-responder" status. The control recruitment process is summarised in Figure 5.





Controls were offered telephone interviews in the first instance with provision for face-to-face interviews if no phone access was available. Participants who returned consent forms by mail were interviewed by either the lead study nurse or the lead researcher. Towards the latter stages of control recruitment when home visits were required to contact those where no postal or phone contact was made, additional casual research nurses were utilised.

4.4.3 Identification and recruitment of cases

Cases were defined as people aged 25 to 59 years of age resident in the Auckland Region, on either the General or Māori electoral roll for the region, and who had a primary admission to one of the three general hospitals that admit adult trauma for the region or who were killed as a result of an unintentional non-occupational fall at home between July 2005 and July 2006.

Hospitalisation was used as a proxy for significant injury in this study. A number of factors can influence admission to hospital including injury severity, age of patient, availability of beds, time of day, hospital admission policy, availability of social support, and so on.¹²⁶ To account for these factors and to ensure a more reliable sample of moderate to serious injury cases were included in the study, hospitalisation was defined as a primary admission to a service other than the emergency department. These criteria are consistent with current recommendations for investigation of the occurrence of significant injury.^{80 176}

Cases were included if they were hospitalised within 48 hours of the fall event and were capable of giving informed consent, or had an acceptable surrogate (proxy) capable of giving consent on their behalf. The maximum period of 48 hours post injury was selected because the study relied on self-report of alcohol use which was a key focus of the study; this approach had been used in previous analytical studies examining acute alcohol use in relation to injury.¹⁰³ Cases were required to be able to complete the interview in English, or have a family member who could assist them with this.

Cases were excluded if they were in residential care at the time of their fall, or were not on the electoral roll for the region. If participants had more than one primary admission for a fall of this nature during the study period then only the first fall was included.

Admission registers of the three recruiting hospitals (North Shore, Auckland City, and Middlemore) were reviewed three times per week by the study research nurse during the study period to identify potential cases meeting the study inclusion criteria. Wherever possible, clinical staff introduced potential cases to the research team. Contact details of potential cases were recorded in the *Study Log* by the study research nurse. A daily admission report of people aged 25 to 59 years admitted to the respective hospitals with either an identified fall injury or injuries that were consistent with a fall injury were provided to the study research nurse. This report was

a quality assurance measure to ensure all potential cases had been assessed for study entry requirements.

Eligibility of cases was verified following a review of medical records by the study research nurse. Wherever possible, the study nurse made contact with potential cases during their hospital stay, at this point eligibility was confirmed, a detailed explanation of the study (including written material) provided, informed consent obtained, and a convenient time to interview the case established. If this was not possible or practical, face-to-face contact took place with the case following discharge.

Fatal cases were identified from the single coroner's office for the region. In New Zealand all injury deaths are investigated by a coroner, therefore complete case ascertainment for cases who died prior to or during hospitalisation could be achieved. Contact with family was made approximately six weeks after the fall event by letter, inviting the next-of-kin to consider taking part in the study as a proxy respondent. If the next-of-kin were agreeable, proxy interviews took place face-to-face at a convenient time.

4.4.4 Study size and potential recruitment rate

In order to estimate the appropriate study size to reliably measure the fall risk associated with the putative risk factors under investigation, it is necessary to know the incidence of hospitalisation and death due to falls, the prevalence of the risk factors of interest in the study base and the likely magnitude of their effect on fall risk. This study was designed to investigate a range of risk factors with varying prevalence's and potential effect sizes.

NZHIS data indicated on average 360 cases would be eligible for inclusion in a one year study. A response rate of 85% was assumed based on previous case-control studies,^{103 177-179} therefore approximately 306 cases would be recruited over the course of the study. This number would be sufficient to detect an odds ratio of 2.0 with 80% power and 95% confidence, for exposure present in 10 to 15% of the controls (Table 3) and a case control ratio of 1:1. This ratio was selected as it was acknowledged a priori that controls would be more expensive and more difficult to recruit than cases.

Based on the NZHIS data indications and the assumption of an 85% response rate, it was estimated that one year would be sufficient to recruit 308 cases.

Table 3: Case-control study sample size calculations						
Proportion of controls exposed						
	0.10	0.15	0.20	0.25		
Number in each group	308	261	187	163		

The study was not powered for subgroup analyses such as ethnicity, and type of fall.

4.5 Study procedures, recruitment and data collection

4.5.1 Study personnel

The research team included the candidate who was responsible for day-to-day management and overall coordination of the study, coordination of control recruitment, and interviewing a proportion of controls. A lead research nurse was employed to undertake the recruitment and interviewing of cases, and a proportion of the control interviews. Four part-time staff were employed to undertake the remainder of the control interviews. In addition three part-time staff assisted with data entry and study administration.

A study manual was developed by the candidate detailing the conduct of the study including recruitment procedures; copies of the data collection instruments, participant information sheets, consent forms; and data quality processes (Appendix Ten).

4.5.2 Data collection

A standardised structured questionnaire was developed based on the review of the epidemiological literature outlined in Chapter 3, and in consultation with the Study Advisory group which included clinicians, Māori and Pacific health experts, housing researchers, injury prevention experts and a consumer representative.

4.5.2.1 Data collection process

The lead study nurse, an experienced interviewer, administered the questionnaire to cases. Trained interviewers (the lead study nurse, the candidate, and three part-time research assistants) interviewed the controls. The interviews were structured and followed the guidelines detailed in the study manual (Appendix Ten). Introductory statements and questions were administered in a standardised fashion to minimise bias. If required the interviewers could answer queries regarding the meaning of questions, and provide assistance with calculating for example hours spent at home awake or number of standard drinks. Interpreters were not available for cases, however for both case and control interviews family members were used on occasion in this capacity. Proxy respondents were used for cases that had died or were unable to complete the interview due to the serious nature of their injuries. The interview took between 20 and 40 minutes to complete.

Control interviews were deliberately conducted during early evening or on Saturdays to accommodate the "working-age" characteristic of the population. However, some misclassification of exposures of interest with a temporal relationship such as recent alcohol use, sleep and recreational drug use may have occurred had we used the time of interview as the reference point in time for questions about these exposures. Therefore to avoid the introduction of this misclassification bias, controls were randomly assigned to an index day of the week from a prewritten list to use as a reference point for questions about recent exposures.

The times and dates on this list were based on the distribution of previous unintentional home fall admissions data.

The majority of case interviews were conducted face-to-face in hospital, the remainder occurring face-to-face at home. The majority of control interviews were conducted via phone, the remainder occurring face-to-face at home.

4.5.2.2 Questionnaire

The questionnaire contained items relating to a range of personal, household composition, lifestyle, and environmental characteristics and included putative risk and protective factors for unintentional falls (Appendix Ten). Where possible question items were replicated from previous falls or alcohol and injury related research.^{19 180-183} Home surveys were not undertaken therefore all information relating to the identification of fall hazards or protective factors was obtained by self-report.

The case and control participant questionnaires were identical with the exception of information collected from cases relating to the circumstances and consequences of the fall. To capture the severity of injury among cases, injury severity scores (ISS) were calculated by a trained ISS coder for all cases using data abstracted by the study research nurse from the medical records of cases. Additional information concerning the hospital admission was collected using the *Medical Record Abstract Form* (Appendix Ten).

The following sections will focus particularly on the measurement of primary exposures of interest (acute and usual alcohol use) and potential confounders.

4.5.2.3 Alcohol exposure measurement

In order to investigate the role of alcohol as a risk factor for injury it is important to determine alcohol use accurately.^{115 184} There are a range of individual level measurements of alcohol use that are relevant to injury research including: blood or breath alcohol levels; self–report; healthcare staff assessments; and reports by witnesses.¹¹⁵ The choice of reference period affects the way in which alcohol consumption can be assessed. Shorter reference periods (e.g. previous six hours, last week) can rely on exact recall and use quantity/frequency approaches such as describing the exact number, volume, and type of drink consumed.⁵⁹ Longer reference periods (e.g. periods (e.g. over one year) are recommended for assessing usual drinking patterns.

As the focus of the research was the role of alcohol in falls, obtaining estimates of acute and usual alcohol use was a key component of data collection. The measurement of both recent (acute) and usual alcohol use was by self report for both cases and controls. BAC levels were not systematically obtained for cases, they were however available for some cases.

The decision to measure recent alcohol use by self-reports was based on a number of reasons. Firstly, we needed to measure and be able to compare alcohol use at two time points (acute and usual) and a major advantage of self-report of acute alcohol use is it is not dependent on the timeliness of admission to ED following injury.¹³³ Secondly, breath or blood alcohol levels are not routinely collected by hospital staff in New Zealand, and it was not feasible to collect levels from controls due to the sampling method employed. Thirdly, there are a number of limitations associated with BAC including: delay from time of injury to time of sampling; cases may have consumed alcohol post injury; biased sampling (road traffic victims more likely to have BAC obtained than other injury types),¹⁰⁵ and sampling not a priority in situations when other more life-threatening situations take priority.¹¹⁵ ¹³³ Finally, previous research has demonstrated the validity of self-report of drinking measures based on the objective criterion of BAC estimates.¹⁸⁵ Self-report of alcohol use is a reasonable approximation of BAC, albeit prone to some degree of measurement error. In addition we were interested in comparing alcohol consumption for different time periods (e.g. 0 to 6 hours and 24 to 30 hours before injury) therefore we needed to rely on self-report for comparison. In addition self-report of acute alcohol consumption allows for measurement of a dose-response relationship.⁴⁶ Finally, it was important that we measured exposure in a way that could be easily translated for injury prevention messages.

To assess recent alcohol use in the period preceding the fall event in cases and the index time among controls we used the following questions. The questions were based on those used in the Auckland Car Crash Injury Study (ACCIS)¹⁷⁹ and developed in conjunction with Dr Jennie Connor^{ix}.

Had you had any alcohol in the 24 hours before the fall/survey?

- □1. Yes
- □2. No
- 3. Unknown / don't recall

What alcohol did you have to drink in the 24 hours before the fall/survey?

Standard drinks are defined as:
1 can/small bottle/handle (of beer) = 1 drink
1quart bottle of beer = 2 drinks
1 jug of beer = 3 drinks
1 flagon /peter of beer = 6 drinks
1 glass of wine/sherry = 1 drink
1 bottle of wine = 6 drinks
1 double nip of spirits = 1 drink
1 ready-to-drink = 1 drink
NB for low alcohol drink ½ the number of drinks
(Number of drinks)
Unknown / don't recall

How long before the fall/survey did you stop drinking?

Hours minutes

^{ix} ACCIS co-investigator and researcher working in the field of alcohol and drug involvement in car crashes. Senior Lecturer Epidemiology, Department of Preventive and Social Medicine, University of Otago, New Zealand.

Unknown / don't recall

What alcohol did you have to drink in the 6 hours before the fall/survey?

(Number of drinks) Unknown / don't recall

Similarly, establishing usual alcohol use was an essential component of the study. Information on usual drinking patterns was ascertained using the Alcohol Use Disorders Identification Test (AUDIT), with a score of eight or more indicative of a hazardous pattern of alcohol use.^{186 187} The test consists of 10 screening questions which include the following:

How often do you drink alcohol?

- 1. Never (proceed to question 108)
- 2. Monthly or less
- \square 3. 2 to 4 times a month
- \Box 4. 2 to 3 times a week
- 5. 4 to 5 times a week
- \square 6. Daily or almost daily
- 7. Unknown / don't recall (proceed to question 108)
- 8. Refused

How many standard drinks do you have on a typical day when you drink?

Standard drinks are defined as:

1 can/small bottle/handle (of beer) = 1 drink 1quart bottle of beer = 2 drinks 1 jug of beer = 3 drinks 1 flagon /peter pf beer = 6 drinks 1 glass of wine/sherry = 1 drink 1 bottle of wine = 6 drinks 1 double nip of spirits = 1 drink 1 ready-to-drink = 1 drink

NB for low alcohol drink ½ the number of drinks

(number of drinks)

Unknown / don't recall

How often do you have \dots (for men have 6 / for women have 4) or more drinks on one occasion?

- 1. Never
- 2. Less than monthly
- 3. Monthly
- 4. Weekly
- 5. Daily or almost daily
- 6. Unknown / don't recall
- 7. Refused

How often during the last 12 months have you...

a) Found that you were not able to stop drinking once you had started?

- b) Failed to do what was normally expected from you because of your drinking?
- c) Had a drink first thing in the morning to get yourself going after a heavy drinking session?
- d) Had a feeling of guilt or regret after drinking?

e) Been unable to remember what happened the night before because you had been drinking?

The response options for these questions were as follows

- 1. Never
- 2. Less than monthly
- 3. Monthly
- 4. Weekly
- 5. Daily or almost daily
- 6. Unknown / don't recall
- 7. Refused

Have you or someone else been injured as a result of your drinking?

- 1. Yes, but not in the last 12 months
- 2. Yes, during the last 12 months
- □3. No
- 4. Unknown / don't recall
- 5. Refused

Has a friend, doctor, or other health worker been concerned about your drinking or suggested you cut down?

- 1. Yes, but not in the last 12 months
- 2. Yes, during the last 12 months
- □3. No
- 4. Unknown / don't recall
- 5. Refused

4.5.2.4 Measurement of potential confounders

Potential confounding variables identified from the literature relating to unintentional falls included age, gender, ethnicity, BMI, living circumstances, recreational drug use, and socioeconomic status. This section describes how these variables were assessed.

Age was calculated by subtracting the self-reported date of birth from the date of interview. **Gender** was self reported. **Ethnicity** was determined by self-identification using the Statistics New Zealand 2001 Census ethnicity question and classified to Level 2 as recommended in the Ministry of Health's *Ethnicity Data Protocols for the Health and Disability Sector*.¹⁸⁸

Body mass index was calculated from self-reported height and weight information.

Living circumstances were self reported and derived from responses to the following questions.

How many other adults (≥18 years) live in the same household as you?

- \Box \Box (Number of adults)
-] None

Unknown / don't recall

Do any children (<18 years of age) live in the same household as you?

(Number of children)



None Unknown / don't recall

Recreational drug use

Usual patterns of use and potential intoxication with recreational drugs at the time of fall or index

time (for controls) was assessed from the following questions based on the ACCIS.

Have you ever used recreational drugs?

(This includes hash, hash oil, cannabis, grass, pot "smoking dope", speed (amphetamines), datura, LSD (acid), heroin, morphine, methadone, cocaine, ecstasy, amyl nitrate (rush, poppers, ram), solvents (glue, gas, plastics), mushrooms, P, "party pills", "herbal highs" and others).

- □1. Yes
- 2. Never
- 3. Unknown / don't recall

Have you used any marijuana during the past 12 months?

(This includes hash, hash oil, cannabis, grass, pot "smoking dope")

- □1. No
- 2. Less than once a month
- 3. Once a week to once a month
- 4. Several times a week
- 5. Every day
- 6. Unknown / don't recall

Had you used marijuana in the 3 hours before the fall/survey?

- □1. Yes
- _____2. No
- 3. Unknown / don't recall

Had you taken any other recreational drugs in the 3 hours before the fall/survey?

(This includes speed (amphetamines), datura, LSD (acid), heroin, morphine, methadone, cocaine, ecstasy, amyl nitrate (rush, poppers, ram), solvents (glue, gas, plastics), mushrooms, P, "party pills, "herbal highs" and others)

- □1. Yes
- 2. No
- 3. Unknown / don't recall

Have you used any other recreational drugs during the past 12 months?

- □1. No
- 2. Less than once a month
- 3. Once a week to once a month
- 4. Several times a week
- 5. Every day
- 6. Unknown / don't recall

Socio-economic status

Three indicators of socio-economic status were used in this study: self-reported gross household income, self-reported paid employment status, and the New Zealand Index of Deprivation (NZiDep96).¹⁸⁹ ¹⁹⁰ The NZiDep is an individual level measure of deprivation consisting of a five-point socio-economic deprivation index incorporating eight questions designed to identify people who have had significant financial needs in the previous 12-months. The eight questions, listed, have two response options - yes or no.

In the last 12 months.....

a) Have you personally been forced to buy cheaper food so that you could pay for other things?

b) Have you been out of paid work at any time for more than one month? (Note defined as "no" for those who are full time care-givers/home makers)

c) Did you yourself get any income in the 12 months ending today from any of these sources? Domestic Purposes Benefit, Emergency maintenance allowance, transitional retirement benefit, sickness/invalids benefit, widow's benefit.

d) Have you personally put up with feelings of cold to save heating costs?

e) Have you personally made use of special food grants or food banks?

f) Have you personally continued wearing shoes with holes because you could not afford replacement?

g) Have you personally gone without fresh fruit and vegetables, often, so that you could pay for other things you needed?

h) Have you personally received help in the form of food, clothes or money from a community organisation?

4.5.2.5 Information collected on non-participants

Some non-identifiable data were available for eligible cases and controls who did not participate in the study. For controls only gender and NZiDep data were available. For cases information on gender, age, and ethnicity was available.

4.5.3 Data management and analysis

4.5.3.1 Data editing, entry, and quality checks

Completed data forms were checked by the interviewer immediately post-interview and any missing data obtained either from the participant or their medical record. A database was developed for the study using EpiData Version 3.1,¹⁹¹ range and logic checks were included in the database. Data were entered directly from the data forms into the database by an experienced data entry staff member. Weekly team meetings were held with the lead study nurse and the data entry person to monitor recruitment and the data entry processes.

Every 10th questionnaire and *medical abstract* form was audited by a second member of the data entry team. These data forms were compared with the original database entry for keying errors. Any discrepancies were recorded on the *Data Quality Check* sheet and where appropriate changes to the database or data forms were made by the lead study nurse.

4.5.3.2 Data analysis

The candidate undertook all analyses presented in this thesis, with the statistical guidance of Elizabeth Robinson. Analyses were performed using Excel and Stata 8.0⁸⁸ software.

Exploratory analyses were undertaken to initially investigate the distribution of exposure variables, potentially important confounders, and possible effect modifiers among the cases and controls. Frequency tables were used to assess the distribution of categorical variables. The

distribution of continuous variables were examined using histograms, if they were normally distributed the mean and standard deviation were used. Relevant cut-points were used to redefine continuous (e.g. age) and ordinal scales (e.g. AUDIT, ISS) as categorical variables. The choice of cut-points was guided by a number of principles identified by Rothman et al.¹⁷⁵ including: respecting meaningful boundaries present in the variable, ensuring reasonable numbers in each category, and awareness of categories used by previous researchers. Unadjusted odds ratios were then calculated.

All exposure variables considered in the main analyses of this research had less than 10% missing data. Imputations of missing data were not undertaken as it was considered unlikely that individual items would be missing at random.

Multivariable unconditional logistic regression analyses were undertaken to estimate the main effects of interest on the risk of unintentional fall injury, independent of the effects of known confounders. Potential confounding variables were assessed for inclusion in the models by using Greenland's change in estimate method, using a cut point of 5%.¹⁹² Variables were added to a basic model which included age and gender. The most parsimonious model has been used, that is one that takes on an efficient approach to the number of variables and assumptions in the analysis. The models were repeated with interaction terms included to assess the statistical significance of any interaction between exposure variables of interest and any potential effect modifiers.

Population Attributable Risk (PAR), or aetiologic fraction, is the proportion by which the incidence of *disease* (in this case fall injury) would be reduced if a specific exposure (or risk factor) was eliminated from the population. ^{112 165} The measure takes into account the number of people exposed to risk in a population. For example, there may be a risk factor with a high relative risk but which is not an important public health issue because very few individuals are exposed to it.¹⁹³ PAR is a characteristic of the specific population studied, and is determined by both the prevalence of the exposure and the magnitude of the effect of that exposure on the risk of interest among the population studied.¹⁹⁴ The following formula from Coughlin was used to calculate the population-attributable risks in this study:¹⁹⁴

Attributable fraction = $p_e(RR - 1)/[p_e(RR - 1) + 1]$

4.6 Ethical considerations

The study protocol was reviewed and approved by the Northern Regional Ethics Committee and by the relevant hospital research boards and Maori research committees for the three hospitals from which cases were recruited. Written consent was obtained from cases during face-to-face interviews, and controls who posted back their consent forms. In situations where face-to-face contact was not made with participants, such as telephone interviews, study information was given over the telephone and verbal consent obtained. Participants were advised they could withdraw from the study at any time or refuse to answer any question without giving a reason.

All identifiable information was stored separately and securely from the data forms, with individual identifying information remaining confidential to the researchers only.

CHAPTER FIVE: RESULTS

5.1 Introduction

This chapter presents the results of the Auckland Falls Study, focussing on the role of alcohol in the causation of unintentional falls at home among young and middle-aged adults that result in hospitalisation or death. The chapter has three parts and begins with a description of the study numbers and response rates, and the case fall characteristics. In part two the study base is described in detail. The final part of the chapter addresses the question "Is alcohol use an independent risk factor for unintentional falls at home resulting in injury?" Univariate analyses of the effect of the alcohol-related variables (acute alcohol exposure, and usual alcohol consumption) as well as potentially confounding factors are reported. Following this, multivariable logistic regression models investigate the effect of alcohol on fall related injury, controlling for confounding factors. Interactions are investigated and population-attributable risks relating to alcohol are calculated.

The main findings of the results from this research have been published in two papers, an additional paper has been submitted for publication, and a fact sheet produced. The key findings of these papers are reported in this chapter. The details of the publications are:

- Kool,B., Ameratunga, S., Robinson, E., Crengle, S., Jackson, R. Unintentional falls at home among working-aged adults: methodology and population control selection for a case-control study. *Australasian Epidemiologist*, 2008;15,1:14-17¹⁷⁴ (Appendix Six)
- Kool,B., Ameratunga, S., Robinson, E., Crengle, S., Jackson, R. The contribution of alcohol to falls at home among working-aged adults. *Alcohol,* 2008;42: 383-388¹⁹⁵ (Appendix Eight)
- 3. Kool,B., Ameratunga, S., Lee, M., Robinson, E., Crengle, S., Jackson, R. The prevalence of risk and protective factors in the home environment in a population-based survey of young and middle-aged New Zealanders. Submitted to *ANJPH* November 2008. (Appendix Seven)
- Kool,B., Ameratunga, S., Sultana, S., Richards, G. Research Bulletin No.3. Risk factors for serious fall-related injuries at home among working age adults, 2008. Auckland: Injury Prevention Information Centre¹⁹⁶(Appendix Nine)

5.2 Study numbers and response rates

5.2.1 Unintentional falls at home resulting in hospitalisation or death (Cases)

Of the 344 eligible cases identified during the study period, 335 (97.4%) completed interviews, 8(2.3%) declined, and there was one missed case (0.3%). No unintentional (at home) fall deaths occurred prior to hospitalisation during the study period in the age group of interest in the Auckland region. The characteristics of the case responders and those refusing to take part are shown in Table 4. There were too few refusals to make any statistical comparisons meaningful.

Characteristics	Responders (n = 335)	Refusals (n = 9)	All eligible cases (n = 344)
Gender	n (%)	n (%)	n (%)
Male	154 (46.0)	6 (66.7)	160 (46.5)
Female	181 (54.0)	3 (33.4)	184 (53.5)
Age group			
25-29	32 (9.6)	1 (11.1)	33 (9.6)
30-34	31 (9.3)	1 (11.1)	32 (9.3)
35-39	33 (9.9)	2 (22.2)	35 (10.2)
40-44	45 (13.5)	2 (22.2)	47 (13.7)
45-49	55 (16.5)	2 (22.2)	57 (16.6)
50-59	138 (41.3)	1 (11.1)	139 (40.5)
Ethnicity			
Māori	37 (11.0)	2 (22.2)	39 (11.3)
Pacific	29 (8.7)	1 (11.1)	30 (8.7)
NZ European	214 (63.9)	5 (55.6)	219 (63.7)
Other	55 (16.4)	1 (11.1)	56 (16.3)

Table 4: Characteristics of case responders	, refusals,	and total e	ligible
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The majority of case interviews were conducted face-to-face (n=227, 68.0%), almost a third were conducted by telephone (n=105, 31.4%), and two were conducted by a combination of face-to-face and telephone. Seven interviews (2%) were proxy interviews, and in all but one of these the proxy was a spouse.

5.2.2 Sample of the study base (Controls)

Of the 1299 individuals randomly selected from the electoral roll to take part as controls during the data collection period from July 2005 to July 2006, 570 (56.1%) could not be contacted, and 174 (23.9%) were found to be ineligible when contacted (Figure 6). Of the 555 who were eligible and contactable, 352 (63.4%) were interviewed.





Because of the sampling frame used there was limited data available on those who did not agree to take part. Individual level data were not available to assess the socio-economic status of control responders and refusals therefore the home address-based NZDep96 score was used. NZDep96 is a population level measure of deprivation that divides New Zealand into deciles based on the characteristics of people living in census area meshblocks (a meshblock has a population of between 150 and 300 people).¹⁸⁹ An NZDep96 score of 10 indicates that the census meshblock is in the least deprived 10% of the country. No significant differences were apparent between controls who took part in the study compared with those who refused to take part, by socio-economic status as measured by NZDep96 (x^2 7.35, p= 0.11) (Table 5). There were however significant differences by gender with control responders more likely to be male than female (x^2 5.04, p= 0.025). Overall the distribution of socio-economic status and gender among control responders was similar to the distribution among the total eligible controls (Table 5).

Characteristics	Responders (n = 352)	Refusals (n = 203)	Total eligible controls (n = 555)
Gender	n (%)	n (%)	n (%)
Male	144 (40.9)	100 (49.3)	244 (44.0)
Female	208 (59.1)	103 (50.7)	311 (56.0)
NZDep96			
1 to 2 least deprived	84 (25.4)	50 (26.6)	134 (25.8)
3 to 4	67 (20.2)	41 (21.8)	108 (20.8)
5 to 6	60 (18.1)	48 (25.5)	108 (20.8)
7 to 8	57 (17.2)	25 (13.3)	82 (15.8)
9 to 10 most deprived	63 (19.0)	24 (12.8)	87 (16.8)

Table 5: Characteristics of control responders and refusals

Eighty-two percent (n=287) of control interviews were conducted via telephone, the remaining interviews were carried out face-to-face. No proxy control interviews were undertaken.

5.3 Characteristics of the fall events

This section provides a brief summary of the characteristics of the fall events based on the information obtained from cases. Information discussed includes the type and location of fall, the time of day and day of week of fall, and the short term outcome following falls.

5.3.1 Type and location of fall

Of the 335 unintentional non-occupational falls at home, half (49.6%) were "*fall(s) on and from stairs/steps*" (ICD external cause code W05), followed by falls "*on and from ladders*" (W11)(16.4%) and falls "*out of or through building/structure*" (W13) (11.9%). There were significant differences in the mechanism of injury for males and females falls (p < 0.001). For females, nearly two-thirds (63.9%) of falls involved stairs or steps, and 11.1% involved ladders. For males, one-third (32.9%) involved stairs or steps, 22.6% were "*on and from ladder*"; and 19.4% were falls "*from out of or through buildings or structures*".

Cases were more likely to fall in their own home (n=272; 81.2%) than another's home (n=63; 18.8%) (p < 0.001). The majority of falls occurred outdoors (n=203; 60.6%), of these 29% (n=58) occurred on stairs, 20% (n=41) in or around the garden, 20% (n=42) took place on driveways or pathways, 14% (n=28) involved balconies, and the remaining 16% (n=33) of outdoor falls occurred on roofs, in garages or other places. Of the 123 (31.9%) falls which occurred inside the home, almost a third (n=39; 30%) occurred in living areas, 29% (n=38) took place on stairs or steps, both the bedroom (n=15) and kitchen (n=15) areas each accounted for 11% of falls occurring inside the home, 6% (n=7) took place in either bathroom or toilet areas, and the remaining 14% (n=18) took place in hallways, laundries or other places.

5.3.2 Temporal factors

Time of fall frequency peaked between 2 and 4PM (n=41), and was lowest between the hours of 4 and 6AM (n=5) (Figure 7). There was no statistically significant difference between the time of fall for males and females. The time of day for females to fall peaked during the period 9AM to 12PM, whilst males tended to fall slightly later in the day during the 3PM till 6PM period.

Falls were most likely to occur during the weekend with 22.7% (n=76) of falls occurring on Saturdays, and 19.1% (n=64) on Sundays. The pattern for males and females differed but not statistically. There were no significant differences in the distribution of falls by month or season.



Figure 7: Distribution of case falls by time of day of fall occurrence, by gender, n=333 (males n=153, females n=180)

5.3.3 Outcome of falls

The Injury Severity Score (ISS) is an anatomically based scoring system that provides an overall score (0 to 75) for patients with multiple injuries.¹⁹⁷ The median ISS for the fall cases was 4 (SD 3.94, range 0 - 29). There were no statistically significant differences in ISS by gender. Over sixty percent (62.5%) of individuals had an ISS between 4 and 8 (moderate injury), and 21.1% had an ISS of 9 or more (serious to critical).

The mean length of hospital stay was 4.91 days (SD 4.56), range 1 to 32 days. There were no statistically significant differences in length of hospital stay by gender. The majority of cases (97.3%, n=319) were discharged home.

5.4 Characteristics of the study base

This section describes the characteristics of the controls from the Auckland Falls Study who were randomly sampled from the study base from which the cases arose.

5.4.1 Demographic profile

5.4.1.1 Gender and age

As described in section 5.2.2, response rates were higher in females than males, leading to an under-representation of males and over-representation of females in the control population compared with the Auckland population. The younger age groups (25 to 39 years) among controls were underrepresented in the study with this age group contributing 29.1% of controls compared with 49.9% of the population for the region (Table 6).¹⁹⁸ Compared with the age distribution of the electoral population in the Auckland region, the controls participating in this study were most underrepresented in the youngest (25 to 29 years) and most over represented in the eldest (50 to 59 years) age groups.¹⁷¹

Characteristics	Participants (n= 352)	Proportion of Auckland region population 25-59 years (2001 census)
Gender	n (%)	
Male	144 (40.9)	47.8
Female	208 (59.1)	52.2
Age group (years)		
25-29	22 (6.3)	15.5
30-39	97 (27.9)	34.3
40-49	114(32.8)	28.9
50-59	115 (33.1)	21.2
Ethnicity		
NZ European	204 (58.0)	66.1
Māori	27 (7.7)	9.2
Pacific	35 (9.9)	10.5
Other	86 (24.4)	14.3
NZ Deprivation index scores		Salmond <i>et al.</i> NZ national estimates*
1: No deprivation characteristics	210 (59.8)	50.7
2: 1 deprivation characteristic	78 (21.6)	20.3
3: 2 deprivation characteristics	26 (7.6)	10.7
4: 3 or 4 deprivation characteristics	25 (7.3)	10.5
5: ≥5 deprivation characteristics	13 (3.8)	7.8

 Table 6: Baseline distribution of demographic characteristics of controls in the Auckland Falls

 Study compared with census data for the region

* Salmond, S., Crampton, P., King, P. *et al.* NZiDep: A New Zealand index for socio-economic deprivation for individuals¹⁹⁹

5.4.1.2 *Ethnicity and socioeconomic status*

Controls self-identifying as Māori, New Zealand European or Pacific were underrepresented compared with the general population for the region. The NZiDep index was used to assess socio-economic status, this is an individual level non-occupational, deprivation-based, socio-economic index.¹⁹⁰ Respondents were less deprived than Salmond *et al*'s national estimates.¹⁹⁹ This may simply reflect the lower levels of unemployment and higher median household income among residents in the Auckland Region compared with National estimates.²⁰⁰ Around 16% (n=56) of controls did not report their gross household income, and of those who did, over half (57.3%) reported annual incomes of \$70,001 or greater. These data have not been equivalised to reflect the size and the composition of the household. The median annual gross household income for New Zealand is \$57,947 (Household Economic Survey, 2008), but no regional figures are available.²⁰¹

The size of households varied with almost half (48%) living in two-person dwellings, 16% housed four or more people, and 9% were single-person households. The average household size was 3.5 persons; this is slightly higher than the average for the region (2.9 people).²⁰⁰ Over half (53.1%) of respondents had resided in their home for five years or more, a third for two to four years (33.8%). The average length of time was four years.

5.4.2 Prevalence of alcohol-related characteristics in the study base

5.4.2.1 Measures of acute alcohol use

Over one third (36.9%) of controls had consumed alcohol in the 24 hours preceding the index time assigned for the purposes of the study (Table 7). Females were less likely to have consumed alcohol in this period (x^2 5.77, p = 0.016). Only 24 (6.8%) controls had used alcohol in the six hours preceding their index time, with no statistically significant gender difference apparent for this variable.

Measure	Males (%)	Females (%)	Total (%)
	n=144	n=208	n=352
Alcohol use in prev	ious 24 hours		
No	55.6	68.3	63.1
Yes	44.4	31.7	36.9
Alcohol use in previous	s 6 hours		
(standard drinks)			
0	90.9	94.7	93.1
1	4.2	2.9	3.4
2	2.8	0.5	1.4
≥ 3	2.1	1.9	2.0

	Table 7:	Distribution	of acute measures	of alcohol use in	the study base,	by gender
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5.4.2.2 Measures of usual alcohol use

Around 20% of controls reported never drinking (Table 8). There were statistically significant differences in the distribution of usual frequency of drinking (AUDIT question 1), with males more likely to drink frequently than females (x^2 11.31, p = 0.045). Almost 20% of males reported drinking daily or almost daily compared with only 11% of females.

Overall 13.5% of controls met the criteria for potentially 'hazardous' drinking patterns (AUDIT \geq 8). Males were almost three times as likely to have this pattern of consumption as females (x^2 13.74, p < 0.001) (Table 8). National estimates indicate 17.7% of the total adult population have potentially hazardous drinking patterns (AUDIT \geq 8).²⁰²

Measure	Males (%)	Females (%)	Total (%)
	n=144	n=208	11=352
Usual frequency of alcohol	use		
Never	14.6	23.3	19.7
Monthly or less	16.7	23.3	20.6
2 – 4 times per month	20.1	17.0	18.3
2 – 3 times per week	20.1	19.9	20.0
4 – 5 times per week	9.0	5.8	7.1
Daily or almost daily	19.5	10.7	14.3
Alcohol screen (AUDIT)*			
Low risk	78.3	92.2	86.5
Hazardous	21.7	7.8	13.5

Tahlo 8.	Distribution	of usual fr		f alcohol us	o in the stud	ly haso hy a	andor
i able o.	DISTUDUTION	or usual II	equency o	alconor us	e in the stud	iy base, by ye	ander

5.4.3 Prevalence of other characteristics in the study base

5.4.3.1 Risk and protective factors for falls

Traditional risk factors for falls in general and for falls in the home were also examined, in particular the relationship between socio-economic status and presence or absence of these factors. A paper summarising these findings has been prepared and submitted for publication to the *Australasian Journal of Public Health* (Appendix Seven). The main points from the paper are summarised in this section.

The factors of interest were identified from the relevant published literature and where possible, question items were drawn or adapted from previous falls research.^{19 180-183} Information was obtained from self-report. Direct observation in the home was not undertaken.

More than half (53%) the controls reported having indoor stairs in their homes (Table 9) and of these 88% had at least one set with three or more continuous stairs. The majority (86%) of responders' homes had outdoor stairs, and 81% had at least one set with three or more continuous stairs. Section D1 of the New Zealand Building Act (2004)²⁰³ requires that stairs with more than three risers have a handrail. Fifty-four percent of responders reported that at least one set of stairs with three or more consecutive stairs inside or outside their homes had no handrail or banister.

Ladder use during the past 12 months was reported by 64% of respondents (Table 9), one third of whom had used a ladder seven times or more during that time. Males (78%) were more likely to have used ladders than females (54%) ($x^2 = 21.39$, df = 1, p < 0.0001). There was no statistically significant association between age group and ladder use in the past year ($x^2 = 9.89$, df = 1, p = 0.13).

Of the 294 respondents who had baths at home, only 9% reported the presence of grab or hand rails near the baths and 42% reported using antiskid bath mats or having antiskid surfaces in the bath. Only 11% of the 345 respondents with showers in the home had grab or handrails near or in the shower. Anti-skid mats or surfaces were present in 56% of showers. Most participants reported the lighting to be "adequate" in bathrooms (97%) or kitchen (90%). However, 21% of the sample reported being unable to reach a light from their bed.

Those reporting one or more individual deprivation characteristics (NZiDep) were less likely to have stairs indoors (44%, p= 0.007) or use a ladder (54%, p= 0.003) but more likely to have outdoor stairs (91%, p= 0.034) than those reporting no deprivation characteristics (Table 9). There was no statistical difference by socio-economic status with respect to presence of a grab bar/ handrail in or near showers (p= 0.0503) or baths (p= 0.212), and antiskid mats/surfaces in or near showers (p= 0.953) or baths (p= 0.568).

	Sample	NZ individual deprivation characteristics			
Characteristics	(n = 352) % (95% Cl)	One or more deprivation characteristics (n=142) % (95% Cl)	No deprivation characteristics (n=210) % (95% Cl)		
Stairs					
Indoor stairs	53.1 (47.9-58.3)	44.4 (36.5, 52.6)	59.1 (52.3, 65.5)		
Outdoor stairs	86.1 (82.1-89.3)	90.9 (85.0, 94.6)	82.9 (77.2, 87.4)		
Ladder use Ladder use at home in past 12 months	63.6 (58.5-68.5)	54.2 (46.0, 62.2)	70.0 (63.5, 75.8)		
Bathroom *					
Grab bar/handrails near/in	8.5 (6.0-11.9)	10.6 (6.5, 16.7)	7.1 (4.4, 11.5)		
Antiskid bath mat/surface near/in baths	42.0 (37.0-47.3)	39.4 (31.8, 47.7)	43.8 (37.3, 50.6)		
Grab bar/handrail in/near showers	11.1 (8.2-14.8)	14.8 (9.9, 21.6)	8.6 (5.5, 13.1)		
Antiskid shower mat/surface in showers	55.7 (50.5-60.8)	54.2 (46.0, 62.2)	56.7 (49.9, 63.2)		

Table 9: Prevalence of selected environmental falls risk and protective devices in the homes of a study sample by NZ individual deprivation characteristics

In homes with more than one bathroom the bathroom most commonly used was the reference

5.4.3.2 General housing design issues

The majority of indoor stair surfaces were carpet (64.3%), followed by wood (23.2%). Outdoor stair surfaces were predominantly wood (50.5%), and concrete (37.1%). The most common kitchen flooring surface was linoleum (42%), followed by wood (27.3%). Tiles (39.8%) and linoleum (39.25) were the most common surface in the most used bathroom. Just under a third (n=103) of responders reported loose rugs on their kitchen floors; only half (54%) of these had slip-resistant backing.

Responders with an annual gross household income of less than \$70,000 were most likely to have linoleum on their kitchen (56.3%) and main bathroom floors (51.6%). In contrast those with an annual household income of greater than \$70,000 were more likely to have wooden kitchen floors (38.7%) and tiles (46.4%) on their main bathroom floor.

5.5 Is alcohol use an independent risk factor for unintentional falls at home resulting in serious injury among young and middle-aged adults?

5.5.1 Introduction

The analyses presented in this section quantify the association between the use of alcohol and the risk of unintentional non-occupational fall injury at home among young and middle-aged adults, by comparison of exposures among cases with the exposures in the study base (i.e. controls). The main exposures of interest are measures of acute (recent) and usual alcohol use. In order to examine the influence of potential confounders, other factors known or postulated to be determinants of fall injury from research in other settings and among older adults were also examined. The rationale for the use of these alcohol consumption measures and the examination of other potentially related factors has been described in previous chapters. The univariate analysis of these relationships is investigated, followed by an examination of potential confounding variables. Finally, the development of and results of multivariable models are presented. These models estimate the effects of the alcohol-related factors on fall-injury risk while controlling for the effect of known confounders. Potential interactions are considered and population-attributable risks reported for the identified risk factors.

5.5.2 Univariate analysis of effect of alcohol use and other factors on risk of fall injury

5.5.2.1 Alcohol use

The level of acute alcohol use preceding the fall or survey was established by using two reference periods, 24 hours and six hours. Approximately 45.6% of cases reported drinking some alcohol in the previous 24 hours compared with only 36.8% of controls. The crude OR for alcohol use in the previous 24 hours was 1.44 (95% CI 1.06-1.96) (Table 10). Approximately 28.1% of cases reported drinking some alcohol in the previous six hours, compared with only 6.8% of controls. The data for the amount of alcohol consumed (number of standard drinks) in the preceding six hours was categorised into four groups: "no drinks", "one drink", "two drinks", and "three or more drinks". Fall injury risk increased with the number of drinks consumed (Table 10).

Usual alcohol use was measured by two methods: AUDIT (Alcohol Use Disorders Identification Test)¹⁸⁶ screen to establish the presence of hazardous drinking behaviour; and the frequency of usual alcohol use. The AUDIT data were categorised as 'low-risk' (AUDIT= 0-7) and 'hazardous' (AUDIT \geq 8).¹⁸⁷ The prevalence of hazardous drinking (AUDIT score \geq 8) was 24.5% and 13.5% among cases and controls respectively. The OR for an AUDIT assessment of hazardous

drinking patterns was associated with an increase in fall risk (OR = 2.08; 95% CI 1.39 – 3.10). The risk of fall injury was not associated with the usual frequency of alcohol use (p = 0.74).

Factors	Cases (<i>n</i> =335)	Controls (n=352)		
	n (%)	n (%)	OR (95% CI)	P value
Alcohol use in previous 24-hours				
No	179 (54.4)	220 (63.2)	1.0	p = 0.020
Yes	150 (45.6)	128 (36.8)	1.44 (1.06, 1.96)	,
Alcohol use in previous 6-hours				
0	240 (71.9)	327 (93.2)	1.0	p < 0.001
1	13 (3.9)	12 (3.4)	1.48 (0.66, 3.29)	
2	16 (4.8)	5 (Ì.4)	4.36 (1.58, 12.07)	
≥3	65 (19.5)	7 (2.0)	12.65 (5.7, 28.08)	
Alcohol screen (AUDIT) 2 categories				
Low-risk	243 (75.5)	301 (86.5)	1.0	p < 0.001
Hazardous	79 (24.5)	47 (13.5)	2.08 (1.39, 3.10)	
Usual alcohol consumption frequency				
Never	62 (18.9)	69 (19.7)	1.0	p = 0.738
Monthly or less	57 (17.3)	73 (20.8)	0.87 (0.53, 1.41)	
2-4 times/month	55 (16.7)	64 (18.2)	0.96 (0.58, 1.57)	
2-3 times/week	73 (22.2)	70 (19.9)	1.16 (0.72, 1.87)	
4-5 times/week	29 (8.8)	25 (7.1)	1.29 (0.68, 2.44)	
Daily/almost daily	53 (16.1)	50 (14.3)	1.18 (0.70, 1.98)	

5.5.2.2 Physical and emotional wellbeing

Two or more prescribed medications were associated with risk of fall injury (Table 10). General health status, established using the most commonly used item of the SF 36 instrument²⁰⁴ did not show an association with a person sustaining a fall injury (p = 0.30).

A disability screening question from the 1996/97 *Disability in NZ Survey* (screening question 24)²⁰⁵ was used to establish if people needed help because of a disability. The analysis of this screen showed a non-significant increase in fall injury risk for people with disability (p = 0.18). There was no association demonstrated between history of previous fall/s requiring medical attention in the past 12 months and the risk of fall injury (p = 0.32). There were two cases that fell twice during the study period; as per the study protocol their second fall was excluded from analyses. Examination of their records revealed both were females, and both required the use of a wheelchair, and both falls involved transfer from or to their wheelchair. One of these subjects' sustained four falls requiring medical attention in the year prior to the index fall that led to her recruitment to this study, each of these falls occurred during transfer from her wheelchair (three occurring in the bathroom). The second subject had sustained three falls requiring medical treatment during the previous year, all occurred during transfer from her wheelchair to the toilet.

No association was found between a positive visual difficulty screen (VIP Falls Prevention Trial – VF-14 Baseline, question 1)²⁰⁶ and risk of fall-injury (p = 0.61). Neither a positive depression
screen²⁰⁷ (p = 0.81), nor being on antidepressant medication (p = 0.54) were significant factors in these analyses.

Factors	Cases (<i>n</i> =335)	Controls (n=352)	OR (95% CI)	
	n (%)	n (%)		P value
Prescribed medications				
0 to 1	255 (76.1)	307(87.2)	1.0	p < 0.001
≥2	80 (23.9)	45 (12.8)	2.14 (1.43, 3.20)	-
Conoral Health				
Evcellent	107 (32 1)	87 (24 0)	10	n = 0.302
Very good	113 (33.0)	136 (39 0)	0.68 (0.46, 0.99)	p = 0.302
Good	86 (25.8)	95 (27 2)	0.00(0.40, 0.00) 0 74 (0 40 1 11)	
Fair	22 (6 6)	27 (7 7)	0.66(0.35, 1.11)	
Poor	5 (1 5)	27 (7.7) 4 (1 2)	1.02(0.26, 3.9)	
1 001	0 (1.0)	+(1.2)	1.02 (0.20, 0.0)	
Need help because of a	disability?			
No	305 (91.3)	329 (94.0)	1.0	p = 0.180
Yes	29 (8.7)	21 (6.0)	1.45 (0.83, 2.67)	
Number of provious fol				
modical attention in pas	t 12 months			
	317 (05.8)	324 (03 1)	10	n = 0.323
1	12 (3.6)	21 (6 0)	0.58 (0.28 1.21)	p = 0.323
> 3	2(0.6)	21(0.0)	0.50(0.20, 1.21) 0.68(0.11, 4.11)	
20	2 (0.0)	5 (0.9)	0.00 (0.11, 4.11)	
Difficulty small print, ev	en with glasses			
reading?	-			
No difficulty	264 (79.0)	292 (83.0)	1.0	p = 0.613
A little	53 (15.9)	53 (12.5)	1.33 (0.86, 2.05)	
Moderate	12 (3.6)	11 (3.1)	1.20 (0.52, 2.78)	
Great deal/unable to	5 (1.5)	5 (1.4)	1.11 (0.32, 3.86)	
do the activity				
Positive depression scr	een			
No	250 (76.2)	264 (75.4)	1.0	p = 0.810
Yes	78 (23.8)	86 (24.6)	0.96 (0.67, 1.36)	,
		,		
Currently prescribed an	ti-depressant			
medication	000 (01 1)	040 (00 4)	4.0	
NO	296 (91.1)	316 (92.4)	1.0	p = 0.536
Yes	29 (8.9)	26 (7.6)	0.84 (0.48, 1.46)	

Table 11: Self-reported physical and	emotional wellbeing and risk	of fall injury: Univariate analysis
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5.5.2.3 Sleepiness

Two measures were used to determine chronic sleepiness in this study: the absences of at least one full night's sleep in the past week, and work patterns (types of shifts worked). Neither of these measures was associated with an increase in risk of a fall injury.

The quantity of sleep in the preceding 24 hours and the Stanford Sleepiness Scale and were used to assess acute sleepiness. The Stanford Sleepiness Scale is a seven point self–rating scale that quantifies progressive steps in acute sleepiness.^{208 209} This scale was used to assess sleepiness immediately prior to the fall (for cases) or index time (for controls). However, the scale is intended for use in people who are awake, and we had not anticipated that a number of

controls would be asleep for their index time. This is likely to introduce bias to the association between sleepiness and fall-related injury (in effect, minimising the risk or suggesting a protective effect), therefore this measure was not considered further in this study.

A threshold of at least five hours in the preceding 24 hours was used to assess quantity of sleep.²¹⁰ There was an increase in risk of fall injury associated with acute sleep deprivation of five hours or less sleep in the preceding 24 hours (Table 12).

Factors	Cases (<i>n</i> =335)	Controls (n=352)	OR (95% CI)	
	n (%)	n (%)		P value
Sleep in last week				
At least one full night's				
sleep [†]	263 (81.2)	301(86.0)	1.0	p = 0.091
No full night's sleep	61 (18.8)	49 (14.0)	1.4 (0.94, 2.15)	
Work pattern (paid work)				
Daytime or rotating shifts without nights	176 (85.9)	237(85.0)	1.0	p = 0.145
Irregular or other	14 (6.8)	30 (10.7)	0.62 (0.32, 1.22)	
Rotating shifts with nights or permanent nights	17 (7.3)	12 (4.3)	1.68 (0.76 – 3.68)	
Sleep in previous 24 hours				
> 5 hours	273 (87.2)	321 (92.0)	1.0	p = 0.0406
< 5 hours	<u>/0 (12 8)</u>	28 (8 0)	1 68 (1 01 2 70)	<i>p</i>
≥ 0 H0015	40 (12.0)	20 (0.0)	1.00 (1.01, 2.79)	

Table 12:	Self-reported mea	sures of sleepiness	and risk of fall inju	rv: Univariate analvsis
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[†] = 7 hours or more

5.5.2.4 Lifestyle factors

The level of usual self-reported physical activity was assessed using the New Zealand Physical Activity Questionnaire (NZPAQ-SF).²¹¹ Having less physical activity than the national recommended weekly guidelines (30 minutes or more of moderate exercise, or 15 minutes or more of vigorous exercise) doubled the risk of fall injury (Table 13).²¹²

There was evidence of an association between smoking and risk of fall injury. Past smokers had one and a half times, and current smokers double, the risk of fall injury compared with those who had never smoked. The self-reported use of marijuana in the three hours preceding the fall or survey was associated with a more than threefold increase in risk. There were insufficient control numbers of affected subjects to assess the association between the use of recreational drugs other than marijuana and the risk of fall injury.

Time spent at home awake was considered "exposure time". The mean amount of hours spent at home (or another's) awake was 63.4 and 61.4 for cases and controls respectively; this factor was not associated with risk of fall injury (p = 0.21).

Factors	Cases (<i>n</i> =335)	Controls (n=352)	OR (95% CI)	
	n (%)	n (%)		P value
Physical activity: ≥30 mi ≥15 minutes vigorous exe	nutes moderate or rcise on ≥5 days /			
Yes No	82 (24.7) 250 (75.3)	139 (39.5) 213 (60.5)	1.0 1.99 (1.43, 2.76)	p < 0.001
Smoking Never Past Current	137 (41.1) 84 (25.2) 112 (33.6)	196 (56.3) 79 (22.7) 73 (21.0)	1.0 1.52 (1.04, 2.22) 2.19 (1.52, 3.17)	p < 0.001
Marijuana use in previou No Yes	us 3-hours 313 (96.9) 10 (3.1)	345 (99.1) 3 (0.9)	1.0 3.67 (1.00, 13.47)	p = 0.050
Average hours at home a Mean hours	awake per 7 days 63.4 (61.1–65.8)	61.4 (59.1- 63.6)	1.01 (0.99, 1.01)	p = 0.213

Table 13: Self-reported lifestyle factors and risk of fall injury: Univariate analysis

5.5.3 Potential confounders

The distributions of a range of socio-demographic characteristics and their associations (unadjusted odds ratios) with falls are presented in Table 14. These data were considered relevant as potential confounders of the relationship between alcohol use and risk of fall injury.

Age and gender

Age has been included in all analyses as a continuous variable due to the linear relationship between age and the risk of injurious fall at home. Fall injury risk increased with age. Gender was not associated with risk of fall injury (p = 0.16).

Ethnicity

Overall there was no clear association between ethnicity and fall-injury risk, although compared with New Zealand Europeans, there was a significant reduction in risk for those classified as "other" (OR=0.61; 95% CI 0.41-0.90).

Socioeconomic status

Socioeconomic status was determined using three self-report measures: paid employment, the New Zealand Deprivation Index,¹⁹⁰ and annual gross household income. Being unemployed was associated with increased risk of fall injury (OR=2.41; 95% CI 1.69-3.43). Overall there was evidence that increasing deprivation (based on NZiDep) was associated with increasing fall risk (p = 0.03).

Twenty-six percent of cases and 17% of controls refused to answer the gross household income question. As those who did not respond could have differed systematically from those who did, this measure was not used in further analyses.

Other factors

Living alone (OR = 1.56; 95% CI 0.84 – 2.90) did not show a statistically significant association with fall risk however the numbers of people living alone was small, so the estimates were imprecise. BMI showed no clear pattern of association with risk of fall injury, although obese people had a significantly increased risk (OR = 1.65; 95% CI 1.09 – 2.49) compared with normal weight individuals.

Characteristics	Cases (<i>n</i> =335)	Controls (n=352) Crude OR		
	n (%)	n (%)	(95% CI)	P value
Age group (years)				
25-29	32 (9.6)	22 (6.3)	1.0	p = 0.043
30-34	32 (9.6)	54 (15.5)	0.41 (0.20, 0.82)	-
35-99	33 (9.9)	43 (12.4)	0.53 (0.26, 1.07)	
40-44	44 (13.2)	57 (16.4)	0.53 (0.27, 1.04)	
45-49	55 (16.5)	57 (16.4)	0.66 (0.34, 1.28)	
50-54	59 (17.7)	56 (16.1)	0.72 (0.37,1.39)	
55-60	79 (23.7)	59 (17.0)	0.92 (0.49,1.74)	
Gender				
Female	180 (53.7)	208 (59.1)	1.0	p = 0.157
Male	155 (46.3)	144 (40.9)	0.80 (0.59, 1.09)	
Ethnicity				
NZ European	214 (63.9)	204 (58.0)	1.0	p = 0.034
Maori	37 (11.0)	27 (7.7)	1.36 (0.77, 2.22)	
Pacific Islands	29 (8.7)	35 (9.9)	0.79 (0.47, 1.34)	
Other	55 (16.4)	86 (24.4)	0.61 (0.41, 0.90)	
Socioeconomic status (in p	aid employment)			/
Yes	216 (65.1)	287 (81.8)	1.0	p < 0.001
NO	116 (34.9)	64 (18.2)	2.41(1.69, 3.43)	
Socioeconomic status (NZil	Dep)			
1: no deprivation characteristics	196 (60.7)	205 (59.8)	1.0	p = 0.024
2: 1 deprivation characteristic	52 (16.1)	74 (21.6)	0.73 (0.49, 1.10)	
3: 2 deprivation characteristics	39 (12.1)	26 (7.6)	1.57 (0.92, 2.67)	
4: 3 -4 deprivation characteristics	14 (4.3)	25 (7.3)	0.58 (0.29, 1.16)	
5: \geq 5deprivation characteristics	22 (6.8)	13 (3.8)	1.77 (0.87, 3.61)	
Living alone				
Yes	26 (7.8)	18 (5.1)	1.0	p = 0.159
No	309 (92.2)	334 (94.6)	1.56 (0.84, 2.90)	
BMI*				
Normal	139 (41.9)	171 (49.0)	1.0	p = 0.100
Underweight	12 (3.6)	9 (2.6)	1.6 (0.67, 4.00)	
Overweight	106 (31.9)	113 (32.4)	1.15 (0.82, 1.63)	
Obese	75 (22.6)	56 (16.0)	1.65 (1.09, 2.49)	

Table 14: Unadjusted	d odds ratios and 95%	confidence intervals	for socio-economic	variables
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*BMI = body mass index (normal 18.5 – 25; underweight < 18.5; overweight 26 – 30, obese >31)

5.6 Multivariable models

In the next phase of analysis unconditional logistic regression models were developed using Greenland's *change in estimate model*¹⁹² to examine the relationship between potential confounders and postulated risk factors and risk of fall (Table 15). Potentially confounding variables were added to the age and gender adjusted model (Model 1) if they were significant in the univariate analyses or if when added individually they resulted in a 5% or greater change in the odds ratio. Using this method age, gender, ethnicity, paid employment, and NZiDep were included in the models while living alone and BMI were not. Therefore the logistic regression displayed in Model 2 contains all the single risk factors considered significant following adjustment for potential confounders.

5.6.1 Alcohol use

There was an association between the risk of fall injury and acute alcohol use (within six hours) after controlling for age, gender, ethnicity, paid employment and deprivation. This association remained following adjustment for chronic hazardous drinking, prescription medication use, physical activity, and sleep in previous 24 hours, smoking, and marijuana use (Table 15). The odds ratios for two drinks or three or more drinks compared with no drinks were 3.53 (95% CI 1.18–10.53) and 13.12 (95% CI 5.29 – 32.52) respectively suggesting a dose-response relationship, although the confidence intervals surrounding the estimates are relatively wide reflecting the relatively small sample size.

A positive association was also apparent in the single risk factor model (Model 1) between a hazardous drinking pattern (AUDIT score \geq 8) and the risk of fall injury after adjustment for potential confounders. However, this association was attenuated when acute alcohol use (in the preceding six hours) and potential confounding factors were included in the regression model.

Factors	Model 1: Single risk factor model,	Model 2: including all risk factors	
	adjusted OR ^a (95% CI)	Multivariable adjusted OR ^b (95% CI)	<i>P</i> value ^c
Alcohol use in previous 6-hours			
0	1.0	1.0	p < 0.001
1	1.30 (0.57-3.00)	1.36 (0.57-3.26)	
2	3.78 (1.33-10.7)	3.53 (1.18-10.53)	
≥3	13.79 (6.02-31.6)	13.12 (5.29-32.52)	
Alcohol screen (AUDIT) 2 categories	S		
Low-risk	1.0	1.0	p = 0.762
Risky-harmful	2.09 (1.34-3.25)	0.92 (0.53-1.59)	
Prescribed medications			p = 0.023
0 to 1	1.0	1.0	
≥2	2.01 (1.30-3.14)	1.76 (1.08-2.88)	
Physical activity: ≥30 minutes moder 15 minutes vigorous exercise on ≥5 da	rate or ays / week		
Yes	1.0	1.0	p < 0.001
No	2.05 (1.44-2.91)	2.16 (1.46-3.21)	
Sleep in previous 24 hours			
> 5 hours	1.0	1.0	p = 0.300
≤ 5 hours	1.62 (0.94-2.79)	1.38 (0.77-2.57)	
	(
Smoking			
Never	1.0	1.0	p = 0.212
Past	1.61 (1.07-2.43)	1.49 (0.96 -2.33)	
Current	2.03 (1.35-3.04)	1.15 (0.71-1.85)	
Marijuana use in previous 3 -			
nours	4.0	1.0	
		1.U	p = 0.428
res	2.11 (0.05-11.10)	1.95 (0.37-10.21)	

Table 15: Risk factors significant in multivariable adjusted model

^a Model 1: Adjusted for age, gender, ethnicity, paid employment, and NZiDep

^b Model 2: Adjusted those variables in Model 1, plus the other variables in the model

^c Model 2 *p* value

5.6.2 Other factors associated with an increase in fall risk

Although not the primary exposures of interest, other factors that were associated with fall risk after adjustment for potential confounders in the multivariable model included subjects on two or more prescribed medications, and not meeting the national recommended weekly guidelines for physical activity (30 minutes or more of moderate activity or 15 minutes or more of vigorous activity at least 5 days).

Following adjustment for confounders sleep for less than five hours (in the previous 24), hazardous drinking patterns (based on the AUDIT score), cigarette smoking, and marijuana use within the preceding three hours were no longer statistically significantly associated with the risk of fall injury.

5.6.3 Population-attributable risks and interactions

Population attributable risk estimates and their confidence intervals were calculated using the formulae proposed by Coughlin's.¹⁹⁴ Unadjusted ORs were used in the formula as this was considered unlikely to introduce bias given the unadjusted and adjusted ORs for the major risk factors were similar (Table 15).

To calculate the PAR associated with acute alcohol use the variable 'alcohol consumed in *previous 6-hours*' from the multivariable model in Table 15 was collapsed into two categories: 'less than two drinks', and 'two or more drinks'. Drinking two or more alcoholic drinks in the previous six hours is associated with a PAR of 21% (95% CI 16 -26), suggesting 21% of unintentional falls at home among this population are attributable to drinking two or more standard alcoholic drinks in the previous six hours (Table 16).

In order to consider if fall prevention interventions should differ by gender interaction term was included in the multivariable model. There were no statistically significant interactions evident between alcohol use in the previous six hours and gender (p = 0.46). The presence of a potential interaction between hazardous drinking (AUDIT score ≥ 8) and acute alcohol use (within six hours) in relation to the risk of fall injury was also considered. Acute alcohol consumption increased fall risk for subjects with both low and high risk AUDIT scores. However, the interaction could not be formally tested in the multivariable model because of the small cell sizes in some strata of relevance.

Population-attributable risks were also calculated for other factors associated with an increase in fall injury risk. Taking two or more prescribed medications is associated with a PAR of 13% (95% CI 7 - 20). Undertaking less than the recommended level of weekly physical activity is associated with a PAR of 37% (95% CI 21 - 50), suggesting the incidence of risk of injurious falls could be reduced if people met the national recommended guidelines for weekly physical activity (Table 16). No statistically significant interactions relating to gender were evident in the associations between fall injury and inadequate physical activity (p = 0.76).

Factors	Cases n(%)	Controls n(%)	Unadjusted OR	PAR	95% CI
Alcohol use in previous 6-	hours				
<2	254 (76.0)	339 (96.6)	1.0		
≥ 2	81 (24.0)	12 (3.4)	8.89 (4.75, 16.7)	21%	16 – 26%
Prescribed medications					
0 to 1	255 (76.1)	307 (87.2)	1.0		
≥2	80 (23.9)	45 (12.8)	2.14 (1.43, 3.20)	13%	7 – 20%
Physical activity ≥30 moderate or ≥15 vigo exercise on ≥5 days / week Yes	rous minutes 82 (24.7)	139 (39.5)	1.0		
No	250 (75.3)	213 (60.5)	1.99 (1.43, 2.76)	37%	21 – 50%

Table 16: Population-Attributable Risks (PAR) for risk factors for falls

5.7 Summary

These findings suggest that drinking in the previous six hours has a strong and consistent relationship with the risk of unintentional non-occupational falls at home among young and middle-aged adults resulting in admission to hospital or death. This relationship remained when associations were adjusted for age, gender, ethnicity, paid employment and deprivation and other risk factors deemed potential confounders. A positive association was also apparent between hazardous drinking (AUDIT score ≥ 8) and the risk of having a fall injury. However, this association was attenuated when acute alcohol use (in the preceding six hours), and confounding variables were included in the regression model.

While they were not the primary exposures of interest, a positive association between risk of fall injury and taking two or more prescribed medications and having inadequate physical activity remained after adjustment for potential confounders.

The population-attributable risk estimates calculated for the risk factors identified demonstrated that these factors could make a significant contribution to the burden of fall-related injury in this population, assuming no important residual confounding. The avoidance of alcohol was estimated to have the potential to reduce the number of these injuries by up to 21%.

CHAPTER SIX: DISCUSSION

6.1 Introduction

The main aim of this thesis was to investigate the epidemiology of, and specifically the role of alcohol, in unintentional non-occupational falls at home among young and middle-aged adults, an area that has received relatively little epidemiological research attention. This final chapter starts with a brief overview on the significance of unintentional falls at home in this age group and current knowledge on the role of alcohol in these falls described in the systematic review (Chapter 3). This is followed by a discussion of the findings from the case-control study investigating the contribution of alcohol to falls of this nature. The relationship of these findings to previous research in the field is considered together with a critical appraisal of the methodology of the present study. Finally, the implications for research and prevention are explored.

6.2 Unintentional falls at home among young and middle-aged adults

The international research confirms falls in the home account for a high proportion of morbidity and mortality among young and middle-aged adults. Falls in this age group have received considerably less research attention than falls in older adults. There is a lack of published data both nationally and internationally focusing on the incidence, mechanism of injury, short term outcomes, and risk factors associated with unintentional falls at home among young and middleaged adults. In light of this, a review of routinely collected national injury data were undertaken to gain a New Zealand perspective on the size of the problem.

This review, described in Chapter 2, indicated that at least one third of unintentional falls in New Zealand resulting in inpatient admission or death among 25 to 59 year olds occur at home. For every fall-related death at home there are approximately 150 in-patient admissions. Females in this age group experience higher rates of hospitalisation for falls at home than males, but the reverse pattern is observed for fatal falls. The strengths of this review of routinely collected injury data are the use of national population-based data over a substantial period (10 and 12 years), the ability to identify broad categories in terms of the circumstances surrounding serious falls, and the opportunity to identify socio-demographic subgroups at increased risk of these injuries. The limitations of this review include the likely under-representation of Māori in these data; the focus on more serious injury (i.e. hospitalisations and deaths) which does not take into minor injuries some of which may result in significant longer-term disability; and the absence of

relevant contextual or exposure information about postulated or known risk factors at the individual level.

This is the first time a review of this nature focusing on falls at home among young and middleaged adults using New Zealand data has been undertaken and published. The findings of the review confirm the significance of falls among this age group as an important public health issue. The impact of injury in this population may have significant implications for both work productivity and family life.

In New Zealand a National Falls Strategy was released in 2004 signalling the commitment of the government and other agencies to reduce the rate and impact of fall injury in the community.⁷⁷ Priority areas identified in the strategy include falls in the home. The findings of this review of routinely collected data highlight the importance of developing injury prevention initiatives that are appropriate and effective for this younger population as well as those targeting older age adults. The incidence data obtained from this review provides useful baseline data to monitor the effectiveness of the national strategy in reducing the morbidity and mortality associated with unintentional falls at home among young and middle-aged adults.

6.3 What is already known about the role of alcohol in unintentional falls?

Central to the prevention of injuries resulting from falls is an understanding of the factors that contribute to the risk of having a fall. Risk factors for falls among elderly people have been extensively characterised in the literature and have been the focus of a number of systematic reviews. In comparison, risk factors for unintentional falls among young and middle-aged adults have received considerably less research attention.

The relationship between alcohol and injuries such as road traffic crashes, drowning and intentional injuries is well established in both younger and older adults. However, the published research investigating the role of alcohol in falls among older adults is equivocal and no studies have specifically investigated alcohol as a risk factor for falls in younger people. To establish what is currently known about the relationship between alcohol use and falls among young and middle-aged adults the literature was systematically searched for sub-group analyses involving this younger age group (Section 3.2, Chapter 3).

The systematic review found a limited number of epidemiological studies investigating the role of alcohol in non-occupational unintentional falls that included young and middle-aged adults. Studies examining the effect of acute alcohol use found a consistent positive relationship with falls in this age group although the estimates of risk varied with respect to magnitude and precision. There was some evidence of a dose-response relationship with acute alcohol use though again the estimates lack precision. Evidence regarding differences in this relationship by

gender was inconsistent. The studies reviewed revealed inconclusive evidence of an association between usual alcohol use and fall risk in this population.

The strengths of this review included: a systematic evaluation of the published literature using a comprehensive reproducible search strategy, making contact with experts in the field to assist in the identification of relevant research, and applying recommended criteria to critically appraise and synthesise the evidence. The limitations of this review included: the potential for publication bias and language bias as the review was limited to published English language abstracts.

The multifactorial nature of falls requires the consideration of other potential contributing causes, confounders, and consideration of interactions between alcohol and other factors such as fatigue and recreational drug use. To assist in identifying potential factors to be considered in subsequent primary analytical studies examining the role of alcohol in falls, a brief summary of the published literature was prepared (Section 3.3, Chapter 3). This review identified the following risk factors identified from the literature that may have a relationship with alcohol use and unintentional home fall risk among young and middle-aged adults: the daily use of hypnotics or sedatives among women aged 60 years or younger; a history of myocardial infarction, diabetes mellitus, 'poor or rather poor health', six or more physical difficulties, a history of previous falls, higher levels of leisure time activity, frequent sleeping problems, and living alone.

In summary, the systematic review of the literature demonstrated a paucity of analytical epidemiological studies examining the role of alcohol in unintentional falls among young and middle-aged adults. These findings suggest sufficiently powered population-based studies that consider relevant confounders are required to enable estimation of the fall injury burden attributable to acute and usual alcohol use.

6.4 What role does alcohol play in nonoccupational unintentional falls at home among young and middle-aged New Zealanders?

In order to address the research gap identified in the systematic review of the literature, the main research component of this thesis focused on a population based case-control study (The Auckland Falls Study). The study was undertaken to investigate determinants of these falls resulting in hospitalisation or death in the Auckland region, with a particular emphasis on the role alcohol plays.

6.4.1 Acute alcohol use and risk of fall injury

The case-control analyses suggest that acute alcohol use (drinking in the preceding six hours) has a strong and consistent relationship with the risk of unintentional non-occupational falls at home among young and middle-aged adults. This relationship remained when associations

were adjusted for potential confounding factors. There was evidence of a dose-response relationship. Compared with no drinks, the risk of a fall increased from three and a half times for two drinks to over 13 times for three or more drinks consumed in the previous six hours.

The acute alcohol results of this study are consistent with the findings of studies investigating acute alcohol use identified in the systematic review conducted as part of this thesis. Studies by Vinson¹⁰³ and Borges²¹³ reported increases in risk of at least two and a half times for alcohol consumed in the previous six hours compared with no alcohol use. A study by Kuendig et al published after the systematic review for this thesis was completed, noted an increase in risk of injury with increasing numbers of drinks consumed among ED admissions. Compared with non-drinking, the study reported a more than twofold increase in risk of fall injury for 'low' alcohol consumption (women $- \le 1$ unit, men $- \le 5$ units) within the previous six hours.²¹⁴

Previous studies have shown that the risks of fall injury associated with acute alcohol use are comparable with those for traffic injury. Borges et al in a case-control study of ED presentations reported a three to four fold increase in risk of falls and traffic injuries for breathalyzer readings of 10mg or more compared with readings of 9mg or less.¹⁰⁰ Vinson et al in a case-crossover study of ED injury presentations found around a threefold increase in risk for both falls and motor vehicle-related injury for any alcohol consumption in the six hours before injury compared with none.¹⁰³ A Swiss study of ED admissions reported greater adjusted odds ratios for falls (OR = 5.92; 95% CI 3.82 - 9.18) than transport-related injuries (OR = 4.26; 95% CI 2.41 - 7.53) among those who consumed a moderate amount of alcohol (women - two to three units, men - three to four units) within the previous six hours compared with no alcohol in the same time period.²¹⁴

In a case-control study of fatal injuries, the adjusted ORs for unintentional falls and motor vehicle-related injuries were 1.38 (95% CI 1.05,1.82) and 1.75 (95% CI 1.56, 1.97) respectively for current drinkers compared with abstainers and prior drinkers.¹⁰¹

Population-attributable risks (PAR) provide an estimate of the proportion of cases that are related to a given exposure. The PAR estimate calculated for acute alcohol use in the present study suggest that the avoidance of two or more drinks in the preceding six hours may reduce the burden of serious falls at home among young and middle-aged adults by up to 21%. The attributable risk is specific to the population studied (people on the General and Māori electoral rolls, aged 25 to 60 years residing in the Auckland region), and were derived from the prevalence of exposures and from the odds ratios in this study population. Nevertheless, these findings should be reasonably generalisable nationally as the study population was similar to the New Zealand population particularly with respect to alcohol use. Previous studies investigating ED presentations have reported all-cause injury PAR estimates for self-reported alcohol use (any alcohol) in the previous six hours ranging from 5.8% to 8.5%.^{215 216} The higher PAR of 21%

for two or more drinks found in the present study may reflect differences in the prevalence of alcohol use in this relatively young population, and the exclusion of acute alcohol consumption of less than two drinks. A recent emergency department study comparing injured surgical patients with non-injured surgical patients reported higher PAR estimates for falls compared with transport-related injuries for all three categories of acute alcohol consumption (high, medium, and low) compared with nil consumption in the previous six hours.²¹⁴

In our study acute alcohol consumption was associated with an increased fall risk for participants with both low and high risk AUDIT scores, suggesting this is not just a concern for problem drinkers. While the use of alcohol use in the six hours preceding the fall was associated with an increase in fall risk, there was no increase in risk associated with alcohol use within 24 hours of the fall after controlling for confounders.

6.4.2 Usual alcohol use and risk of fall injury

This study found that the apparent association between chronic hazardous drinking (AUDIT score \geq 8) and the risk of fall injury was attenuated when the analyses took into account the effect of acute alcohol use and confounders. The systematic review of the literature in this area found inconclusive evidence of an association between usual alcohol use and fall risk among young and middle-aged adults.

6.4.3 The prevalence of alcohol use among young and middle-aged adults

The information derived from control data in this study provided a description of the prevalence of alcohol use in a random sample of people aged 25 to 59 years in the Auckland region of New Zealand.

Around 20% of controls reported never drinking. Males were more likely to drink frequently than females, with almost 20% reporting drinking daily or almost daily compared with only 11% of females. The prevalence of drinking alcohol in the population-based studies included in the systematic review described in Chapter 3 ranged from 57% to 76%.^{98 100 101 217} This range is slightly lower than the 80% found in this study, which may reflect the younger age of our sample. Our findings are consistent with the New Zealand national estimate of 84% for adults aged 15 years and older.²⁰²

The National New Zealand Health Survey undertaken in 2006/07 estimates 18% of the total adult population have potentially hazardous drinking patterns (AUDIT \geq 8).²⁰² This is higher than the 14% found in this study. However, over 20% of males in the current study were classified as having 'hazardous' drinking patterns (AUDIT score \geq 8), compared with only 8% of females.

Over one third of controls in this study had consumed alcohol in the 24 hours preceding their index time; females were significantly less likely to have done so. Only 24 controls (6.8%) had

used alcohol in the six hours preceding their index time. This is consistent with epidemiologic studies examining acute alcohol use and injury risk among adults that have reported between 4% and 15% of the study base sample had consumed alcohol in the preceding four to six hours.^{100 102 103 217 218}

6.5 Other factors associated with increased risk of fall injury

Although not the primary focus of this research other factors found to be associated with falls at home among young and middle-aged adults in this study included insufficient physical activity and being on two or more prescribed medications. This study revealed a strong association between not meeting the recommended minimum weekly requirement for physical activity (at least 30 minutes of moderate or 15 minutes of vigorous exercise on at least 5 days) and the risk of unintentional falls at home resulting in hospitalisation or death. The findings are unlikely to be due to random error, however recall bias and residual confounding may have resulted in a modest inflation of the risk estimates. The increased risk associated with inadequate physical activity is generally consistent with previous research relating to this age group.^{102 142}

Being on two or more prescribed medications increased the risk of fall injury resulting in hospitalisation or death after controlling for the effects of confounding. This finding is consistent with fall risk factor research conducted among older adults.^{137 141 219-221}

6.6 Strength and weaknesses of this case-control study

The methodological limitations of previous studies investigating the role of alcohol in fall risk among young and middle-aged adults have been discussed in Section 3.2.3 of the systematic review. This section describes how the present study has attempted to address many of these limitations and identifies particular issues that nevertheless require consideration when interpreting the current findings.

6.6.1 Study design

A case-control study design was selected because this is an efficient way to study risk factors for relatively rare outcomes.¹¹² ¹²⁶ In addition the case-control methodology allows for the investigation of injury-related risk factors that are transient or have short induction periods such as alcohol, fatigue and recreational drug use.¹¹² Case–control studies are more efficient than cohort studies in terms of resource use and time.¹¹² ¹¹³ While biases relating to recall, selection issues, and confounding are inevitable in most observational studies, efforts were made to minimise the impact of these factors as described below.

6.6.2 Selection issues

The selection of study subjects plays a role in both the internal and external validity of a study.²²² The Internal validity of case-control studies relies on cases and controls being recruited from the same population or virtual cohort. Bias may arise if participating cases do not represent the exposure distribution of all cases in the study population, or if controls do not represent the exposure distribution of the whole study population from which the cases arose.¹¹³ External validity is the extent to which a study's findings are applicable to the other populations.²²² By using a large population-based study the findings are more likely to be generalisable.¹⁷⁵

6.6.2.1 Cases

This study attempted to identify all cases arising from the study base. Case ascertainment is likely to be close to complete because cases were recruited from all three hospitals admitting trauma patients of this nature for the region, and from the only Coroner's office in the region which investigates all deaths due to injury. Using this approach to case ascertainment as opposed to identifying cases from discharge codes helped to minimise selection bias.⁸²

Case response rate was very high (97.4%) so non-responders could not affect the representativeness of the cases who took part. The use of proxy interviews could potentially have introduced some systematic error in the results for specific exposures, however only seven interviews (2%) were conducted in this manner. All cases were able to complete the interview in English with none requiring assistance from family members.

6.6.2.2 Controls

The control information was obtained from a sample of the study base (all young and middleaged adults registered on the General or Māori electoral roll for the Auckland region). The use of a random sampling approach from an established population register was designed to ensure that eligible individuals had the same probability of selection as a control.¹²⁸ A key advantage of using population controls is the opportunity to estimate exposure distributions in the study base for the calculation of attributable risks.^{128 173}

Approaching people by mail proved problematic as it was difficult to establish who had received the letter of invitation. The response rate from potentially eligible control participants was disappointing but consistent with rates of participation amongst general population controls in other epidemiological studies.²²³⁻²²⁸

The disappointing control response rate in this study highlights the disadvantages of using population-based controls. General population samples may lack motivation to participate, there are difficulties making contact with those selected, and the amount of resource required to ensure high participation rates is substantial.

Selection bias may have arisen from the selective participation of subjects. Bias from nonresponse in controls could arise if those who never received the letter of invitation or who declined to take part differed systematically from those who did with respect to relevant exposures. Furthermore, some have argued that control responders, in general, are more health conscious than non-responders.²²⁶ The nature of the sampling method employed meant limited data were available for those who did not agree to take part in the study. No significant differences were noted between controls that were contacted and took part in the study compared with those who refused to take part by gender or socio-economic status (as measured by NZDep). Moreover, adjusting for factors known to be associated with poor response, including age and socio-economic status, should have reduced these biases to some extent. However, as with all observational study designs, residual confounding remains a threat to the internal validity of this study.¹⁷⁵

Three controls (0.009%) with limited English required the assistance of a family member to complete the interview this may have introduced a bias. It is not possible to confidently asses the direction of this bias however as the numbers are low it was not considered a major threat.

Potential alternative sources of controls suggested in the literature include neighbourhood controls, random-digit dialling, hospital or clinic controls, and dead controls.¹¹³ ²²⁹ A key advantage of neighbourhood controls is the ability to match on social class (from an area of residence perspective), while the disadvantages include the high costs associated with recruitment.²²⁹ The main concern with selection of controls by random-digit dialling is the inability to be assured of their representativeness of the general population. Increasing numbers of households use cell phones in preference to landlines,²²⁷ and response rates are often very poor and vary with socio-economic status. These problems can result in biased estimates of the effects of socio-economically patterned exposure distributions.¹⁷³ ²²⁹ ²³⁰ While controls selected from hospitals or clinics often result in higher response rates than those selected from the general population, problems arise in relation to their lack of representativeness of the study base given particular referral patterns to the hospital or clinic, and the fact that they are often not selected independent of exposures of relevance.¹⁷³ ¹⁷⁵

Key strategies suggested in the literature to improve community control response rates include the training, experience and personality of recruiters; the salience of the research topic; the appearance of postal material; and in-person approaches rather than initial telephone contact.²²³ ^{227 228 231} In the present study, strategies used to optimise control response rates included the use of interview staff with extensive previous case-control experience, the piloting and testing of participant information associated with the study to ensure its user-friendliness, in-person approaches to cases, and personalised written invitation to participate for controls. Continued efforts are required to improve control response rates in future case-control studies.

6.6.3 Information biases

Systematic error in a study arises when the information collected from or about study participants is incorrect.¹¹³ Information bias can be an issue for either exposure or outcome variables. Imprecise data collection instruments and the relatively crude classification procedures used in this study could have contributed to misclassification of exposure or outcome variables. Given the relatively small number of events in this study all unintentional falls at home had to be combined into one category. However, examination of the characteristics of the sub groups of fall types suggested for example that falls on the 'same level' were more likely to be associated with self-reported acute alcohol use (three or more drinks) than 'ladder-related' falls. The combination of these types of falls with potentially different associations with acute alcohol use, into one category may have introduced a form of outcome misclassification bias if the types of falls are aetiologically different.¹²⁶ Unfortunately this study was not designed to have sufficient power to undertake these subgroup analyses. This would be a useful approach to consider for future research activities.

Differential recall of information by cases and controls can result in recall bias.¹⁷⁵ Participants and interviewers in the study were aware of participant's outcome status when exposure data were gathered. In addition case interviews were conducted by only one interviewer, whereas control interviews were conducted by a number of interviewers. The majority of case interviews were conducted face-to-face, in contrast the majority of control interviews were conducted via telephone. There is potential for all of these factors to have differentially affected the way information was obtained from cases and controls. We attempted to minimise bias by ensuring that interviews were based on a structured questionnaire standardising the administration of exposure questions for cases and controls, that interviewers were trained to conduct the interviews in a uniform manner for both cases and controls and that they used a standardised set of relevant prompts.

The absence of an objective measure for acute alcohol use in this study may well have resulted in some misclassification bias. Self-reported information on alcohol consumption from cases offers the advantage that it is not dependent on the timeliness of presentation to hospital following injury.¹³³ Self-reports of alcohol use are subject to two main sources of error: forgetting, and denial or deliberate deception,¹¹⁵ both of which would lead to an underestimation of consumption. It is probably also reasonable to assume that cases are more likely than controls to underestimate their recent consumption. Therefore, given that acute alcohol use was found to be a risk factor for fall-related injury in this study, any potential misclassification would likely result in an underestimate of the effect size.¹⁷⁵

Blood alcohol concentrations (BAC) results were only available for cases for which the medical staff elected to take blood samples (16%), although recent alcohol use was recorded in the patient notes as suspected by medical staff in 25% of cases. BACs are frequently used in

epidemiological studies examining the role of alcohol in injuries. However, the prevalence of their routine collection among injury patients is low, with US estimates indicating only about 50% of trauma centres do so.¹²⁹

The relationship between BAC levels and self-reported acute consumption was not specifically compared in the current study as BAC levels were available for few cases and none of the controls. Previous research has shown the prevalence of denying drinking when registering a positive breath analysis is low (estimated to range between 0.4% to 3.6%) suggesting self-report of acute alcohol consumption may provide reasonably valid information.²³² ²³³ Research examining the validity of self-reported alcohol consumption prior to unintentional injury requiring hospitalisation among nondependent drinkers found men more frequently underreported their drinking than women.²³⁴

All exposure variables considered in the main analyses of this research had less than 10% missing data it is therefore unlikely that effect estimates were substantially affected by missing data.

6.6.4 Confounding

We undertook both unadjusted and adjusted analyses to help identify and reduce confounding by a range of relevant demographic, lifestyle and other variables. As with all observational study designs residual confounding remains a threat to the internal validity of this study.¹⁷⁵ Incomplete control of confounding will have occurred due to missing data on exposures of interest, misclassification of potential confounders, and measured and unmeasured factors that may operate as confounding variables. For example, high risk-taking dispositions (i.e. high impulsivity and low risk perception) have been linked to risky behaviours (e.g. binge drinking, low seatbelt usage, drink driving, and being driven by a drunk driver) and injury occurrence,²³⁵⁻²³⁹ but this possible confounder was not considered in our study. While risk-taking dispositions may have a relationship with both alcohol use and fall risk, it could also be argued that these personality traits are in the causal pathway between harmful use of alcohol and falls. For these reasons it was considered inappropriate to include these factors in the multivariable models.

Other factors not included in this study but worthy of future exploration include environmental factors such as household clutter, and physical or functional limitations such as gait impairments.

6.6.5 Precision

The study power calculations are discussed in Section 4.4.4. The projected sample size was achieved. However, as demonstrated by the relatively wide confidence intervals for some estimates (e.g. three or more drinks in the previous six hours.), a larger study would have been

useful to improve precision of the estimates. In retrospect the assumptions made about likely effect estimates were over optimistic.

6.6.6 External validity

The *external validity* of a study requires that the population being studied adequately represents the population to which one wishes to apply the findings.¹⁶⁵ This study was population-based and had few exclusion criteria. The key exclusion criterion that could have affected the representativeness of the sample was the requirement to complete the interview in English. However, the most recent census (2006) data indicates that 96% of New Zealanders speak English,²⁴⁰ so it is unlikely to have caused important bias. The controls were sampled from the General and Māori electoral rolls for the region. Around 98% of the New Zealand population in this age group who are eligible to vote are registered with Elections New Zealand.¹⁷¹ This criterion was also applied to cases to ensure consistency.

While fall injury cases who usually resided outside the region were excluded (consistent with the definition of the study base), this study did not include Auckland residents admitted to hospitals outside the region as a result of fall injuries sustained at home. Anecdotally the numbers of such cases are expected to be very low.

6.7 Meaning of the study and implications

This study has found a strong and consistent relationship after controlling for the effects of potential confounders, between: drinking in the previous six hours and the risk of unintentional non-occupational fall at home resulting in serious injury among young and middle-aged adults. There is evidence of a dose response relationship. Of significance, even low-levels of alcohol consumption were noted to increase the risk of fall injury at home.

The role of acute alcohol and unintentional non-occupational falls at home among young and middle-aged adults is a largely unrecognised problem that has received little research interest and minimal attention in the injury prevention field. The findings of this research suggest that even small reductions in alcohol consumption could lead to significant reductions in fall-related injuries at home. Such injuries are likely to have important adverse consequences in this age group given the potential impact on their economic productivity and the ability to care for dependents.

6.7.1 Future research

6.7.1.1 Acute alcohol use

Acute alcohol use has been identified in this study as an important factor in falls at home among young and middle-aged adults. The current study was inadequately powered to explore the relationship between patterns of drinking and risk of fall, the relationship between acute alcohol

use and different types of falls at home, the context in which drinking takes place and its relationship to acute alcohol use, or the relationship between sleepiness and acute alcohol use.

Crude analyses also showed an increase in risk for fall-related injury among people who had five hours or less sleep in the previous 24 hours. However, this effect was not apparent after adjustment for confounders. Evidence from road traffic crash aetiological studies indicates a strong relationship between acute sleepiness and risk of an injury crash.¹⁷⁹ Given the increasing recognition of the significant influences of sleepiness, fatigue and their association with other factors such as alcohol use, these relationships require careful investigation in future research in appropriately designed studies with large sample sizes.

6.7.1.2 Falls surveillance

The review of routinely collected national data on unintentional falls in the home in New Zealand conducted as part of this research found the place of the event was not recorded in 31% of hospitalisations and 15% of fatalities. A review of unintentional falls coded in NZHIS data as occurring in 'unspecified places' is required to ascertain the characteristics of the people who fall and the circumstances in which these injuries occur. This information will aid in better understanding the burden of all injuries resulting from falls at home, and will potentially assist with improving coding of this mechanism of injury in routinely collected data.

6.7.1.3 Contextual issues

The current case-control study was limited to the Auckland region which is a predominately urban environment with a temperate climate. Variations in characteristics of falls and context of falls may differ in rural regions and in areas with differing weather patterns. In order to capture risk factor and exposure information on the full spectrum of unintentional falls at home it would be desirable to undertake research involving participants from rural regions and other urban centres located in a range of geographic regions. The current study also had insufficient power to undertake ethnic specific analyses. The selection of areas with large Māori populations in future research will ensure studies are sufficiently powered to enable meaningful analysis of Māori-specific data.

6.7.1.4 The longer-term burden of falls in this age group

The current study did not investigate the consequences of falls of this kind including immediate and ongoing healthcare costs, quality of life, disability, and financial implications. These are important aspects to consider among the working-aged population given the potential for adverse impacts on economic productivity and family life. Opportunities exist for a prospective study that includes linkage of trauma registry and ACC data to investigate issues surrounding serious injury resulting from falls at home and early predictors of adverse outcomes.

6.7.2 Injury prevention activities

The findings of this study suggest that even small reductions in the harmful use of alcohol could lead to significant reductions in unintentional non-occupational fall injuries at home among young and middle-aged adults. The calculation of the population-attributable risk estimate of 21% for two or more drinks in the previous six hours compared with no alcohol provides policy-makers with evidence-based information about potential benefits of prevention activities.

The National Alcohol Strategy⁴⁷ released in 2001 identified three priority alcohol-related injury areas: road traffic crashes, drownings, and violence. The current research would suggest that consideration should be given to widening this focus to include falls in the home. The National Alcohol Action Plan: Consultation Document⁷⁵ released in 2008 identifies changing social norms, cultures and environments as key to minimising alcohol related harm. The plan highlights a number of "actions" that have the potential to impact on the responsible use of alcohol in homes.

Specific interventions to reduce the risk of fall injuries at home among young and middle-aged adults associated with alcohol use could include primary prevention efforts to raise public awareness of the potential risks and promoting and supporting responsible host policies including those relating to private residences. Secondary prevention strategies could include screening for alcohol abuse and brief interventions among hazardous drinkers in the ED and primary care settings.^{241 242}

A US study examining public perceptions of alcohol's contribution to fatal injuries found participants underestimated the proportion of fatal fall victims who were intoxicated and overestimated the proportion of motor vehicle crash drivers who were intoxicated.²⁴³ This study indicates a lack of awareness among the general public regarding the role alcohol plays in falls and a heightened awareness of the role alcohol plays in motor vehicle crashes. In New Zealand a study undertaken to measure people's perception of safety culture found 72% of people believe they are most likely to be injured on the roads. Only 49% of respondents felt that everyone is at risk of being injured at the home.²⁴⁴ This study highlights the relative under appreciation of injury risks at home. As identified by Smith et al, falls in the home and work settings are likely to share many common characteristics.²⁴⁵ ²⁴⁶ The role of alcohol in occupational injuries is emerging as a significant factor with studies indicating 14% to 20% of fatal occupational injury cases,⁹⁴ ²⁴⁷ and around 4% of non-fatal occupational injuries,²⁴⁸ testing positive for alcohol. These factors deserve greater attention in injury prevention strategies that transcend the boundaries of workplace and home.

There is compelling evidence highlighting the effectiveness of screening and brief intervention counselling targeting people presenting to ED's and trauma centers with an alcohol-related

injury.^{71 249-254} Brief interventions have been shown to be effective at reducing consumption and harmful events among nondependent drinkers.^{249 252 255-257}

The acute period following a traumatic event such as an injury-related presentation to hospital has been identified as a window of opportunity to encourage people to consider changing risky behaviours such as drink driving^{249 250 255} and in this instance a fall at home in which alcohol may have played a role. In spite of the evidence supporting the effectiveness of brief interventions in the acute post injury period, a recent review of the management of 120 trauma cases at a large New Zealand metropolitan hospital found no documented evidence of any formal alcohol screening interviews being conducted.¹³² These findings suggest there are significant missed opportunities to reduce alcohol-related problems.

The success of fall injury prevention activities depend on an understanding of the relationship between the risk factors and the settings where the events take place.²⁵⁸ As discussed previously there remain significant research opportunities to further understand these relationships among young and middle-aged adults who fall at home. Coupled with this, are the lack of evidence-based risk reduction interventions specifically for this group. The US Centers for Disease Control and Prevention recently supported the preparation of The Handbook of Injury and Violence Prevention (2007, Springer)²⁵⁸ a "comprehensive manual" that details interventions that have been proven to be effective across the life course. It is interesting to note that the chapter on falls focuses only on older adults, despite falls being the leading cause of non-fatal injuries treated in hospital ED's, and the third leading cause of unintentional injury deaths, across all ages in the US^x.

In New Zealand the situation is not dissimilar with the majority of falls prevention interventions focusing predominantly on those aged 65 years and older.⁴³ The New Zealand falls prevention strategy (Preventing Injury from falls: the National Strategy 2005-2015)⁴³ focuses on unintentional injury caused by falls. The Strategy goals are to reduce the incidence and severity of injury from falls, and to reduce the impact of falls on individuals, whānau and the community. The home is identified as a "priority setting" in the Strategy, however, young and middle-aged adults are not recognised as "priority groups". The Falls Strategy acknowledges a gap exists in the availability of evidence-based interventions to address falls among young and middle-aged adults. Opportunity exists to assess the effectiveness of proven falls interventions among older adults such as the Otago Exercise Programme,^{259 260} clinical assessment and referral or treatment,²⁶¹ and to explore novel interventions to reduce the morbidity and mortality associated with unintentional falls among young and middle-aged adults.

In 2002 ACC launched a "slip, trips and falls" public awareness campaign, targeting home injuries. Since that time the campaign has expanded to focus on falls from heights and do-it-

^x The National Vital Statistics System, National Center for Health Statistics, CDC, US.

yourself related injuries. The campaign has included a series of television campaigns targeting 25 to 55 year olds, and a variety of printed material. The complex nature of injury causation requires a multifaceted approach. The approach needs to engage with communities, social marketers, policy makers, legislators, enforcement agencies, health care providers, and advocates.²⁶²

This study has provided some simple evidence-based messages that can be employed in primary prevention strategies to raise awareness and educate the public regarding the role of alcohol in falls at home. To date the findings of this thesis have been published in three international journals (Appendix One, Six, and Eight), with two additional papers submitted for publication (Appendix Four and Seven). A further two publications are in draft form. In addition the findings of this study have been used in the following ways:

- The development of an Injury Prevention Information Centre fact sheet¹⁹⁶
- The development of teaching resources used in the national Foundations of Injury Control and Prevention Certificate
- Used in discussion with policy makers regarding injury prevention priorities and opportunities for intervention
- Presented at four international conferences, including the 9th World Injury Conference on Injury Prevention and Safety Promotion, Mexico where the paper detailing the alcohol findings won best oral presentation (Unintentional Injury Stream)
- Part of the information generated by this research has been presented around falls and alcohol in a video presentation for the 2008 Accident Compensation Corporation Safety Week campaign "Safety Begins at Home " (http://www.homesafety.co.nz/didyouknowpresentation/)
- Quoted in a North and South article on how to save your own life decade by decade²⁶³
- As a result of the research conducted for this thesis and subsequent research in the area the candidate has been invited to be a member of the New Zealand Injury Prevention Strategy Stakeholder Reference Group. The Group is made up of 24 injury prevention experts from across a variety of injury areas. The Group's purpose is to provide advice to the Minister for ACC (the sponsor of the NZIPS) and the Secretariat and to assist in the development of the Strategy's implementation plans. Appointments to the Group are made through the Government Appointments and Honours Cabinet Committee.

As is the case with much of the developed world, the consumption of alcohol is entrenched in New Zealand culture. While many people drink without causing harm to themselves or others,

the findings of this thesis indicate that even moderate amounts of alcohol can result in negative health effects including injuries which impose a considerable burden on society.

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APPENDICES

Appendix One: Injury paper





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Hospitalisations and deaths due to unintentional falls at home among working-aged New Zealanders

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KEYWORDS	Summary
Injuries; Accidental falls; Accidents; Home; Adults	 Aims: To describe the incidence and characteristics of unintentional fall-related injuries at home resulting in death or hospital inpatient treatment among working-aged New Zealanders. Patients and methods: Relevant data on all individuals aged 25–59 years meeting the case definition (using ICD-9-AM E codes E880-886, 888, and ICD-10-AM E codes W00-19) were obtained from the national morbidity (1993–2004) and mortality (1993–2002) databases compiled by the New Zealand Health Information Service. Results: Almost one-third of unintentional falls resulting in injury and a subsequent in-patient admission among working-age people were reported to occur at home. This is likely to be an underestimate as the place of occurrence of approximately one-third of falls resulting in a hospital admission was not documented. The average annual mortality rate from unintentional falls at home was 0.41 per 100,000 (95% CI 0.32–0.51) while the primary hospitalisation rate was more than 100-fold greater at 52.0 per 100,000 (95% CI 51.1–53.0). Rates of admission to hospital following a fall at home were three to four-fold greater among people aged 55–59 years compared to those aged 25–29 years. Conclusion: A significant proportion of unintentional fall-related injuries among the working-age population occur at home. Until the aetiology of fall-related injury in this age group is better understood, future research should focus on identifying modifiable risk factors that can be targeted to reduce the burden of these injuries and their consequences in a context where the adverse impact on economic productivity is particularly high. © 2006 Elsevier Ltd. All rights reserved.

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Introduction

Falls account for a significant burden of injury in New Zealand and were responsible for 43% of unintentional injury hospitalisations for the 1994–2003 period.¹⁰ Falls are also a major cause of injury death in New Zealand, accounting for 21% of unintentional injury mortality during the 1992–2001 period.¹⁰

The home is the most common location for injury hospitalisations and second to roads as the location for injury mortality.^{21,12,6,16,22} A US populationbased study found 54% of unintentional fall deaths occurred at home.²² A Scandinavian study of people aged 25–64 years of age sustaining an unintentional home injury requiring medical treatment reported 44% of injuries were as a result of falls.¹² New Zealand data on self-reported injuries requiring medical attention indicates nearly a third occur within the home.⁴ Home is the most common location for falls resulting in hospitalisation across all age groups in New Zealand.³¹

Falls among the elderly have received consider-able attention in the literature.^{25,32,17,24,9,28,20,27} In contrast falls among people of predominantly working-age (25-59 years) have received less attention.^{7,23,29} The impact of injury in this population may, however, have significant implications for both work productivity and family life.²⁹ For the 2004 Accident Compensation Corporation (ACC is New Zealand's accident compensation scheme providing 24-hour no-fault personal injury cover) financial year the 25–55 years age group accounted for over half of the \$150 million in ACC claims for moderate to serious falls in the home.¹¹ In this age group ACC new and ongoing entitlement claims for falls occurring in the home have risen by nearly a third from \$61 million (NZD) for the 2002–2003 financial year to \$81 million (NZD) for the 2004–2005 financial year.¹¹

The aim of this study was to describe the incidence and characteristics of unintentional fall-related injuries at home resulting in death or hospital inpatient treatment among working-age New Zealanders as a first step towards developing prevention initiatives. Ethical approval for the study was obtained from the Northern Regional Ethics Committee.

Methods

The study population included all people aged 25– 59 years with a primary in-patient admission to hospital for a fall-related injury occurring at home during 1993–2004 or who died as a result of an unintentional fall-related injury occurring at home in New Zealand during 1993–2002. The analysis used data from the national mortality and morbidity databases compiled by the New Zealand Health Information Services (NZHIS). The NZHIS morbidity database contains information on all in-patient admissions to New Zealand public hospitals; the mortality dataset contains information on all deaths registered in New Zealand. Only the primary inpatient admission for an event was used as opposed to discharge events, as the latter can result in readmission bias leading to overestimation of the occurrence of injury.² A minimum in-patient admission to hospital of overnight was selected to give a more reliable estimate of moderately severe and serious injury incidence.¹⁴

The NZHIS mortality dataset was searched for fatalities with an International Classification of Diseases (ICD) external cause of injury code for falls ICD-9-AM¹⁸ *E880-888* (1993–2000 data), and ICD-10-AM¹⁹ *W00-19* (2001–2004 data). Cases with the external cause ICD-9-AM *E887* (*fracture, cause unspecified*) were excluded as in ICD-10-AM this external cause is no longer included in the *Falls* (*W00–W19*) category and instead appears in the Accidental exposure to other and unspecified factors (X59 exposure to unspecified factor) category.

Primary hospitalisation cases were identified from the NZHIS morbidity dataset using the same ICD external cause of injury codes as used for fatal falls. Cases with no injury diagnosis or where "late effect of injuries" was recorded in the principal diagnosis field were excluded.

The ICD *place of injury* code "home" was used to identify falls that had occurred in a home environment ("home" includes driveway to home, garage, garden to home, yard to home and swimming pool in private house/garden).

Average annual rates of fall-related hospitalisation and death were calculated per 100,000 for people resident in New Zealand using Statistics New Zealand 1996 and 2001 census, and inter-censal estimates.

Rates and means are presented with 95% confidence intervals. Chi-squared tests have been used to test for differences in proportions and Poisson regression for analysis of trends over time. The statistics programme STATA version 8 was used for all analyses.²⁶

Results

Fatalities

During the 10-years period 1993–2002, 281 people aged 25–59 years died in New Zealand from unintentional fall related injury, 26% (n = 73) of these falls occurred at home. The place of occurrence was



Figure 1 Frequency and rate of unintentional fatal falls at home, by age band: among 25-59 year olds, New Zealand, 1993-2002 (n = 73). (Rate per 100,000 and 95% confidence intervals).

not recorded in the NZHIS data in a further 15% of the fatalities following unintentional falls. During the study period two to nine deaths per annum were attributed to unintended falls at home, corresponding to an average annual rate of 0.41 per 100,000 (95% CI 0.32–0.51).

The mean age of decedents was 47.6 years (95% CI 45.5–49.8), with half (51%) being 50 years or older. The death rate increased with age, with people in the 55–59 years old age band having nearly a three times higher rate than people aged 25–29 years (Fig. 1).

The fatality rate for males (0.63 per 100,000 95% CI 0.46-0.80) was three times that for females (0.20 per 100,000 95% CI 0.11-0.29). There were insufficient deaths to examine ethnic differences.

The most common type of unintentional fatal fall occurring in the home environs was *falls from build-ings or structures* (n = 19) followed by *falls involving stairs or steps* (n = 14). In 25% (n = 18) of fatal events the type of fall was not specified. Men were most likely to die as a result of a fall from a building or structure (17/55 versus 2/18). Females were most likely to die as a result of a fall involving stairs or steps (7/18 versus 7/55) (p = 0.014).

Hospitalisations

During the 12-year period 1993–2004, 40,370 people aged 25–59 years had an admission for an injury caused by an unintentional fall. In 31% (n = 12,529) of cases, the location of injury occurrence was not specified. In 28% (n = 11,236) of cases, the falls were coded as having occurred at home, representing an average annual rate of hospitalisation of 52.0 per 100,000 (95% CI 51.1–53.0). Fifty-four (4.8 per 1000 cases hospitalised) of these cases died in hospital.

The annual rate of fall hospitalisations increased during the 10-year period (Fig. 2). The gradual increase in hospitalisations for all falls at home mirrors the patterns of hospitalisations for all falls (Fig. 3). The number of fall hospitalisations with an



Figure 2 Number and annual rate of hospitalisations for unintentional falls at home: among 25-59 year olds, New Zealand, 1993–2004 (n = 11,236). (Rates per 100,000 with 95% confidence intervals).

unspecified location of injury has remained relatively static since 2000.

There were statistically significant albeit small differences in the monthly distribution of hospitalisations (p < 0.001) and in the seasonal distribution of fall hospitalisations for the period under review (p < 0.001). The summer months had the greatest proportion of falls resulting in hospitalisation (n = 2947, 26%) and spring had the least (n = 2731, 24%).

The mean age of hospitalised cases was 44.9 years (95% CI 44.7–45.1). The incidence of fall hospitalisations increased with age, the 55–59 years age group incidence rate (110.2 per 100,000, 95% CI 105.8–114.6) was more than three times the 25–29 years age group rate (30.3 per 100,000, 95% CI 28.4–32.2), p < 0.0005.

Amongst admissions that were coded as a fall at home, 12% and 3% were classified to people of Maori and Pacific ethnicity, respectively. Fifty-three percent of admissions were females (p < 0.001). Male rates were higher than female rates until age 45 years when the pattern reversed. As age increased, the difference between gender rates also increased, with the 55–59 years age group rate for women being 1.5 times the male rate (Fig. 4).



Figure 3 Annual numbers by location of event for unintentional falls hospitalisations: among 25-59 year olds, New Zealand, 1993-2004 (n = 40,370).



Figure 4 Number and overall average rate of hospitalisations for unintentional falls at home by age group: among 25–59 year olds, New Zealand, 1993–2004 (n = 11,236). (Rates per 100,000 with 95% confidence intervals).

Falls on the same level were responsible for almost a third of hospitalisations, and falls involving stairs or steps accounted for 19% (Fig. 5). Males were four times more likely to fall from a building or structure than females and to fall from a ladder or scaffolding. In contrast females were almost twice as likely to fall on the same level as males and to have a fall involving stairs or steps.

The mean length of stay was 4.97 days (standard deviation 7.14 days). Among the hospitalised patients, the principal injury diagnosis at discharge was lower limb fracture (38%), followed by upper limb fracture (16%). Eleven percent of cases had a principal injury diagnosis at discharge of intracranial injury (including skull fracture) and 9% had a neck or trunk fracture. Collectively, skull, neck or trunk factures were more likely to have been sustained by males than females (26.6% compared with 14.8%). Females were more likely to have sustained a lower or upper limb fracture than males (62.1% compared with 45.4%).



Figure 5 Characteristics of fall: unintentional fall hospitalisation rates at home by gender: among 25-59 year olds, New Zealand, 1993-2004 (n = 11,236). (Rates per 100,000 with 95% confidence intervals).

Discussion

In New Zealand, almost one-third of unintentional falls resulting in-patient admission or death among working age people occur at home. This is likely to be an underestimate due to the number of cases where the place of the fall was not specified (31% of hospitalisations and 15% of fatal, unintentional falls). Deaths from falls at home are uncommon in this age group (in contrast to the high case fatality rate seen in older adults) but for every death there were approximately 150 in-patient admissions, broadly consistent with the "injury pyramid" for New Zealand.³⁰ During the time period reviewed, a small increase in the rate of fall-related injuries at home resulting in hospitalisations was apparent.

Surprisingly, even among people in this relatively young working-age group (i.e. 25–59 years) rates of hospitalisation due to fall-related injury at home increased three to four-fold across the age range. The steady increase in rates of injury from about 45 years of age onwards suggests that consideration should be given to commencing fall prevention initiatives at an earlier age than has traditionally been the case.

Our findings indicate that males experienced higher rates of fatal falls than females, with the reverse pattern seen with hospitalisations. This may be due to differences in context and type of fall, comorbidities and quantitative and qualitative differences in the exposure to the home environment.

The strengths of this study are the use of national population-based data over a substantial period (10-years) providing reasonably reliable estimates of the burden of serious fall-related injury at home; the ability to identify broad categories in terms of the circumstances surrounding serious falls; and the opportunity to identify characteristics of subgroups at increased risk of these injuries. The reliability of New Zealand hospital inpatient external cause of injury data is consistent with US and Australian experience.¹⁵

It was acknowledged, a priori, by the researchers that the well-recognised under-reporting of Maori in mortality statistics, was likely to result in an underrepresentation of Maori in this data.⁸ In addition changes to the 1996 census definition of ethnicity mean the denominator for Maori during the period 1996–2002 differs from earlier years,³ therefore interpretation of Maori findings should be treated with caution.

The limitations of using hospitalisations as an indicator of non-fatal injury is well-recognised as numerous extraneous factors influence admission to hospital.^{5,14,13} Cryer and Langley examined trends in serious non-fatal injury hospitalisations (discharge

data) in New Zealand and reported an increase over the transition period from ICD-9-ICD-10.5 In the present study, we noted the proportion of falls with an unspecified location of injury has remained relatively static since 2000, suggesting the trends observed are unlikely to be related to the introduction of ICD-10-AM in July 2001. However, the trends over time observed in this study may be in part be due to factors such as access to health services, changes in treatment practices, or other artefacts as opposed to alterations in severity or incidence of fall-related injury. In addition, as noted by Langley et al. the use of hospital discharge data in New Zealand (cases with a principal diagnosis, primary admission and a day stay of 1-day or more) for determining injury incidence may result in overestimating the occurrence of such injuries by up to 3%.14

The main limitation of this study is the absence of relevant contextual or exposure information (e.g. amount of time spent at home) and postulated or known risk factors (e.g. co-morbidities, bone density, alcohol use) which limits the ability to make inferences about aetiology. There is a lack of published epidemiological studies examining risk factors for unintentional falls in the working age population. The risk factors in this population may differ from risk factors identified for falls in older populations. Such differences could relate to their lower levels of morbidity but more active lifestyles as well as reduced exposure (especially for men) to the home environment. Nevertheless, general risk factors for injury such as alcohol and sleep deprivation can be expected to influence their risk of fallrelated injury; but the magnitude of this risk has not been quantified in the working-age population.

The study was also unable to assess the total burden of fall-related injuries at the societal level as non-hospitalised injuries are not systematically reported in New Zealand. In a US study of self-reported falls, Talbot and colleagues found 19% of young adults (20–45 years), 21% of middle-aged adults (45–65 years) and 35% older aged adults (>65 years) reported one or more falls in the previous 2 years.²⁹ Six percent of falls in the young adults and 12% of falls among the middle-aged adults resulted in fractures, compared with 15% of falls among the older aged adults.²⁹ This is consistent with a New Zealand study of self-reported injury which indicated that around 10% of fall-related injuries result in hospitalisation.⁴

In New Zealand a national fall strategy was released in 2005 that signalled the commitment of the government and other agencies to reduce the rate and impact of fall injury in the community.¹ Priority areas identified in the strategy include falls in the home. Future research will need to focus on identifying modifiable risk factors that can be targeted to reduce the burden of these injuries and their consequences in a context where the adverse impact on economic productivity is particularly high.

Conflict of interest statement

None.

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Appendix Two: Falls NZHIS data fact sheet



Unintentional falls at home among 25 – 59 year-old New Zealanders

Background

Falls account for a significant burden of injury in New Zealand. Self-reported injury data indicate that nearly a third of injuries occur within the home.¹ While falls among the elderly have received considerable research attention, falls among working-aged people have received very little. Yet in 2004, the 25-55 year age group accounted for over 50% of the \$150 million in ACC claims for moderate to serious falls in the home.²

This fact sheet summarises findings from a review of routinely collected data on deaths and in-patient hospital admissions following unintentional falls, focusing particularly on those occurring at home among 25 to 59 year olds in New Zealand. The data was supplied by the New Zealand Health information Service (NZHIS).³

Public hospital admissions (overnight stay or longer):

- 40,370 New Zealanders aged 25 to 59 years had a primary (first admission) public hospital admission for an injury caused by an unintentional fall, during the 12-year period 1993 to 2004. Of these, 28% (n=11236) occurred at home.
- The mean age of hospitalised cases in this age group was 44.9 years (median 46.0 years) years. Approximately 12% of cases were classified as people of Maori ethnicity and 3% were Pacific peoples.
- The age-specific hospitalisation rates increased three to four-fold across the age range (Figure1)
- Up to 45 years, these rates were higher among male relative to females.
- Falls on the same level were responsible for almost a third of hospitalisations, and falls *involving stairs or steps* accounted for 19%.
- Males were four times more likely to fall from a building or structure or from a ladder or scaffolding than females.
- Females were almost twice as likely to fall on the same level as males and to have a fall involving stairs or steps.



Figure 1: Primary injury hospitalisations for unintentional falls at home by age group, New Zealand, 1993 – 2004, n= 11,236. * Rates per 100,000 with 95% confidence intervals

injury deaths:

- 281 New Zealanders aged 25 to 59 years died from injuries sustained following an unintentional fall during the 10-year period 1993 to 2002. Of these, 26% (n=73) were reported to have occurred at home.
- The mean age of victims was 47.6 years (median 50.0 years).
- The age-specific rates increased over the age range examined with the rate among those aged 55 to 59 years being nearly three times higher than that among people aged 25 to 29 years.
- The fatality rate for males was three times that for females.
- Of the categories coded in this NZHIS database, the most common type of fall resulting in death was falls from buildings or structures (n=19). This was the commonest type of fall-related death among men, while women were more likely to die as a result of a fall involving stairs or steps.

Summary

Almost one third of unintentional falls resulting in-patient admission or death among working age people in New Zealand occur at home. Deaths from falls at home are uncommon in this age group. For every death, however, there were approximately 150 in-patient hospital admissions due to a fall-related injury. The rates of hospitalisation due to fall-related injury at home increased three to four-fold across the age range. The steady increase in rates of injury from about 45 years of age onwards suggests that consideration should be given to commencing fall prevention initiatives at an earlier age than has traditionally been the case. In addition to the costs to ACC, the potential adverse impact on economic productivity from falls in this age group is significant. There is a need to identify and address modifiable risk factors using strategies that can reduce the fatal and non-fatal consequences of these falls.

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Appendix Three: Injury Control Bulletin Item

Study looks at falls at home in working-aged population

hat puts working-aged people at risk for injurious falls at home and whether the risk factors are the same as for older-aged adults are some of the questions being addressed in an ACC-funded study being conducted by Bridget Kool from the Injury Prevention Research Centre (IPRC) at the University of Auckland.

Falls in New Zealand account for about 40% of unintentional injury hospitalisations and 20% of unintentional injury deaths. A third of all injuries requiring medical attention in New Zealand are reported to occur at home. The focus on falls research internationally has traditionally been the elderly as the associated risk of death and disability in this age group is extremely high. In contrast the burden and characteristics of injurious falls at home among the working-aged population (25 to 60 years of age) has received little attention.

The Auckland Falls Study is examining the overall characteristics and patterns of injury due to unintentional falls at home among people aged 25 to 60 years resulting in hospitalisation or death in the Auckland region. The study will investigate risk factors for falls of this nature and examine how prevalent such factors are in the general population. Bridget has a specific interest in the role alcohol might play in falls in this age group.

The study involved identifying and interviewing people admitted to hospital with a fall of this nature and comparing information about potential risk factors with information collected from a random selection of people in the same age band from the electoral roll. Between July 2005 and August 2006, 336 "cases" were interviewed.

"We are excited by the very favourable 98% participation response rate from cases, which reaffirms for us the significance of these injuries for those involved" Bridget said.

The information on risk factors will be compared between the two groups and then analysed to see which factors increase or decrease the risk of having a fall. The findings will help inform injury prevention

activities to reduce the occurrence of injurious falls.

"This research is very exciting not only because it is unique but because it may offer some solutions as to how to reduce falls in this productive and relatively healthy population," said Bridget.

An analysis of routinely collected New Zealand data on public hospital discharges and deaths was undertaken earlier this year as part of the background for the Auckland Falls Study. The analysis revealed that almost one third of unintentional falls resulting in patient admission or death among working-age people occur at home.



Tanya Black is one of the participants in the Auckland Falls Study. Tanya fell down eighteen stairs at her home resulting in a crushed vertebra.

"This is likely to be an underestimate due to the high proportion of such falls where the place of occurrence was not specified (31% of hospitalisations and 15% of fatal, unintentional falls). Deaths from falls at home are uncommon in this age group (in contrast to the high fatality rate seen in older adults) but for every death there were approximately 150 in-patient admissions, reflecting the 'injury pyramid' for New Zealand."

Bridget is supported by an ACC Career Development Award.

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THE ROLE OF ALCOHOL IN UNINTENTIONAL FALLS AMONG YOUNG AND MIDDLE-AGED ADULTS: A SYSTEMATIC REVIEW OF EPIDEMIOLOGICAL STUDIES

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ABSTRACT

Objective: To appraise the published epidemiological evidence quantifying the risk of falls associated with acute and usual alcohol consumption among young and middle-aged adults.

Design: Systematic review.

Data sources: Searches of electronic databases (e.g., Medline, EMBASE, CINAHL, PsycINFO, Scopus), websites of relevant organisations, major injury journals, reference lists of relevant articles, and contact with experts in the field.

Inclusion criteria: Epidemiological studies with an English language abstract investigating alcohol use as a risk factor (exposure) for unintentional falls or related injuries among individuals aged 25 to 60 years.

Methods: Studies were critically appraised using the GATE LITE[™] tool. Metaanalysis was not attempted because of the heterogeneity of the eligible studies.

Results: Four case-control, three cohort and one case-crossover study fulfilled the inclusion criteria. The studies demonstrated an increased risk of unintentional falls among young and middle-aged adults with increasing exposure to alcohol use. However, the magnitude of this risk varied considerably across studies with most estimates being relatively imprecise. Modest evidence of a dose-response relationship with acute alcohol use was observed. The association between usual alcohol use and fall risk was inconclusive, and evidence of a gender difference was inconsistent.

Conclusions: Alcohol use appears to be an important risk factor for falls among young and middle-aged adults. Controlled studies with sufficient power that adjust effect estimates for potential confounders (e.g., fatigue, recreational drug use) are required to determine the population-based burden of fall-related **BKool 021303 post review V2.doc** 2 injuries attributable to alcohol. This can help inform and prioritise falls prevention strategies for this age group.

KEYWORDS: Falls; home; adults; alcohol, drinking

INTRODUCTION

Injury prevention strategies targeting the harmful effects of alcohol use on road traffic crashes are well-established. While serious falls are a leading cause of injury-related morbidity worldwide,[1-6] the evidence base for determining if fall prevention strategies should target alcohol use has received relatively little attention. A number of major reviews have examined the role of alcohol in non-traffic injuries.[7-10] However, only one review published by Hingson and Howland in 1987 has specifically examined the link between alcohol and falls.[11] This review found an association with acute alcohol use and risk of fall, but concluded that more case-control studies were required to establish the magnitude of the risk. Over a decade later, Smith et al. found alcohol was an important contributor to serious falls in a review of non-traffic fatal injuries.[12] The aggregated proportion of fall cases determined to be intoxicated was 32.2% comparable to 32.8% of motor vehicle crash victims. These authors also noted a lack of case-control and prospective cohort studies investigating the relationship between alcohol use and fatal non-traffic injuries.

The aim of this study was to quantify the magnitude of fall risk associated with both acute and usual alcohol use among young and middle-aged adults including the research published in the 20 years since the paper by Hingson and Howland. This review will help establish the evidence base for targeted fall prevention strategies in this age group.

METHODS

Inclusion criteria

We included epidemiological studies examining the association between alcohol use and the occurrence of unintentional falls or fall-related injury. The exposure of interest was defined as either usual alcohol use, or the acute consumption of alcohol in a defined period immediately prior to the event (or reference period). Study inclusion required the following criteria to be met: study population to include young and middle-aged adults defined for the purposes of this study as 25 to 60 years (or a sub-group within this age range), information regarding alcohol use, and an English language abstract.

Studies including subjects in residential care, work-related falls, or studies of injuries limited to a specific body region (e.g. hip fracture, traumatic brain injury, maxillofacial injuries) were excluded. Given the focus of the review, data specific to unintentional falls was extracted from studies focusing on injury more generally, if this was not possible the study was excluded.

Data sources and search terms

Research published from 1983 to 2007 was reviewed. The review period included the only case-control study[13] in the Hingson and Howland review. Bibliographic computerised searches using the Ovid search engine of the following databases were undertaken: Medline, EMBASE, CINAHL, PsycINFO, and Scopus. Main Medical Subject Heading (MeSH) and text words search terms included: accidental falls; accidents, home; alcohol, ethyl; BAC; and alcohol drinking.

Additional strategies utilised to identify potentially relevant studies included: examination of reference lists of retrieved articles and proceedings of applicable conferences; hand-searching of the table of contents of the following journals - *Injury*; *Injury Prevention*, *Journal of Safety Research*, *Journal of Trauma*, *Journal of Trauma*, *Injury*, *Infection and Critical Care*, *Alcohol and Alcoholism*, and *Alcohol*; electronic media searches of internet sources, websites of institutions involved in research and policy in the areas of falls or alcohol, particularly focusing on publication lists; and contact with key researchers in the field.

Quality assessment

The quality of studies fulfilling the inclusion criteria was assessed using the GATE LITE[™] (www.epiq.co.nz) which is an abbreviated form of the GATE frame a visual framework used to appraise epidemiological studies.[14] Evidence tables for included studies were developed including information regarding participants, comparison group, exposure, confounders considered, outcomes, results, and appraisals of study quality and biases of the research. The identified studies were heterogeneous in many respects and were not considered sufficiently robust to quantitatively combine.

RESULTS

Out of the 106 studies identified from the search strategy, 54 were considered potentially relevant based on the title or abstract and the full-text retrieved for detailed evaluation. Eight studies from the United States(US),[15-18] Finland,[13, 19] Sweden,[20] and Canada,[21] published between 1983 and January 2005, fulfilled the review inclusion criteria (Figure 1).

Study characteristics

The primary focus of four of the studies was falls,[13, 17, 19, 21] the remaining four were general injury studies where data on falls could be identified as a sub-group (Table 1).[15, 16, 18, 20] Three studies were explicitly population-based.[16, 19, 20] Participants in the other studies were identified from selected emergency departments(ED) and hospitals in four,[13, 15, 17, 18]

and a medical clinic in one.[21] The research designs included four casecontrol studies,[13, 15-17] three cohort studies,[19-21] and a case-crossover study.[18] The individual sample sizes ranged from 118 to 19,582. The overall mean age for the four studies providing information was 47.4 years.

The proportion of fall subjects who had been drinking within six hours of the event (where data was reported) ranged from 14% to 53%.[13, 15, 18]

Study	Participants	Exposures	Outcomes	Confounders considered	Results	Comments
1. Honkanen (1983), Finland, case- control [13]	Cases: 313 adults (≥ 15 years)fall injury in a public place between 3 – 11P.M. and admitted to ED* Controls: 626, randomly selected from accident sites 1 week post event	Acute alcohol: • cases: BAC† • controls: breath samples	Unintentional fall requiring ED visit	Slippery road, disease, age, psychotropic meds, shoe sole, social class Matched on: gender, location of fall, day of week, hour of day	Acute alcohol use; cases 53%, controls 15% Compared to BAC of 0: • BAC 60 – 100mg/100ml, RR ^t =3, • BAL 100-150mg/100ml, RR=10 for • BAL ≥160 mg/100ml, RR=60 for No Confidence Intervals (CI) or p values given	 Selection bias: interviewed on evening shifts only cases older than controls Misclassification bias: self report for some exposures
2. Malmivaara (1993), Finland, population- based cohort [19]	19,518 adults (20 - 92 years) from 4 regions of Finland (8- 11 year follow-up) Falls = 628 injuries/ 187,405 person years	Usual frequency of alcohol consumption: Gms/month	Hospitalisation / death for fall injury	Age, sex education, martial status, smoking, physical exercise, BMI, psychopharmacologic agents, CVD, diabetes, musculoskeletal disorder, previous history of severe injury, other chronic diseases	57% current drinkers Monthly alcohol intake (gm/month) cf. abstainers: • 100-499g RR=1.43 (1.13, 1.82) • 500-999g RR=2.32 (1.71, 3.17) • ≥1000g RR=3.05(2.05,4.55) 20-44: 500-999g cf. abstainers • Men RR=3.00 (1.45,6.19) • Women RR=0.77 (0.10, 6.03)	• Misclassification bias: Alcohol consumption recorded at baseline, outcomes measured 8-11 years later.
3. Borges (1994), USA, case- control[15]	Cases : 274, \geq 15 years, injury (fall, assault/fight, MVC, home injury) resulting in presentation to hospital Falls: 73/214 34% Controls 115, \geq 15 years, injury (recreational, animal bite, workplace injury) resulting in presentation to hospital	 Breath alcohol Self report: Previous 6 hours Usual alcohol 	Injury (fall, assault, MVC, home) requiring an ED visit	Gender, day of accident, schooling, place of residence, age, occupation	66% current drinkers Acute alcohol use: fall cases 26%, controls 11% OR [§] for fall injury: • Breathalyser: ≥10mg/100ml cf. ≤9 mg/100, OR=3.45 (1.23, 9.66) • Prev 6 hours: • ≤100nl cf. abstainer, OR = 2.09 (0.66,6.56) • 101-2001 ml cf. abstainer, OR = 6.73 (1.54,29.34) for • SR of drunkenness: yes cf. abstainer, OR= 5.70 (1.96,16.56) • Habitual use non-significant	Misclassification bias: Unusual comparison group

Table 1 : Alcohol consumption and the risk of fall injury among young and middle-aged adults: summary of epidemiological evidence

Study	Participants	Exposures	Outcomes	Confounders considered	Results	Comments
4. Vinson (1995), USA, case-crossover [18]	350 acutely injured adults (≥18 years) presenting at EDs of 2 hospitals for the region Falls = 87/350 27% Excluded: head injury or life- threatening trauma , presentations ≥48 hours after injury	 Acute alcohol: Self report number of drinks Alcohol use: Previous 30 hours Previous 6 hours - same day of week for the preceding 28 days 	Injury requiring an ED visit Injury Severity	Age, sex , weight, severity of injury, SES, day of the week, hospital type	Acute alcohol use 13.5% Falls: Acute alcohol use cf. no alcohol, OR=3.0 (0.54 – 30)	 Selection bias: interviewed evening only recruitment late spring & early summer days of week selected to have equal probability of enrolment Misclassification bias: self report for exposures
5. Gray (2000), Canada, cohort[21]	118 randomly selected Parkinson's clinic patients (\geq 40 years) (3 month follow-up) \geq 1 falls = 70 No falls = 48	Daily alcohol intake (not stated how obtained)	Self-reported fall (injurious and non-injurious falls)	None reported	≥ 1 drink/day vs. < 1 drink/day, OR= 1.85 (0.73-4.67)	 Misclassification bias: self reported fall data (daily diary & interviews) Confounders not considered
	Exclusions: unable to stand / walk short distance, unable to complete a diary, conditions that could predispose to fall e.g. epilepsy					
6. Stenbacka (2002), Sweden, Population- based cohort [20]	4,023 randomly selected adults (20 – 89 years). (12 year follow-up) Falls = 330 Men= 1,828	Usual alcohol consumption per month: • low: 0.001- 100g • moderate: 100-500g • moderately high: 500- 1000g	Fall resulting in hospitalisation or death	Living alone, poor/rather poor health, earlier injuries	RR for falls among 20 to 89 yr olds: ≥500g/month cf.0g/month • 1 fall RR=2.27 (1.45,3.57) • ≥2 falls RR=2.08 (1.23,3.53) 1 or more falls: ≥500g/month cf.0 g/month:	 Selection bias: no data on injury rates for non-responders may have had more than one fall potentially overestimating some exposures
	falls/20,782 person years Women = 2,195 falls/ 25,231 person years				 Women (20-59 yr olds): RR=3.65 (1.48,8.99) Men: RR=2.49 (0.96,6.45) 	 Misclassification bias: Included all injurious falls exposures only measured at baseline, outcome period 12 years

			Outcomes	considered	Results	Comments
7. Keegan (2004) USA, case- control[17]	Cases= 2348 (≥45 years) fracture as a result of a fall to the ground/floor or attributed their injury to a fall Exclusions: pathological fractures, non- English/Spanish speakers Controls: 512 (≥45 years) medical centre members Exclusions: non- English/Spanish speakers, fracture	Acute alcohol: self report (number of drinks) Usual alcohol: number of drinks per week	Fall resulting in fracture identified from inpatient and outpatient hospital records	Age, gender, ethnicity	 Acute alcohol use: 2.3% Alcohol use in the previous 4 hours and risk of foot fracture OR=3.1 (1.6,6.0) but not for other fracture sites Consuming alcohol in past year not associated with increase in risk 	 Selection bias: Kaiser patients may differ systematically from non-Kaiser patients Misclassification bias: index time for acute alcohol use for controls was time of interview - may have resulted in under / overestimate of exposures with temporal component e.g. meds and alcohol use recall bias: mean time from fall to interview 3.9 months
8. Chen (2005), USA, Population- based case- control [16]	since age of 45, Cases = 5549 (≥ 15 years) persons who died from injury NB: Falls as a component not stated Controls = 42,698 National Longitudinal Alcohol Study	Current drinkers= ≥12 drinks in last year of life	Fatal unintentional falls	Age, sex, race/ethnicity, education, marital status, working status, drug use	 57.2% current drinkers Risk of dying from unintentional falls for current drinkers cf. abstainers and prior drinkers OR 1.38 (1.05-1.82) males: OR=1.39 (0.94, 2.05) females: OR=1.35 (0.91, 1.99 	 Selection bias: 1993 national survey - case information cf. 1994 national survey - control information Misclassification bias: Alcohol information: Cases- from proxies Controls-self report

Footnote: In general injury studies we only reported fall-related outcomes

The outcome measures included self-reported falls (injurious and non-injurious),[21] ED visit or admission to hospital for a fall-related injury,[13, 15, 18-20] death as a result of a fall-related injury,[16, 20] and fractures as a result of falls.[17] While two studies described the circumstances of the falls in limited detail,[17, 19] neither reported if the association with alcohol varied in different contexts.

Selection biases

The identification and recruitment of study cases from hospital ED and admission records may have introduced selection biases due to the unreliability of the coding of fall injury, [22, 23] and to referral patterns and access issues that result in some cases attending ED whilst others seek care from alternative providers or not at all.[24, 25] Moreover, trauma studies based only on admitted patients may be more likely to include intoxicated minor injury cases due to the difficulty of initial clinical assessment among intoxicated patients which can result in biased estimates of association between alcohol and injury risk.[25]

In the seven studies reporting response rates, these ranged from 65% to 96%.[13, 15-20] Studies with unreported or low response rates are more likely to yield biased effect estimates as respondents may be systematically different from non-responders with regard to exposure measures. A cohort study of individuals with TBI, found subjects lost to follow-up were more likely to be those who were intoxicated at the time of injury and those with a history of substance abuse.[26]

The selection of non-injured patients[17] and patients injured by other mechanisms[15] as controls in two studies meant that these controls may not have represented the same populations generating the cases.[24, 27, 28] Previous studies have found non-injured

patients to be more frequent heavy drinkers than the general population,[29] potentially resulting in conservative estimates of the effect of alcohol on injury.

Information biases

The measurement of exposures and outcomes commonly relied on self-report raising the possibility of recall bias and socially desirable responses. The latter may have resulted in an underestimate of effect in some studies.[30] Follow-up periods for two of the cohort studies exceeded ten years,[19, 20] it is likely that drinking patterns changed within that period.

The alcohol use measures investigated were self-reported volume of alcohol consumption in the preceding four to six hours,[15, 17, 18] blood alcohol concentration (BAC),[13] breath alcohol concentration,[13, 15] self-reported level of drunkenness,[15] and usual alcohol consumption.[15-17, 19-21] ED records were used in two studies to identify BAC.[13, 15] These data are commonly incomplete,[23, 31, 32] potentially resulting in missing exposure or confounder information.

Confounding

The effect of recreational drug use and fatigue on the relationship between alcohol and falls appears to have been considered in only two studies.[20, 21] These variables may have a relationship with both alcohol use and risk of fall, and could have distorted the risk estimates of interest.[30] Previous research has found the association between acute alcohol consumption and injury risk can be confounded by usual patterns of drinking, risk-taking behaviours and the use of other substances.[33] Although age, gender, and socio-economic status could have an association with both alcohol use and risk of falls,[33] it was unclear if their potential confounding effects were adequately considered in one study.[21]

Effect estimates

Two[15, 17] of the four studies[13, 15, 17, 18] investigating the association between acute use of alcohol and fall risk found statistically significant increases in risk. The first of these, a case-control study[15] examining ED presentations for falls compared with presentations for injuries from animal bites, recreational "accidents" or workplace "accidents" reported odds ratios (OR) of 3.45 (95% CI; 1.23, 9.66) for breathalyser readings of 10 or more mg/100ml compared with 9 mg/100ml or less; OR=6.73 (95% CI; 1.54, 29.34) for self-reported consumption of 101 to 2000 ml of alcohol in the previous six hours compared to abstainers; and OR=5.70 (95% CI; 1.96, 16.56) for those self-identifying as "drunk" compared with abstainers.[15] As alcohol could also have influenced the injuries experienced by the control group, these estimates may be biased and result in an underestimation of the risk.

A subsequent case-control study of hospital presentations (in-patient and outpatient) for fractures attributed to falls compared with presentations for other conditions found the fracture group had a 3-fold greater risk of exposure to alcohol use in the previous four hours (OR=3.1; 95% CI 1.6, 6.0).[17] However, the generalisability of these findings is limited by the particular type of fall injury investigated.

The remaining two studies that examined acute alcohol use found an increased fall risk but the precision of these estimates was of concern.[13] [18] The first of these was a case-control study examining BAC levels among ED presentations following a fall in a public place compared with controls randomly selected from the incident site.[13] While the authors report an increased fall risk associated with BAC of 60mg/100ml and greater, information regarding the precision of these estimates was not provided. The second was a case-crossover study of ED fall injury presentations which found alcohol use in the preceding six hours was associated with an OR=3.0 (95% CI; 0.54, 30).[18] These findings are equivocal as the confidence interval was extremely wide.

There was some evidence of a dose-response relationship with acute alcohol use and fall risk reported in two of the studies reviewed.[13] [15] The case-control study by Honkanen et al. reported relative risks (RR) of around 3 for BAC of 60mg/100ml to 100mg/100ml, RR=10 for BAC 101mg/100ml to 150mg/100ml and RR=60 for BAC of 160mg/100ml or more compared to BAC of 0 mg/100ml.[13] While this study indicates a dose-response relationship, information regarding the precision of these estimates was not reported. Another case-control study of fall-injury requiring hospitalisation reported an OR of 2.09 (95% CI, 0.66, 6.56) for breath alcohol levels of 100mg/ml or less compared with abstainers, increasing to OR 6.73 (95% CI, 1.54, 29.34) for 101 – 2000 mg/ml.[15] Despite the imprecision of the estimates in this study, the direction of the relationship is clear.

While three[16, 19, 20] out of six studies found that usual alcohol use increased fall risk, others did not find a significant association.[15, 17, 21] Two cohort studies[19, 20] examining usual alcohol intake per month compared with abstainers reported statistically significant relative risks of around 2.0 for consumption of 500gm or more of alcohol per month. The more robust of these two studies demonstrated a dose response relationship with increased usual alcohol consumption correlating with an increase in risk of fall.[19] Compared to abstainers, relative risks increased from 1.43 (95% CI, 1.13, 1.82) for those consuming 100 to 499 gms of alcohol per month to RR 3.05 (95% CI, 2.05, 4.55) for consumption of 1000gm per month or more. A case-control study investigating drinking history and risk of fatal injury found current drinkers (at least 12-drinks in the last year of

life) were at increased risk of death from falls compared with abstainers and prior drinkers (OR=1.38; 95% CI 1.05, 1.82).[16]

Two case-control studies examining usual alcohol consumption and fall risk found no significant relationship.[15, 17] Gray et al. in a cohort study of self-reported falls found a non-significant increase in fall risk associated with the consumption of one or more drinks per day compared to less than one drink (OR=1.85; 95%CI 0.73,4.67).[21]

No studies reported statistically significant gender differences in fall risk associated with acute alcohol use, and the evidence relating to usual alcohol consumption was inconsistent. One study found a significantly increased risk for women (aged 20-59 years) with high usual alcohol consumption (500gm/month or more) of fall-related hospitalisation or death, after controlling for confounders, while the risk was only marginally significant for males of the same age.[20] However, another study using similar cut points but examining consumption by age group found males aged 20 to 44 years consuming 500-999gms/month had a threefold increase in risk (RR=3.00; 95%CI 1.45, 6.19) of hospitalisation or death resulting from falls, after controlling for confounders, compared with women of the same age (RR=0.77; 95%CI 0.10, 6.03).[19] This pattern was reversed in the older age group (45 to 64 years) with women consuming 500gm/month or more having almost double the risk of their male counterparts (RR=4.57; 95% CI 1.68, 12.45 cf. RR=2.75; 95%CI 1.58, 4.79). A study investigating fatal falls found similar risks among male and females who were current drinkers compared with abstainers.[16]

DISCUSSION

Several studies have investigated the association between alcohol consumption and fall risk since the last substantive review by Hingson and Howland in 1987.[11] Studies

examining associations between acute alcohol use and risk of non-occupational unintentional falls among young and middle-aged adults have found a consistent relationship although the estimates of risk varied with respect to magnitude and precision. There was some evidence of a dose-response relationship with acute alcohol use though again the estimates lack precision. Evidence of any gender difference is inconsistent.

There is inconclusive evidence of an association between usual alcohol use and fall risk among young and middle-aged adults. Confounding was not adequately considered in a number of studies. Some studies were compromised by the delay between measurement of alcohol consumption and measurement of outcomes, and gross measures of usual alcohol use, resulting in potential recall and other measurement biases. The wide range of measures used to characterise usual alcohol consumption highlights the need for a consistent measure that can be used across countries.

With these caveats, the findings of this review are consistent with those from Hingson and Howland's review and provide additional support for the contention that acute alcohol use increases the risk of unintentional falls.[11] The findings also support some of the Bradford Hill criteria used to assess if an association is consistent with a causal relationship. Specifically, the temporal and statistically significant relationship between alcohol and falls is plausible and coherent, and there is some evidence of a doseresponse effect. However, the magnitude of this risk among young and middle-aged adults remains subject to several sources of systematic error and imprecision. Moreover there is insufficient evidence to conclude that there is an important association between usual alcohol use and fall risk in this age group.

Publication bias arising as a result of a number of factors including studies with significant findings being more likely to be published;[34, 35] and computerised data bases being

less likely to index non-English language published research, research undertaken by low-income countries, or research in the grey literature,[36, 37] can threaten the validity of systematic reviews.[34] Threats to this review from publication and language biases were reduced by implementing a broad and comprehensive search strategy and by making contact with experts in the field. Acknowledging these strengths and limitations, it is noteworthy that all eligible studies were conducted in high income countries in North America and Europe. Yet the burden of falls is disproportionately borne by low and middle-income countries,[38] indicating an important gap in context-based evidence.

The heterogeneity in research designs, variable definitions and study context made the meta-analyses of pooled data inappropriate in the present review. Instead, recommended criteria were used to critically appraise and synthesize the evidence.[14, 39, 40]

The primary focus of this review was to use well recognised criteria to evaluate the evidence regarding the magnitude of unintentional fall risk associated with both acute and usual alcohol consumption among young and middle-aged adults. Therefore we did not include studies limited to study populations with injuries in specific regions of the body (e.g. traumatic brain injury, maxillofacial injuries, and hip fracture). These studies may have provided insights regarding the role of alcohol in these particular types of injuries, not all of which may be generalisable to falls.

The studies selected for this review were either case-control, case-crossover or cohort studies, methodological designs suited to investigate the aetiology of injury.[24, 27, 28, 41] While our inclusion criteria were relatively strict with regard to eligible study designs, the quality of the included studies was quite variable. The lack of primary analytical studies with a population focus is a major limitation identified in this review. A number of
studies drew participants from specific emergency departments, hospitals or clinics, introducing a number of selection biases.[22, 23, 42, 43]

The use of non-population based controls was a limitation in a number of the studies reviewed and may have resulted in differential ascertainment of exposure among cases and controls.[24, 28, 44]

Several studies were compromised by the lack of objective measures of acute alcohol exposure. Research by Cherpitel *et al.* indicates that only about 50% of US trauma centres routinely obtain blood alcohol on injury patients.[45] In addition, clinician detection of acute alcohol intoxication is unreliable and screening for alcohol intoxication is undertaken inconsistently.[46-48] Those with severe injuries may also be less likely to have BAC estimated in a timely fashion due to other clinical management priorities.[30, 49] In some situations the consumption of alcohol may have taken place after the injury event, an argument for complementing BAC levels with self-report data on when – in relation to the injury - alcohol was consumed.[30]

The use of abstainers as the reference group for the calculation of risk estimates for alcohol use was common.[16, 19] Concerns previously identified regarding the use of self-identified abstainers as a control group include their potential heterogeneity, measurement error, and representativeness of the underlying study populations.[50, 51] Abstainers may be life-time abstainers, long-term abstainers, or former drinkers. Rehm et al. estimate that inconsistencies in self-report of lifetime abstention from alcohol can result in the underestimation of alcohol-attributable all-cause mortality by 2% to 17%.[50]

Other factors with a transient effect on fall risk, such as recreational drugs and fatigue were seldom considered as potential confounders in the studies reviewed. Information on

the type and circumstances of falls was not reported in most studies. This information is required to identify whether the relationship differs in different contexts e.g. home, public places and by type of fall e.g. stairs, ladder, slips and trips.

This review excluded work-related falls, Smith et al. identified that falls at work and other settings such as the home are likely to share many common characteristics. [52, 53] Opportunities exist to explore injury prevention strategies aimed at reducing alcohol related harm that transcend the boundaries of workplace and home. Specific interventions to reduce the risk of fall injuries among young and middle-aged adults could include strategies aimed at screening for alcohol abuse and brief interventions for hazardous drinkers in the emergency department and primary care settings.[54, 55]

In conclusion, this review has been unable to precisely quantify the risk associated with acute alcohol use and unintentional falls among young and middle-aged adults. However, the findings of the review suggest alcohol increases the risk of falls, although the magnitude of this risk remains uncertain. Sufficiently powered population-based studies conducted in settings that encompass a range of socio-economic contexts are required to enable estimation of the fall injury burden attributable to alcohol. The multifactorial nature of falls requires the consideration of other potential contributing causes, confounders, and consideration of interactions between alcohol and factors such as fatigue and recreational drug use.

KEY MESSAGES

What is already know on the subject

 An association between acute alcohol and risk of fall among adults has been noted but previous reviews have identified a gap in epidemiological evidence regarding the magnitude of the risk.

What this study adds

- Acute alcohol use (within six hours of the event) contributes to unintentional fall risk resulting in serious injury among young and middle-aged adults and accounts for at least a three-fold increase in risk.
- There is inconsistent evidence of an association between usual alcohol use and unintentional fall risk resulting in serious injury among young and middleaged adults.

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COMPETING INTERESTS

None

CONTRIBUTORSHIP

BK carried out the search, selected included papers, critically appraised the papers, developed the evidence tables, and wrote the initial draft of the paper. RJ and SA were reviewers for included critically appraised papers and contributed substantially to the interpretation of study findings and writing the paper.

EXCLUSIVE LICENCE

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GLOSSARY

ACC	Accident Compensation Corporation
BAC	Blood Alcohol Concentration
CI	Confidence Interval
ED	Emergency Department
MeSH	Main Medical Subject Heading
mg	milligram
ml	millilitre
OR	Odds Ratio
RR	Relative Risk
US	United States

Year	First Author	Title	Location / Source
Risk fa	ctors		
2004	Skelton, D.	What are the main risk factors for falls amongst older people and what are the most effective interventions to prevent these falls? How should interventions to prevent falls be implemented?	WHO regional Office for Europe (Health Evidence Network): Copenhagen. ¹⁶
2004	Black, A.	Vision and falls	Clinical and Experimental Optometry. 88:4:212-222. ¹⁵²
2004	Moreland, J.D.	Muscle weakness and falls in older adults: A systematic review and meta-analysis	Journal of American Geriatrics Society. 52: 1121-112940-50. ¹⁵³
2002	Reid, M.C.	The health-related effects of alcohol use in older persons: a systematic review	Substance Abuse. 23:3; 149-164 ¹⁶⁰
1999	Lepzig, R.M.	Drugs and falls in older people: A systematic review and meta-analysis: I. Psychotropic drugs	Journal of American Geriatrics Society. 47 (1), 30-39. ¹⁵⁴
1999	Lepzig, R.M.	Drugs and falls in older people: A systematic review and meta-analysis: II. Cardiac and analgesic drugs	Journal of American Geriatrics Society. 47 (1), 40-50. ¹⁸
1987	Hingson, R.	Alcohol as a risk factor for injury or death resulting from accidental falls: A review of the literature	Journal of Studies on Alcohol. 48 (3), 212-219.46
Preven	tion of falls		
2007	McClure, R	Population-based interventions for the prevention of fall- related injuries in older people.	Cochrane Database of Systematic Reviews.2, 2007 ¹⁵⁵
2007	Campbell, A. J. Robertson, M. C.	Rethinking individual and community fall prevention strategies: a meta-regression comparing single and multifactorial interventions.	Age and Ageing Journal. 36 (6) ²⁶⁴
2004	Bischoff-Ferrari, H.	Effect of Vitamin D on falls. A meta-analysis	JAMA, 291 (16):1999-2006 ¹⁵⁸
2004	Chang, J.T.	Interventions for the prevention of falls in older adults: systematic review and meta-analysis of randomised clinical trials	BMJ, 328:1-7 ¹⁵⁹
2004	National Institute for Clinical Excellence	Clinical practice guideline for the assessment and prevention of falls in older people	Royal College of Nursing: London ¹³⁹
2003	Gillespie, L.D.	Interventions for preventing falls in elderly people.	Cochrane Database of Systematic Reviews.1, 2003 ²⁶⁵

Appendix Five: Summary of fall-related systematic reviews

Year	First Author	Title	Location / Source
2001	American Geriatrics Society,	Guidelines for the prevention of falls in older persons	Journal of American Geriatrics Society. ²⁶⁶
	British Geriatrics Society,		
	American Academy of Orthopaedic Surgeons Panel on Falls Prevention.		
2000	Feder, G.	Guidelines for the prevention of falls in people over 65	BMJ, 321:1007-1011 ¹⁵⁷
1997	Robertson, M.C.	Prevention of falls in older populations: Community perspective.	A report for the National Health Committee ¹³⁶

Appendix Six: Methods Paper

Unintentional falls at home among working-aged adults: methodology and population control selection for a case-control study

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Recruitment of controls representative of the study base for case-control studies can present several challenges. We describe the methodology and control recruitment processes of the Auckland Falls Study, a population-based case-control study investigating the relationship between lifestyle, socio-demographic and environmental factors, and risk of moderate to serious injury due to unintentional falls at home among people of working-age. The study base is working-age adults residing in the Auckland region and registered on the electoral roll for the region. Cases were 335 people aged 25 to 59 years who were admitted to hospital or died as a result of unintentional falls at home. The control subjects participating in this study were 352 people from the same age band as cases who were randomly selected from the electoral roll for the region. Participants completed a structured interview that ascertained data on socio-demographic, personal and lifestyle factors. Control response rates were considerably lower than anticipated but typical of response rates in epidemiological studies of this nature currently being conducted in New Zealand and elsewhere. Recruitment of population-based controls is challenging and resource intensive.

Introduction

Recruitment of controls representative of the study base for casecontrol studies can present several challenges.¹⁻⁶ A central tenet in studies of this nature is that cases and controls are sourced from the same study base thereby ensuring the control exposure experience is representative of the individuals who compose the study base.^{3, 5, 6} Achieving contact with potential controls is a major challenge of population-based studies.⁷

We describe the methodology of the Auckland Falls Study, a population-based case-control study that aims to identify potentially preventable risk factors for unintentional fallrelated injury at home among people of working age. Particular emphasis is placed on the control recruitment processes. A case-control study design was selected because case-control studies are an efficient way to study risk factors for outcomes which are relatively rare events.^{1,3} In addition the case-control methodology allows for the investigation of injury-related risk factors which are transient or have short induction periods such as alcohol, fatigue and recreational drug use.¹ The study was approved by the Northern Regional Ethics Committee.

The aim of this paper is to present the methodology of the Auckland Falls Study and outline the issues encountered with the selection and recruitment of population-based controls for this case-control study.

Materials and methods

Study base and recruitment of cases

The study base comprised people aged 25 to 59 years registered on the General or Māori electoral roll for the region. Cases in the study were all people aged 25 to 59 years resident in the Auckland region of New Zealand and who were killed or admitted to hospital in the region as a result of an unintentional non-occupational fall at home between July 2005 and July 2006. The region's 1.3 million population is predominantly urban with approximately 630,000 aged 25 to 59 years.8 Hospitalisation was defined as a primary admission to a service other than the emergency department. Cases were included if they were hospitalised within 48 hours of the fall event and were capable of giving informed consent, or had an acceptable surrogate (proxy) capable of giving consent on the subject's behalf. We excluded three people who were unable to complete the interview in English. If participants had more than one primary admission for a fall of this nature during the study period then only the first fall was included. Two cases had subsequent primary admissions both of these subsequent admissions were excluded from the study. Hospitalised cases were identified prospectively through a monitoring system established at the three hospitals in the region that received adult admission for acute trauma. Fatal cases were identified by regular surveillance of the region's coroner's office.

Selection and recruitment of controls

The control group for the study comprised a random sample of people from the General and Māori electoral rolls for the region from the same age band as the cases. In New Zealand, 98% of people in this age group who are eligible to vote are registered on the electoral rolls.⁹ Controls who had a fall at home resulting in hospitalisation or death were also eligible to be a case.⁵ The process for control recruitment is detailed in *Figure 1*.

Figure 1: Process of follow-up for controls



Measurement of study variables

A standardised structured questionnaire was developed based on a review of the relevant literature, and in consultation with the Study Advisory Group which includes clinicians, Māori and Pacific health experts, housing researchers, injury prevention experts and a consumer representative. The questionnaire contained items relating to a range of personal, household composition, lifestyle, and environmental characteristics and included putative risk and protective factors for unintentional falls. Ethnicity was determined by self-identification using the Statistics New Zealand 2001 Census ethnicity question as recommended in the Ministry of Health's Ethnicity Data Protocols for the Health and Disability Sector.¹⁰ Where possible, question items were replicated from previous falls research.¹¹⁻¹⁵ Following piloting of the instrument, questions and response options were refined and interviewing commenced in August 2005.

To facilitate analysis of exposures specifically related to the time of the falls, controls were randomly assigned an index day of the week and time of day as a reference point for control interviews. Times were based on the distribution of previous unintentional home fall admission data.

Participants were interviewed by trained research interviewers. Proxy interviews, usually with the next-of-kin or close friend, were undertaken for cases that died or were too unwell to be interviewed. Home surveys were not undertaken therefore all information relating to the identification of fall hazards/ protective factors was obtained by self-report. The average length of interviews was 15 minutes. Data was transferred from the completed questionnaires to Stata (version 8)¹⁶ for analysis.

Statistical methods

New Zealand Health Information Service data indicated on average 360 cases would be eligible for inclusion in the study. Based on an expected response rate of 85%, it was assumed that approximately 306 cases would be recruited over the course of the study. This number was sufficient to detect an odds ratio of 2.0 with 80% power and 95% confidence, for exposure present in 10 to 15% of the controls. A case to control ratio of 1:1 was selected.

The characteristics of study participants are described in terms of frequencies, means and proportions, and where relevant compared with national data.

Results

A total of 344 eligible cases were injured as a result of an unintentional (non-occupational) fall at home during the study period. All of these cases were identified during hospital surveillance, with none identified from the coroner's office. Interviews were completed for 335 (97.4%) of the 344 eligible people. Eight cases (2%) declined to participate, and there was one missed case. There were no statistical differences detected between case responders compared to non-responders with respect to gender, age group or ethnicity. Seven interviews (2%) were proxy interviews, in six of these the proxy was a spouse.

A total of 1,299 letters of invitation to participate were sent to potential controls. No contact was able to be made either by post, phone or home visit for 44% (n=570) of people. The cooperation, response and contact rates for controls in the study were 72.2%, 40.5%, and 56.1% respectively. These rates were calculated using formulas reported elsewhere (*Table 1*).¹⁷

Table 1: Methods of calculation of control cooperation, response, and contact rates

Cooperation rate =	The proportion of individuals that participated of those with whom there was contact	
	I + P + NE	
	$\overline{I + P + R + NE}$	
Response rate =	The proportion of individuals that participated of the total number of those invited to participate	
	I + P + NE	
	$\overline{I + P + R + NE + NI}$	
Contact rate =	The proportion of individuals for which there was contact made	
	I + P + R + NE	
	$\overline{I + P + R + NE + NI}$	
Where:	I = Interviewed	
	P = Partially interviewed	
	R = Refused	
	NE = Not eligible by study criteria	
	NI = not interviewed - no answer, no contact made	

Based on the limited data available on those who did not agree to take part, no significant differences (chi2 7.35, p= 0.11) were apparent between controls who took part in the study compared with those who refused to take part, by socio-economic status as measured by NZDep96 (*Table 2*). NZDep96 is a population level measure of deprivation that divides New Zealand into deciles.¹⁸ An NZDep96 score of 10 indicates that the census meshblock is in the least deprived 10% of the country. There were however significant differences by gender (chi2 5.04, p= 0.025) with control responders more likely to be male and less likely to be female than those who refused to take part.

Table 2: Characteristics of control responde	s and refusals
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Characteristics	Responders n = 352 (%)	Refusals n = 203 (%)		
Gender				
Male	208 (59.1)	100 (49.3)		
Female	144 (40.9)	103 (50.7)		
NZDep96				
9 to 10 most deprived	63 (19.0)	24 (12.8)		
7 to 8	57 (17.2)	25 (13.3)		
5 to 6	60 (18.1)	48 (25.5)		
3 to 4	67 (20.2)	41 (21.8)		
1 to 2 least deprived	84 (25.4)	50 (26.6)		

The younger age groups (25 to 40 years) among controls were underrepresented in the study with this age group contributing 29.1% of controls compared to 49.9% of the population for the region (*Table 3*).¹⁹ Controls self-identifying as Māori, New Zealand European or Pacific were underrepresented compared to the general population for the region. Limited data is available on the demographic composition of the New Zealand electoral roll. Controls participating in this study were underrepresented in the youngest (25 to 29 years) and over represented in the eldest (50 to 59 years) age groups compared with the electoral roll for the region.⁹

Table 3: Baseline distribution of socio-demographiccharacteristics of controls in the Auckland FallsStudy compared to census data for the region

Characteristics		Controls (n=352) n (%)	Proportion of Auckland region population 25 – 59 years (2001 census)
Age	25 - 29	22 (6.3)	15.5
	30 - 39	97 (27.9)	34.3
	40 - 49	114 (32.8)	28.9
	50 – 59	115 (33.1)	21.2
Gender	Male	208 (59.1)	47.8
	Female	144 (40.9)	52.2
Ethnicity	NZ European	204 (58.0)	66.1
	Māori	27 (7.7)	9.2
	Pacific Islands	35 (9.9)	10.5
	Other	86 (24.4)	14.3

Discussion

The Auckland Falls Study is the first population based case-control study in New Zealand or internationally that is primarily designed to investigate determinants of unintentional falls at home among working-age adults. While the case recruitment involved a very high response rate (97.4%), the conduct of the study exposed difficulties in recruiting control participants. The response rate from potentially eligible control participants was disappointing but consistent with rates of participation amongst general population controls in other epidemiological studies. ^{17, 20-24}

Controls were a random sample of the study data base (all people of working-age on the General or Māori electoral rolls for the Auckland region). The random selection from an established population register was designed to ensure that eligible individuals had the same probability of selection as a control thereby.⁶ However, selection bias may have arisen from the low response rate. Bias from non-response in controls could arise if those who declined to take part or who never received the letter of invitation differed systematically from those who did with respect to relevant exposures. Furthermore, some have argued that control responders are more health conscious than nonresponders.²² While some residual bias is inevitable, our casecontrol analyses will adjust for factors known to be associated with poor response, including age and socio-economic status.

A key advantage of using population controls is the opportunity to estimate exposure distributions in the study base for the calculation of absolute or attributable risks.^{6,25} As suggested by the control response rate in this study disadvantages of using population-based controls selected from the electoral roll using the approaches we employed include the potential lack of motivation to participate, difficulty in making contact with those selected, and the level of resource required to ensure high participation rates. It is important to note that we did not offer any financial or material incentives for participation.

Sources of controls that have been suggested as potential alternatives to the underlying population include neighbourhood controls, random-digit dialling, hospital or clinic controls, and dead controls.^{2, 5} A key advantage of neighbourhood controls is the ability to match on social class, while the disadvantages include the potential for selection bias related to exposures of interest and the high costs associated with recruitment.² The main concern with selection of controls by random-digit dialling is the ability to be assured of their representativeness of the general population, a problem that can result in biased estimates of the effects of socio-economically patterned exposure distributions.^{2, 25, 26} While controls selected from hospitals or clinics often result in higher response rates than those selected from the general, problems arise in relation to their lack of representativeness of the study base given particular referral patterns to the hospital or clinic, and the fact that they are not selected independent of exposures of relevance.^{4, 25}

A number of strategies have been identified that can improve participation rates amongst controls participants.⁷ Key strategies include the training, experience and personality of recruiters; the salience of the research topic; the appearance of postal material; and in-person approaches rather than initial telephone contact.^{7, 17, 23, 24} Web-based approaches are relatively new and increasingly popular but cannot be assured to generate samples representative of the general population given the non-random distribution of on-line access. Despite the multiple strategies employed to make contact with potential controls for the Auckland Falls Study no contact was made with 43.9% of those selected to participate. Contact was less successful with those who were younger possibly reflecting the high mobility among this age group. Addresses and telephone numbers that were invalid or out of date were important limiting factors in the ability to make contact with potentially eligible controls.

Conclusion

Well designed and rigorously conducted case-control studies are an important source of information to establish modifiable risk factors for unintentional injury. This study has addressed some short-comings of previous studies by selecting controls representative of the population from which the cases arose. However, the low overall response rate may have implications for the validity of estimates that will need to be carefully considered during case-control analyses.

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Appendix Seven: Prevalence paper

Prevalence of risk and protective factors for falls in the home environment in a population-based survey of young and middle-aged adult New Zealanders

Kool, B., Ameratunga, S., Lee, M., Robinson, E., Crengle, S., Jackson, R.

ABSTRACT:

Objective

To estimate the prevalence of hazards in the home environment that may contribute to unintentional falls among young and middle-aged New Zealanders.

Methods

A random sample of 352 young and middle-aged people (25-60 years) residing in Auckland was drawn from the electoral roll. The prevalence of environmental factors that may have an impact on risk of falls was investigated using a structured interviewer-administered questionnaire.

Results

Potential risk factors for falls were common in the study population (ladder use in the past year - 64%; inability to reach a light from bed - 21%; lack of handrails for stairs - 54%). Only 9% and 11% of baths and showers, respectively, had grab or hand rails; 42% and 56% had anti-skid mats/surfaces. Compared to those reporting no socio-economic deprivation characteristics, respondents reporting one or more such characteristics were less likely to use a ladder and have indoor stairs, but more likely to have outdoors stairs. There was no significant relationship between socio-economic status and presence of a grab/handrail or antiskid mats/surfaces in or near showers/baths.

Conclusion and implications

Structural hazards that are likely to result in falls at home are common in New Zealand. The greater prevalence of some environmental risk factors for falls among the least socially deprived population may account for the inconsistent association between socio-economic deprivation and fall-related injuries reported in previous research. Information regarding the contribution of these and associated factors to the occurrence of falls can help target and reduce the risks involved.

Globally, falls are a leading source of injury-related morbidity and a significant contributor to injury-related mortality, with the majority of falls occurring in the home setting.[1, 2] In New Zealand falls are responsible for around 43% of unintentional injury hospitalisations and 21% of unintentional injury deaths.[3]

Traditionally the focus of fall prevention strategies has been children and older people as the incidence of falls is greatest amongst these age groups. Multi-intervention prevention programs involving home assessment and modifications have resulted in reductions in the risk of falling in older people by up to 46%.[4] Far less is known about falls among young and middle-aged adults for whom the impact of injury has high costs and implications for lost productivity. [5-7] This age group accounts for over half of the moderate to serious injury claims for falls at home submitted to the Accident Compensation Corporation of New Zealand providing no-fault personal injury cover to all residents.[8]

We conducted a population-based survey of young and middle-aged adults in the Auckland region to estimate the prevalence of known environmental factors that influence the occurrence of falls at home. The findings are expected to inform the development and prioritisation of initiatives to reduce falls in this and similar settings.

Methods

As part of the Auckland Falls Case-control Study,[9] we invited the control group, a random sample of people aged 25 to 60 years of age on the general and Māori electoral rolls for the region (population of 1.3 million), to complete a questionnaire about the presence or absence of risk and protective factors relevant to unintentional falls at home. People unable to complete the survey in English and those not resident in the region at the time of interview were excluded. The study was approved by the Northern Regional Ethics Committee.

Subjects were sent a letter inviting them to participate in the study. If no postal response from the letter was received, a follow-up phone call was made; if no phone number was available a home visit was undertaken. Those unable to be contacted were considered "non-responders".

Participants agreeing to take part were contacted by trained interviewers who administered a structured questionnaire exploring a range of personal, demographic and structural characteristics relating to the home which are identified in the literature as risk or protective factors for unintentional falls. Direct observation in the home was not undertaken. Where possible, question items were drawn or adapted from previous falls research and validated self-report measures. Variation in the prevalence of risk factors by age, gender and socio-economic status (using NZiDep - an individual-level socio-economic deprivation index)[10] was also explored. Ethnicity was determined by self-identification using the Statistics New Zealand 2001 Census ethnicity question and classified to Level 2. Subgroups were too small to undertake ethnic-specific analyses.

The sample size was based on the requirements for the case-control study.[9] Data were analysed using Stata (Version 8) with chi-squared tests used to test for differences in proportions.

Results

Response rate

Of the 1299 individuals randomly selected from the electoral roll as potential participants, 570 (56.1%) could not be contacted, and 174 (23.9%) were found to be ineligible when contacted. Of the 555 who were eligible and contactable, 352 (63.4%) were interviewed. Eighty-two percent (n=287) of the interviews were conducted via telephone with the remainder carried out face-to-face.

Characteristics of respondents

Compared with the general population, survey respondents were more likely to be older (\geq 40 years) and female, but less likely to be socio-economically disadvantaged (Table 1). No significant differences were noted between subjects who were contacted and took part in the study compared with those who refused to take part by gender or socio-economic status (as measured by NZDep). The average household size was 3.5 persons; this is slightly higher than the average for the region (2.9 people).[11]

Prevalence of fall hazards and protective factors

The majority (86%) of responders' homes had outdoor stairs, and more than half (53%) had indoor stairs (Table 2). The New Zealand Building Act (2004) requires that stairs with more than three risers require a handrail. Over half of responders (54%) reported that at least one set of stairs with three or more consecutive steps inside or outside their homes had no handrail or banister.

Almost two thirds (64%) of respondents had used a ladder use during the past 12 months (Table 2). Males (78%) were more likely to have used ladders than females (54%) ($x^2 = 21.39$, df = 1, p < 0.0001). There was no statistically significant association between age group and ladder use in the past year ($x^2 = 9.89$, df = 1, p = 0.13).

Of the 294 respondents who had baths at home, only 9% reported the presence of grab or hand rails near the baths and 42% reported using antiskid bath mats or having antiskid surfaces in the bath. Of the 345 respondents with showers in the home, 11% had grab or handrails near or in the shower and 56% reported anti-skid mats or surfaces.

Most participants reported the lighting to be "adequate" in bathrooms (97%) or kitchen (90%). However, 21% of the sample reported being unable to reach a light from their bed.

Variations in the presence of hazards by socio-economic status

Compared with respondents reporting no deprivation characteristics, those reporting one or more such characteristics were less likely to have indoor stairs or use a ladder, but more likely to have outdoor stairs (Table 2). The presence of handrails or antiskid surfaces in or near baths and showers was not significantly associated with socioeconomic status.

Discussion

This survey of people aged 25 to 60 years in the Auckland region revealed that fall hazards were common in the homes of the majority of respondents. These included the presence of factors that increase the risk of falls (e.g., ladder use) as well as the absence of devices that can mitigate this risk (e.g., hand rails on stairs, anti-skid surfaces in baths and showers). Those reporting socio-economic deprivation characteristics were significantly less likely to have indoor stairs and use a ladder, but more likely to have outdoor stairs.

These findings must be interpreted in light of several limitations. The response rate from potentially eligible participants was disappointing but consistent with rates of participation amongst general population samples in other recent epidemiological studies.[12-14] Only 56% of the electoral sample was able to be contacted via post, telephone, or home visit. These low rates highlight the increasing limitation of this traditional method of subject selection for population-based studies. People who refused to participate or who were ineligible may have had different prevalence distributions of the risk and protective factors examined, resulting in biased study estimates. We are unable to quantify the extent to which this may have biased the results. Another significant limitation in the New Zealand context was the inability to undertake ethnic specific analyses due to insufficient power.

Household visits were not undertaken due to resourcing issues. This limited the ability to validate self-reported information and to investigate other environmental issues such as stair design and household clutter. Homeownership was not established therefore we were unable to investigate if the distributions of particular hazards or protective devices varied between rental and owner-occupier properties.

US studies have reported a higher prevalence of indoor stairs, and use of grab/handrails and antiskid mats/surfaces for baths, but a lower prevalence of outdoor stairs than the present study.[15][·][16] In contrast an Australian study reported a lower prevalence of indoor stairs than the current study.[17] The higher prevalence of ladder use among those reporting no individual socio-economic deprivation characteristics in this study is similar to US national estimates.[15] Despite these apparent socio-economic differences in some home hazards, the few studies that have investigated the association between falls and socio-economic status (SES) have been inconclusive.[18]

Conclusions and Implications

The greater prevalence of some environmentally-related risk factors for falls among the least socially deprived observed in the present study and in others may account for the lack of consistency in previous research on the association between deprivation and fall-related injury in the home. This is in contrast to the linear increase in risk with increasing socioeconomic deprivation frequently observed for road traffic crashes[19, 20], residential fire incidents[21], intentional injury[22], and injury mortality in general.

It is possible that important risk factors for falls as well as the socio-economic differentials in the presence of these factors may vary in different settings and among

different demographic groups (such as ethnicity). These relationships deserve scrutiny alongside aetiological studies that can estimate the contribution of risk factors to the occurrence of fall-related injuries among working aged adults.

Acknowledgements

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Characteristics	Participants n (%)	2001 census data % of Auckland region population 25-59 years
Sex		
Male	144 (40.9)	47.8
Female	208 (59.1)	52.2
Age group		
25-29	22 (6.3)	15.5
30-34	54 (15.5)	17.1
35-39	43 (12.4)	17.3
40-44	57 (16.4)	15.6
45-49	57 (16.4)	13.3
50-54	56 (16.1)	12.1
55-60	58 (17.0)	9.1
Ethnicity		
NZ European	205 (58.2)	65.5
Māori	27 (7.7)	9.3
Pacific	37 (10.5)	10.7
Asian	47 (13.4)	13.3
Other	36 (10.2)	1.2
NZ Deprivation index ^a scores		NZ national estimates ^b
1: No deprivation characteristics	210 (59.7)	50.7
2: 1 deprivation characteristics	78 (22.2)	20.3
3: 2 deprivation characteristics	26 (7.4)	10.7
4: 3 or 4 deprivation characteristics	25 (7.1)	10.5
$5: \ge 5$ deprivation characteristics	13 (3.7)	7.8

Table 1: Demographic characteristics of participants compared with 2001 census data

^a Salmond, S., Crampton,P., King,P. et al. NZiDep: A New Zealand index for socio-economic deprivation for individuals[10]
 ^b National estimates were used as regional estimates were unavailable

Table 2: Selected fall risks and protective devices in a study sample by NZ individual deprivation characteristics

		NZ individual deprivation characteristics	
Characteristics	Sample (N = 352) % (95% CI)	One or more deprivation characteristics (N=142) % (95% CI)	No deprivation characteristics (N=210) % (95% CI)
Stairs			
Indoor stairs	53.1 (47.9-58.3)	44.4 (36.5-52.6 CI)	59.1 (52.3-65.5 CI)
Outdoor stairs	86.1 (82.1-89.3)	90.9 (85.0-94.6 CI)	82.9 (77.2-87.4 CI)
Ladder use			
Ladder use at home in past 12 months	63.6 (58.5-68.5)	54.2 (46.0-62.2 CI)	70.0 (63.5-75.8 CI)
Bathroom ^a			
Grab bar/handrails near/in baths	8.5 (6.0-11.9)	10.6 (6.5-16.7 CI)	7.1 (4.4-11.5 CI)
Antiskid bath mat/surface near/in baths	42.0 (37.0-47.3)	39.4 (31.8-47.7 CI)	43.8 (37.3-50.6 CI)
Grab bar/handrail in/near showers	11.1 (8.2-14.8)	14.8 (9.9-21.6 CI)	8.6 (5.5-13.1 CI)
Antiskid shower mat/surface in showers	55.7 (50.5-60.8)	54.2 (46.0-62.2 CI)	56.7 (49.9-63.2 CI)

^a In homes with more than one bathroom the bathroom most commonly used was the reference

Appendix Eight: Results paper



ALCOHOL

Alcohol 42 (2008) 383-388

The contribution of alcohol to falls at home among working-aged adults

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Abstract

The role of alcohol in the occurrence and burden of fall related injury at home is unclear. We examined the contribution of alcohol to fatal and hospitalized injuries due to unintentional falls at home among working-aged adults. We conducted a population-based case—control study in Auckland, New Zealand between July 2005 and July 2006. Cases were 335 people aged 25–60 years who were admitted to hospital or died as a result of unintentional falls at home. Control subjects were 352 people randomly selected from the electoral roll from the same age band as the cases. The participants or next-of-kin completed a structured interview that ascertained data on socio-demographic, personal, and lifestyle factors including alcohol consumption. After controlling for confounding, the consumption of two or more standard alcoholic drinks in the preceding 6 h relative to none was associated with a significantly increased risk of fall related injury (for two standard drinks: odds ratio: 3.7, 95% confidence interval: 1.2-10.9; for three or more drinks: odds ratio: 12.9, 95% confidence interval: 5.2-31.9). Approximately 20% of unintentional falls at home in this population may be attributable to the consumption of two or more alcoholic drinks in the preceding 6 h. Drinking is strongly associated with unintentional falls at home that result in admission to hospital or death. Moreover, a substantial proportion of falls at home among working-age people can be attributed to alcohol consumption. This largely unrecognized problem should be addressed in falls prevention programs. © 2008 Elsevier Inc. All rights reserved.

Keywords: Accidental falls; Accidents, home; Adults; Alcohol, drinking; Injury

Introduction

The public health impact of unintentional falls is substantial. The published fall-related literature is dominated by studies examining the causes and consequence of these falls among older-age adults. And yet in the United States, unintentional falls are the leading cause of nonfatal injuries resulting in emergency department visits (22%), hospitalizations (24%), and the third leading cause of unintentional injury death in the 25–59 year age group (CDC WIS-QARS, 2005a; 2005b). A review of Norwegian injury register data found 44% of injuries sustained inside the dwelling among people aged 25–64 years were as a result of falls (Kopjar & Wickizer, 1996). In New Zealand, falls account for a significant burden of injury being responsible for approximately 43% of unintentional injury mortality across all

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age groups (Injury Prevention Research Unit National Injury Query System). Among the working-age population (25–59 years) almost one-third of unintentional falls resulting in-patient admissions or deaths occur at home (Kool et al., 2007).

In New Zealand, entitlement claims for injury compensation over the period 2003–2005 for unintentional falls among working-age people have risen by nearly a third from NZ\$61 million to NZ\$81 million (Injury Statistics ACC data warehouse, 2005). The impact of injury in this relatively young population may have significant implications for both work productivity and family life (Talbot et al., 2005).

The role of alcohol in road traffic crashes as well as the proportion of crashes attributable to varying amounts of alcohol consumed in the preceding 6 h is well established (Connor et al., 2004). In contrast the role of alcohol in fall-related injuries is unclear. However it is estimated that 7% of the burden of worldwide disability and death related to falls is attributable to alcohol (Room et al., 2005).

Drinking alcohol can result in impaired cognitive and behavioral skills, predisposing an individual to injury (Driscoll et al., 2004; Li et al., 1994; Paljarvi et al., 2005). Alcohol intoxication may also adversely affect a person's physiological response to serious injury by impairing the cardiovascular response to acute blood loss, promoting electromechanical disassociation, and increasing the likelihood of an adverse outcome following a traumatic brain injury (Moore, 2005).

Studies examining the association of alcohol with falls among older age adults have found mixed results with odds ratios for usual alcohol consumption ranging from 0.35 to 1.70 (Mukamal et al., 2004; Nelson et al., 1992; O'Loughlin et al., 1993; Peel et al., 2006; Pluijm et al., 2006; Sorock et al., 2006). Few studies have investigated the association of alcohol with falls at home among people of working age (25–60 years), an age group where serious injury can result in significant implications for both work productivity and family life.

Previous case—control studies examining the role of acute alcohol use in falls have been limited methodologically by the lack of controls representative of the study base and inadequate adjustment for important confounders such as comorbidities, and prescription medication use (Chen et al., 2005; Honkanen et al., 1983; Keegan et al., 2004; Nelson et al., 1992; Sorock et al., 2006).

We report the findings from a case—control study that aimed to address these limitations and investigate the contribution of alcohol to unintentional falls at home among working-age people.

Materials and methods

A population-based case—control study of unintentional falls resulting in primary hospitalization or death among working-aged people was conducted in the Auckland region of New Zealand between July 2005 and July 2006. The region has a population of approximate 1.3 million (32.5% of the national population) and includes urban, suburban, and rural areas (Statistics New Zealand, 2007). The study base comprised people aged 25—60 years of age registered on the General or Māori electoral roll for the region. We excluded nonEnglish speaking people.

The cases included all individuals from the study base who were admitted to hospital or died as the result of nonoccupational unintentional falls at home in the study region. Case finding and recruitment was undertaken prospectively through each of the three trauma admitting hospitals for the region and the Coroner's office.

The control group comprised a random sample of people from the General and Māori electoral rolls for the region. In New Zealand, 98% of people in this age group who are eligible to vote are registered on the electoral rolls (Elections New Zealand).

Based on the distribution of previous unintentional home fall admission data, an index day of the week and time of day was randomly assigned as a reference point for control interviews. This enabled analyses of exposures specifically related to the time of the falls.

All participants were interviewed by trained research interviewers using a standardized structured questionnaire. Case interviews were conducted face-to-face in hospital. Proxy interviews, usually with the next-of-kin or close friend, were undertaken for cases who had died or who were too unwell to be interviewed. Control interviews were conducted by telephone or face-to-face.

Information on acute alcohol use was obtained by asking participants how many drinks (converted to standard 12 g alcohol units) they had consumed in the 6 h before the fall (cases) or index time (controls). Information on usual drinking patterns was ascertained using the Alcohol Use Disorders Identification Test (AUDIT) with a score of 8 or more considered indicative of a hazardous pattern of drinking (Babor et al., 2001).

Information was also collected on: general health, physical activity, prescription medication use, lifestyle, and environmental risk factors that could potentially confound the association of alcohol with fall risk. In addition, this analysis included data on the age, sex, ethnicity, Body Mass Index, socioeconomic status (employment status and NZiDep—a New Zealand index of socioeconomic deprivation for individuals) (Salmond et al., 2004), living arrangements, and average hours spent at home awake during the week or weekend. All data were self-reported. Ethnicity data was collected using the 2006 Statistics New Zealand census ethnicity question.

Ethical approval for the study was obtained from the Northern Regional Ethics Committee.

Odds ratios and confidence intervals (CIs) were calculated using unconditional logistic regression models. The inclusion of potential confounders in the multivariable model was assessed using Greenland's change in estimate model (Greenland, 1989). Population-attributable risks were calculated according to the methods developed by Walter for adjusted relative risks (Walter, 1978).

Results

Of the 344 eligible cases identified during the study period, 335 (97.4%) completed interviews, 8(2.3%) declined, and there was one missed case (0.3%). Seven interviews were conducted with a proxy respondent (2%). Of the 1,299 individuals randomly selected from the electoral roll to take part as controls, 570 (56.1%) could not be contacted, and 174 (23.9%) were found to be ineligible when contacted (Fig. 1). Of the 555 who were eligible and contactable, 352 (63.4%) were interviewed. Because the sampling frame used the limited data available on those controls who did not agree to take part, there were no apparent significant differences by socioeconomic status as measured by NZDep96 (a population based measure of deprivation) (Salmond & Crampton, 2001) between those who took part and those who refused.



Fig. 1. Control selection and recruitment.

Table 1 displays the distribution of measures of alcohol consumption and potential confounders. The prevalence of hazardous drinking as measured by the AUDIT score (\geq 8) was 24.5% and 13.5% among cases and controls, respectively. Approximately 28.1% of cases reported drinking some alcohol in the previous 6 h, compared with 6.8% of controls.

The type of falls most likely to be associated with selfreported acute alcohol consumption of three or more drinks were falls on the "same level" (W03, W18) n = 3/6; falls involving bed, chair, or other furniture (W06, W07, W08) n = 3/15; falls involving stairs (W05) n = 23/162; falls from building or structures (W13) n = 6/38; and ladder falls (W11) n = 7/54.

There was a significant association between the risk of fall injury and acute alcohol consumption after controlling for age, gender, ethnicity, paid employment, and deprivation, and this remained following adjustment for chronic hazardous drinking, prescription medication use, physical activity, sleep in previous 24 h, smoking, and marijuana use. The odds ratios for two drinks or three or more drinks compared with no drinks were 3.7 (95% CI 1.2–10.9) and 12.9 (95% CI 5.2–31.8), respectively (Table 2).

A positive association was also apparent between chronic hazardous drinking (as measured by an AUDIT score ≥ 8) and the risk of having a fall-related injury after controlling for age, gender, ethnicity, paid employment, and deprivation. However, this association was not statistically significant when acute alcohol use (in the preceding 6 h) and confounding variables were included in the regression model. Acute alcohol consumption was

Distribution of measures of alcohol	consumption and	confounding vari-
ables for case and control subjects		

	Cases $(n = 335);$	Controls $(n = 352);$
	n (%)	n (%)
Alcohol use in previous 6 h (drinks)		
0	240 (71.9)	327 (93.2)
1	13 (3.9)	12 (3.4)
2	16 (4.8)	5 (1.4)
≥3	65 (19.5)	7 (2.0)
Alcohol screen (AUDIT)		
Low risk (score 0–7)	243 (75.5)	301 (86.5)
Hazardous (score ≥ 8)	79 (24.5)	47 (13.5)
Age		
Mean in years (S.D.)	45.9 (SD 10.22)	44.6 (SD 9.36)
Median in years	47 (38 - 54)	44 (36 - 51)
(interquartile range)		
Gender		
Female	180 (53.7)	208 (59.1)
Male	155 (46.3)	144 (40.9)
Ethnicity		
NZ European	214 (63.9)	204 (58.0)
Māori	37 (11.0)	27 (7.7)
Pacific Islands	29 (8.7)	35 (9.9)
Other	55 (16.4)	86 (24.4)
Socioeconomic status		
(in paid employment)		
Yes	216 (65.1)	287 (81.8)
No	116 (34.9)	64 (18.2)
Socioeconomic status		
(NZ Deprivation index)		
1: no deprivation characteristics	196 (60.7)	205 (59.8)
2: 1 deprivation characteristics	52 (16.1)	74 (21.6)
3:2 deprivation characteristics	39 (12.1)	26 (7.6)
4:3-4 deprivation characteristics	14 (4.3)	25 (7.3)
\geq 5: deprivation characteristics	22 (6.8)	13 (3.8)

AUDIT = Alcohol Use Disorders Identification Test.

Column totals could differ as a result of missing data.

associated with an increased fall risk for subjects with both low and high-risk AUDIT scores. No significant interactions between acute alcohol use and chronic hazardous drinking, and sociodemographic variables were apparent.

The population-attributable risk associated with acute alcohol consumption was calculated by dichotomizing the *alcohol use in preceding 6 h* variable from the multivariable model in Table 2 to less than two drinks, and two or more drinks. Drinking two or more alcoholic drinks in the preceding 6 h was associated with a population-attributable risk of 20% (95% CI 17–24).

Discussion

Our findings suggest that drinking in the previous 6 h has a strong and consistent relationship with the risk of unintentional falls at home among working-age people. This

Table 2 Association of self-reported alcohol variables with a moderate to serious injury fall

	Model 1 ^a : single risk factor model; adjusted OR (95% CI)	Model 2 ^b : multivariable model; adjusted OR (95% CI)
Alcohol use in p	preceding 6 h	
0	1.0	1.0
1	1.18 (0.47-2.86)	1.40 (0.58-3.34)
2	3.37 (1.14-9.97)	3.66 (1.23-10.85)
≥3	14.2 (6.11-33.4)	12.85 (5.19-31.82)
Alcohol screen	(AUDIT)	
Low risk	1.0	1.0
Hazardous	2.19 (1.38-3.49)	0.90 (0.51-1.56)

 $\begin{array}{l} AUDIT = Alcohol \mbox{ Use Disorders Identification Test, } OR = Odds \mbox{ ratio}, \\ CI = Confidence \mbox{ interval.} & Figures \mbox{ are adjusted odds ratios and } 95\% \\ confidence \mbox{ intervals.} \end{array}$

^aModel 1: Adjusted for age, gender, ethnicity, paid employment, and NZiDep.

^bModel 2: Adjusted for age, gender, ethnicity, paid employment, and NZiDep. Model included smoking, acute marijuana use, prescription medication use, sleep in previous 24 h, and physical activity.

relationship remained significant when associations were adjusted for potential confounding factors. Importantly, even low-levels of alcohol consumption were noted to increase the risk of fall-injury at home, with the avoidance of alcohol estimated to reduce the number of these injuries by up to 20%. This is a largely unrecognized problem and even small reductions in alcohol consumption could lead to significant reductions in fall-related injuries at home. Such injuries are likely to have important adverse consequences among working aged adults given the impact on economic productivity and the ability to care for dependents.

This case—control study has addressed some shortcomings of previous studies by selecting controls representative of the population from which the cases arose. The study was population based and attempted to identify all cases (fatal and nonfatal) arising from the study base. The study had few exclusion criteria, the most important being participants needed to speak English. The most recent census (2006) data indicates that only 4.1% of New Zealanders do not speak English (Statistics New Zealand, 2007).

Case ascertainment is likely to be complete because cases were recruited from all three hospitals admitting trauma patient of this nature in the region, and from the only Coroner's office in the region. Using this approach to case ascertainment (as opposed to identifying cases from discharge codes) and the very high case response rate (97.4%) helped minimize selection bias.

Although the use of proxy interviews may have introduced systematic error in the measurement of some exposures, only seven (2%) interviews were conducted in this manner. As relatively few records had missing information in key variables relevant to this analysis (acute alcohol consumption measures n = 3), it is unlikely that the effect estimates were substantially affected.

The control information was derived from a sample of the study database (all working-aged people on the General or Māori electoral rolls for the Auckland region). The response rate was disappointing but is typical of response rates in epidemiological studies currently being undertaken in New Zealand (Cardis et al., 2007; Jull et al., 2004). Selection bias may have arisen from the sampling method employed or from the selective participation of subjects. Approaching people by mail proved problematic as it was difficult to establish who had received the letter of invitation. Bias from nonresponse in controls could arise if those who declined to take part or who never received the letter of invitation differed systematically from those who did with respect to relevant exposures. Adjusting for factors known to be associated with poor response, including age and socioeconomic status, should have reduced these biases to some extent.

Differential recall of information relating to a situation by cases and controls can result in recall bias (Rothman & Greenland, 1998). The methods used to minimize recall bias in this study included the standardized administration of identical exposure questions for cases and controls.

Blood alcohol results were only available for cases for which the medical staff elected to take blood samples (15.9%), although alcohol use was suspected by medical staff in 24.9% of cases. The relationship between BAC levels and self-reported acute consumption was not specifically compared in this study as BAC levels were only available from half of the cases (this was not a random sample), and none of the controls. The lack of objective alcohol information from both case and control subject is a weakness of this type of study. Previous research has shown the prevalence of denying drinking when registering a positive breath analysis is low (estimated to range between 0.5% and 3.6%) suggesting self-report of acute alcohol consumption may provide reasonably valid information (Cherpitel et al., 1992). Self-report information offers the advantage that it is not dependent on the timeliness of presentation to hospital following injury (Cherpitel, 2007), and provides the opportunity to explore dose-response relationships (Hingson & Howland, 1987).

We undertook adjusted analyses to reduce confounding by a range of relevant demographic, lifestyle, and other variables. However, as with all observational study designs, residual confounding remains a threat to the internal validity of this study (Rothman & Greenland, 1998). Some factors not included in this study but worthy of exploration include environmental factors (e.g., household clutter), and vision and gait impairments.

The results of our study reflect similar findings to other analytical studies investigating the role of alcohol in injury. A case-crossover study investigating the risk of unintentional injury associated with acute alcohol consumption and injury among adults presenting to emergency departments reported an odds ratio of 2.5 (95% CI 1.2–5.4) for one or more drinks in the preceding 6 h compared with no drinks in the same period, and an odds ratio of 5.0 (95% CI 1.4-27) for four or more drinks compared with three or less drinks (Vinson et al., 1995). Another study of emergency department injury presentations by Borges et al. (2004), found a relative risk of 3.9 (95% CI 2.9-5.5) for alcohol consumed in the previous 6 h compared to no alcohol. As in our study, the authors noted an increase in risk of injury with increasing numbers of drinks consumed but no significant interaction between the effects of acute and chronic alcohol use.

Although this study has helped to quantify the role of alcohol in falls among people of working age, the confidence intervals around these effect estimates were relatively wide. Future studies with sufficiently large sample sizes are required to investigate which subgroups are at increased risk of fall injury associated with acute alcohol use (e.g., by age, gender, ethnicity, type of fall), the relationships between patterns of drinking and the severity of fall-related injuries, and the interrelationships between factors such as fatigue, sleepiness, or shift work and the effects of acute alcohol consumption. Research protocols should particularly focus on enhancing participation rates and incorporating objective measures of acute alcohol use.

As identified by Smith et al. (2001, 2006), falls in the home and work settings are likely to share many common characteristics. These factors deserve greater attention in injury prevention strategies that transcend the boundaries of workplace and home. Specific interventions to reduce the risk of fall injuries among working aged adults could include strategies aimed at screening for alcohol abuse and brief interventions for hazardous drinkers in the emergency department and primary care settings (Beich et al., 2002; Kypri et al., 2008), and efforts to raise public awareness of the potential risks associated with alcohol use and injuries at home.

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Appendix Nine: Falls results fact sheet


Injury Prevention Information Centre

Risk Factors for serious fall-related injuries at home among working-age adults

Background

Unintentional falls account for a significant public health problem for people of all ages. Falls are the leading cause of injury hospitalisation and one of the three leading causes of injury death in New Zealand.¹ The commonest location of such injuries is the home.²⁻⁴ Serious falls among working-age people may have significant consequences for work productivity and family life.⁵

This fact sheet summarises the findings from a population-based case-control study designed to identify modifiable risk factors for unintentional falls at home resulting in death or admission to hospital among working-age adults (25 to 60 years).

The Auckland Falls Study

Cases in this study were individuals aged 25 to 60 years involved in a fall-related injury at home in the Auckland region resulting in death or admission to hospital over the 12-month study period commencing in July 2005. Controls (the comparison group) were randomly selected from the General and Māori electoral rolls for the Auckland region from the same age group as the cases.⁶ Data was collected via questionnaire on a range of known and postulated risk factors for falls, and on potential confounders (factors which can distort the relationship between exposure e.g. alcohol use and outcome e.g. fall). The study recruited 335 cases (97.4% response) and 352 controls (64.2% response).

Main findings

- Consuming alcohol in the previous six hours was associated with an approximately 12-times increased risk of a fall-related injury.⁷
- The risk increased as the level of intake increased with even relatively low levels of alcohol associated with significant risk (Figure 1). For example, people who had consumed two standard alcoholic drinks in a six hour period were up to four times more likely to fall than those who had none, and people who had three or more standard drinks in that same period were up to 12 times more likely to fall than those who had none.



Figure 1: Risk of a fall-related injury due to alcohol use in previous 6-hours. The error bars indicate the 95% confidence intervals of the estimates, a statistical interpretation of the level of precision around the estimates

• People who used two or more prescription medications were approximately 3 times more likely to have a fall-related injury compared to those who were on one or no medication. It is important to note that this finding may reflect risks associated with particular health conditions rather than the medications themselves.



• Compared with people who had levels of activity consistent with the recommended national guidelines, those who did not had double the risk of a fall-related injury.

New Zealand physical activity recommendations:⁸

≥30 minutes of **moderate** exercise or

 \geq 15 minutes of **vigorous** exercise on at least five days per week.

Recommendations

- 1. Reducing the intake of alcohol and increasing regular physical exercise are likely to protect against serious injury-producing falls at home among people of working-age.
- 2. Fall prevention strategies should actively engage working-age adults, complementing existing programmes focusing on people of older ages.
- 3. Future research should particularly examine the effects of fatigue, specific health conditions and medications, and environmental and equipment-related factors that may increase the risk of falls and the cost and disability related to thee injuries.

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Injury Prevention Information Centre, School of Population Health University of Auckland, Private Bag 92019, Auckland Research Bulletins are available online at: http://www.fmbs.auckland.ac.nz/soph/centres/ipic Appendix Ten: Study Manual





STUDY MANUAL

A case-control study of falls of a serious nature occurring in the home environs in the Auckland region in people aged 25 to 60 years.

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Funding Sponsor:	Accident Compensation Corporation PO Box 242 Wellington Phone: 04 918 7700
Protocol Number:	IPRC Core Contract 04/07
Date:	07/07/05 Falls Study Protocol V6.doc

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Auckland Falls Study Research Protocol Study Summary

A case-control study of falls of a serious nature occurring in the home Title environs in the Auckland region in people aged 25 to 60 years. Short Title Risk factors for serious falls in the home in the working age population. Protocol No. IPRC Core Contract 04/07 Three part study: • Part One: Descriptive epidemiological study of serious falls in the home setting in the working age population. Methodology Part Two: Prevalence study of postulated and known risk factors for serious falls in the home setting in the working age population. Part Three: Case-control study of modifiable risk factors for serious in • the home setting in the working age population. Study Duration 12 months data collection period. The study center is the University of Auckland. Study sites include: **Study Center** Middlemore, Auckland City, and North Shore hospitals. 1. To describe the epidemiology of serious falls in home the setting in people aged 25 to 60 years in the Auckland region. 2. To identify issues relating to the miscoding of falls in hospitalisation data. 3. To identify issues relating to the misclassification of ethnicity for this patient group in hospitalisation data. 4. To identify modifiable risk factors for serious falls in the home setting Objectives in people aged 25 to 60 years. 5. To establish the prevalence of postulated or known risk factors for serious falls in the home setting in a random sample of people aged 25 - 60 years in Auckland. 6. To identify opportunities for injury prevention initiatives aimed at reducing the incidence and severity of serious falls in the home setting in people aged 25 - 60 years. Part one: Descriptive Study: approximately 397 subjects. ٠ Number of Part two: Prevalence Study: approximately 300 subjects. • Subjects Part three: Case-control Study: approximately 300 cases and 300 controls. Main Inclusion People aged 25 to 60 years admitted to one of the three Auckland public Criteria hospitals as a result of a serious fall injury in the home setting. The descriptive and prevalence studies will be analysed using descriptive Statistical statistics such as proportions, means and medians. The case-control study analysis will include multiple logistic regressions to estimate odds Methodology ratios (OR) and their 95% confidence intervals.

1 Background

Falls account for a significant burden of injury in New Zealand and are the leading cause of injury hospitalisation. During the period 1993-1998 falls accounted for 38% of all admissions to New Zealand public hospitals. Falls are a leading cause of injury death in NZ, accounting for 14% of injury mortality during the 1993-1998 periods. High risk populations for ACC fall claims include: males aged 25-60 years; older adults; and children less than five years of age. Recent analysis of ACC data indicates an increase in claims in females aged 25-60 years.

The home is the most common location for injury morbidity and second to the roads as the location for injury mortality. New Zealand data of self-reported injuries indicates nearly one third of injuries occur within the home. To date there has been limited rigorous research undertaken to identify modifiable risk factors for falls amongst adults aged 25-60 years. Identification of factors which place individuals at greater risk of sustaining fall-related injury in a home setting will aid in the development of evidence-based interventions to lower the incidence and severity of falls occurring in this setting.

The focus of this research is in line with the New Zealand Injury Prevention Strategy (ACC, 2003) which identifies falls as one of the six priority areas within the Strategy. ACC has developed a draft falls strategy - "Preventing Injury from Falls: the National Strategy 2005-2015" (December 2004). This research directly addresses two of the five objectives in the Strategy:

- Objective two Improve the gathering and dissemination of knowledge focusing on the prevention of injury from falls.
- Objective three Develop and implement best practice fall prevention initiatives.

2 Risk and benefits of participating in the study

Participants' treatment will not be affected by participating in this research.

Participants are providing information to inform research on modifiable risk factors for fall injuries in the home, which will be used by experts to assist with the development of injury prevention initiatives. Participants will be offered an injury prevention fact sheet (Kainga Preventive Injury List) as a benefit for participation in the study and/or as a koha for the manakitanga (hospitality) of a home visit. The research provides a potential opportunity to put participants in touch with support services if required.

3 Study research questions and objectives

The study research questions are:

Part 1 - Descriptive Study:

What are the types, patterns, and outcomes of falls of a serious nature occurring in and around the home for people aged 25 to 60 years?

Part 2 - Prevalence Study:

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What is the prevalence of putative individual and environmental risk factors for falls in random sample of people aged 25 to 60 years?

Part 3 - Case-control Study:

What are the etiological factors for falls of a serious nature occurring in and around the home for people aged 25 to 60 years?

The study objectives are:

- 1. To describe the epidemiology of falls within home settings that result in serious injury (hospitalisation or death) in people aged 25 to 60 years in the Auckland region.
- 2. To identify issues relating to the miscoding of falls in hospitalisation data.
- 3. To identify issues relating to the misclassification of ethnicity for this patient group in hospitalisation data.
- 4. To identify modifiable risk factors for serious fall related injuries occurring within home settings in people aged 25 to 60 years.
- 5. To establish the prevalence of postulated or known risk factors for falls of a serious nature occurring within home settings in a random sample of people aged 25 60 years in Auckland.
- 6. To identify opportunities for injury prevention initiatives aimed at reducing the incidence and severity of falls of a serious nature occurring within home settings in people aged 25 60 years.

4 Study Design

4.1 General Design

The study will be in three parts:

4.1.1 Part One:

A descriptive epidemiological study of falls of a serious nature (resulting in hospitalisation) occurring in the home setting in the working age population (25 to 60 years of age). Participants ("cases") will be identified from admissions to Auckland City, Middlemore, or North Shore Hospitals or from Post Mortem reports of those cases that died prior to admission to hospital. The data collection period will be 12 months. Data will be abstracted from numerous sources:

- Background information from medical records or post mortem records.
- Auckland City Hospital Trauma Registry data for "cases" admitted to Auckland City Hospital.
- Hospitalised cases will complete a face-to-face interview administered structured Study Questionnaire.

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4.1.2 Part Two:

A prevalence study of postulated and known risk factors for falls of a serious nature occurring in the home setting in the working age population. Participants ("controls") will be randomly selected from the General and Mäori electoral rolls for the Auckland region and will be in the same five year age bands as the "cases: in Part One (as detailed above). The data collection period will be 12 months. Data will be abstracted from a telephone (or face-to-face if preferred) interviewer administered structured Study Questionnaire.

4.1.3 Part Three:

A case-control study of modifiable risk factors for falls of a serious nature occurring in the home setting in the working age population. "Cases" (people who have a serious fall in the home) will be identified as described in the descriptive epidemiological study above (Part One). Information obtained from cases will be compared with the information obtained from the "controls" with respect to the exposures of interest in the study.

4.2 Outcomes

The identification of modifiable risk factors for falls of a serious nature in the working age population occurring in the home and its immediate environs will provide valuable information for the development of injury prevention initiatives to reduce the incidence, morbidity, and mortality associated with this mechanism of injury. In addition the quantification of the prevalence of individual and environmental risk factors for falls of a serious nature occurring in the home setting in a random sample of Aucklanders aged 25 - 60 years will aid in the development of targeted injury prevention messages and interventions. The identification of issues relating to the miscoding of home related falls in this age group in hospitalisation data will help to inform changes in practice to increase the accuracy of falls data and thereby its usefulness. Quantification of ethnicity miscoding for Mäori with respect to home setting serious fall injuries will help to more accurately estimate the falls burden of injury for Mäori.

4.3 Subject Selection

4.3.1 Inclusion Criteria:

Part One – Descriptive study:

Subjects "cases":

- 1. Primary admission (including deaths) to a service other than the Emergency Department at one of the three Auckland public hospitals as a result of a fall occurring in the home (including within the boundaries of the property) setting in the Auckland region.
- 2. Died as a result of a fall occurring in the home setting in the Auckland region and were not admitted to hospital.
- 3. Aged 25 to 60 years of age.
- 4. Capable of giving informed consent, or have an acceptable surrogate capable of giving consent on the subject's behalf.

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Part Two – Prevalence study:

Subjects "controls":

- 1. Aged 25 to 60 years of age.
- 2. On either the General or Mäori Electoral Roll for the Auckland region.
- 3. Capable of giving informed consent.

Part Three – Case-control study:

Subjects "cases":

- 1. Primary admission (including deaths) to a service other than the Emergency Department at one of the three Auckland public hospitals as a result of a fall occurring in the home setting (including within the boundaries of the property) in the Auckland region.
- 2. Aged 25 to 60 years of age.
- 3. On either the General or Mäori Electoral Roll for the Auckland region.
- Capable of giving informed consent, or have an acceptable surrogate capable of giving consent on the subject's behalf.

Subjects "controls":

As per Part Two above.

4.3.2 Exclusion Criteria:

Part One – Descriptive study:

Subjects "cases": 1. People falling in the course of undertaking paid work in another's home.

Part Two – Prevalence study:

Subjects "controls":

Nil.

Part Three – Case-control study:

Subjects "cases":

1. Falls occurring in residential institutions.

2. People falling in the course of undertaking paid work in another's home.

Subjects "controls":

Nil

4.4 Subject Recruitment

The study will be carried out in the Auckland region, from Wellsford in the north to Mercer in the south, and will cover the seven Territorial Local Authorities: Rodney

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4.4.1 Case recruitment:

Admission registers of the three recruiting hospitals (North Shore, Auckland City, and Middlemore) will be reviewed three times per week by the study nurse to identify potential cases meeting the study inclusion criteria. Clinical staff will introduce potential cases to the research project both in person and by way of a brief introduction letter, and ask them if they would be interested in meeting with the study research nurse. Potential cases who agree to meet with the study nurse will have their contact details recorded for the study nurse in a log. A daily admission report of people aged 25 to 60 years of age admitted to the respective hospital with either an identified fall injury or injuries that may be consistent with a fall injury will be provided to the study research nurse as a quality assurance measure to ensure all potential cases have been approached by clinical staff.

4.4.2 Control recruitment:

Population-based controls will be randomly selected from the electoral rolls for the Auckland Regional Council constituency (this will include people on both the Mäori and General) from the same age group as the cases. Telephone details of this sample will be sought from telephone service providers. A letter will be sent to potential controls inviting them to participate in the study. The letter will include a brief letter of introduction to the study and the research team, a participant information sheet for controls, the consent form, an ACC falls prevention brochure, and a self-addressed stamped envelope advising them of the study. They are asked to return (in the self addressed stamped envelope) the consent form either signing to say they agree to participate or ticking the "no" box to indicate they do not want to participate.

Potential controls will then be approached via their home telephone by study personnel to arrange a time at their convenience to be telephoned by the study research nurse. If no response is received a follow up phone call will be made to establish if the potential control received the study letter and to inquire if they would like to participate in the study. If no phone number available and no response to invitation of participation then the study nurse will visit each location to determine an outcome. Three phone attempts will be made if unsuccessful then the person will be allocated "non-responder" status.

5 Data Collection

Key informants in the descriptive and case-control studies are:

- "cases" who have been hospitalised as a result of an injurious fall at home, presented within 48 hours of injury in the Auckland region and/or or their proxies.
- "controls" who have been randomly selected from the Auckland region Maori and General electoral rolls.

Key informants in the prevalence study are:

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 "controls" who have been randomly selected from the Auckland region Maori and General electoral rolls

The data collection sources and processes for each of these will now be described.

5.1 Cases

Key informant "cases" in the descriptive and case-control studies will be interviewed using a questionnaire-based (the Study Questionnaire – Appendix One) structured interview, taking 30 to 40 minutes. The interview will be conducted by the study research nurse face-to-face in most instances whilst the case is in hospital, if it is not possible or if the case prefers the interview can take place in the case's home. Whanau/friends/family may be present during the interview if requested.

The Study Questionnaire contains 119 questions in total, of which most participants will skip some sections which are not applicable to them. Areas covered include:

- Demographic information: age, gender, ethnicity, socioeconomic factors.
- Circumstances of the fall: environmental factors, physical circumstances, fatigue, alcohol and drug use.
- Personal factors: medical conditions, prescription medication use, usual alcohol and drug use, sleep patterns.
- Home details: presence of stairs, flooring surfaces, ladder use, lighting.

Individuals included in the descriptive and case-control study that have been hospitalised or died as a result of a serious fall injury in the home will have their medical record and /or post mortem record reviewed and a *Medical Record Abstract* (Appendix Two) completed. For cases admitted to Auckland City Hospital their Trauma Service Trauma Registry file will also be reviewed.

5.2 Controls

Key informant "controls" will be interviewed using a questionnaire-based (the Study Questionnaire) structured interview, taking 20 to 30 minutes. The interview will be conducted by the study research nurse via telephone, if the control prefers the interview can be conducted in the "controls" home face-to-face. Whanau/friends/family may be present during the interview if requested.

The same Study Questionnaire used in the "case" interviews will be used in the "control" interviews. All the "control" participants will skip the "fall related section" and some may also skip other sections if they are not applicable.

6 Statistical Plan

6.1 Sample Size Determination

NZHIS data indicates on average 360 cases will be eligible for inclusion in the study. Assuming a response rate of 85% is achieved, approximately 306 cases would be recruited over the course of 12 months. The table below shows this number would be CONFIDENTIAL

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sufficient to detect an odds ratio of 2.0 with 80% power and 95% confidence, for exposure present in 10 to 15 % of the controls. Case: control ratio 1:1.

	Proportion	of controls e	xposed	
	0.10	0.15	0.20	0.25
Number in each group	308	261	187	163

6.2 Statistical Methods

6.2.1 Part One - Descriptive Study, and Part Two - Prevalence Study

Descriptive statistics such as proportions, means and medians will be reported.

6.2.2 Part Three - Case-control Study

Multiple logistic regressions will be used to estimate odds ratios (OR) and their 95% confidence intervals. Variables such as sleep and alcohol consumption will be included in models as continuous variables to evaluate dose response relationships. Population attributable risks will be calculated to estimate the proportion of cases explained by exposure to specific risk factors. Analyses will be performed using the statistical software package Stata.

7 Safety and Adverse Events

There are unlikely to be any risks associated with this research. There is a possibility that some cases may have some stress associated with talking about the fall episode. Information regarding psychological support services including Mäori support services will be made available to participants if they volunteer that they are stressed or that the researchers identifies that they may be stressed as a result of their fall episode.

8 Data Management

8.1 Confidentiality

Information about study subjects will be kept confidential in keeping with the obligations set out in the Privacy Act 1993, the Health Information Code 1994 and Section 22B to 221 of the Health Act 1956. Confidentiality will be protected by the use of study code numbers, and only aggregated and anonymous data will be reported.

8.2 Study Questionnaire

The Study Questionnaire (Appendix One) is the primary data collection instrument for the study. All data requested on the Questionnaire must be recorded. All missing data must be explained. If a space on the Questionnaire is left blank because the procedure was not done or the question was not asked, write "N/D". If the item is not applicable to the individual case, write "N/A". All entries should be printed legibly in black ink. If any entry error has been made, to correct such an error, draw a single straight line through

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the incorrect entry and enter the correct data above it. All such changes must be initialed and dated. DO NOT ERASE OR WHITE OUT ERRORS. For clarification of illegible or uncertain entries, print the clarification above the item, then initial and date it.

Access to completed questionnaires and other data will be restricted to research staff directly involved in the study.

8.3 Records Retention

It is the Principal Investigator's responsibility to retain study data in a secure place for at least 10 years after completion of the study. Questionnaires will be stored in a locked cabinet without any identifying information about participants. Computerised data will be password protected on a computer at the Injury Prevention Research Centre, and destroyed at the end of 10 years.

9 Ethical Considerations

This study is to be conducted according to the National Ethics Committee Guidelines and the University of Auckland research policies and procedures. This study protocol has been approved by the Auckland Regional Ethics Committee.

Participation in the study is entirely voluntary and maybe withdrawn at any time. The medical care of injured participants will not be affected in any way by their participation in, or withdrawal from the study.

All participants for this study will be provided with a Participant Information Sheet (Appendix Three and Four) and a Consent Form (Appendix Five) describing this study and providing sufficient information for participants to make an informed decision about their participation in this study. The formal consent of a participant, using the Ethics Committee-approved consent form, must be obtained before that participant is submitted to any study procedure. This consent form must be signed by the participant or legally acceptable surrogate, and the investigator-designated research professional obtaining the consent.

10 Funding Source

This study is financed through a grant from the Accident Compensation Corporation.

11 Conflict of Interest

Any investigator who has a conflict of interest with this study must follow the process outlined in the *Policy Statement and Code of Practice for Investigators*.

12 Publication Plan

Neither the complete nor any part of the results of the study carried out under this protocol will be published or passed on to any third party without the consent of the Research Team. Instructions re authorship on publication will be detailed in the Policy Statement and Code of Practice for Investigators.

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13 Advisory group

An Advisory Group has been established to assist with:

- Development of study processes
- Study analysis
- Dissemination of the study findings

The Advisory Group members include:

- Associate Professor Ngaire Kerse, Section of General Practice, University of Auckland.
- Malakai Ofanoa, Lecturer in Pacific Health, Pacific Health Centre, School of Population Health, University of Auckland.
- Vili Nosa, Lecturer in Pacific Health, Pacific Health Centre, School of Population Health, University of Auckland.
- Graham Liggins, consumer representative.
- Kerry, Hiini, Business Manager Integrated Care, Middlemore Hospital Private Bag 93311, Otahuhu
- Jane Sherard, Research Advisor Mäori, Nga Kai Taataki, North Shore Hospital, Private Bag 93-503, Takapuna
- Paula Eden, Falls Prevention, Programme Leader, ACC.
- Dr Michael Baker, research member of Housing and Health HRC Programme Grant.

14 Investigators

Principal Investigator:

Dr Shanthi Ameratunga, Senior Lecturer in Epidemiology, School of Population Health, University of Auckland.

Co-Principal Investigators:

Bridget Kool, Senior Research Fellow, Injury Prevention Research Centre, School of Population Health, University of Auckland.

Dr Jennie Connor, Senior Lecturer in Epidemiology, School of Population Health, University of Auckland.

Co-investigators:

Professor Rod Jackson, Head of Section of Epidemiology and Biostatistics, School of Population Health, University of Auckland.

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Dr Sue Crengle, Head of Discipline – Mäori, School of Population Health, University of Auckland.

Elizabeth Robinson, Statistician, School of Population Health, University of Auckland.

Mr. Alex Ng, Co-director Auckland City Hospital Trauma Service, Auckland City Hospital.

Dr Wayne Hazell, Emergency Care Physician, Middlemore Hospital.

Mr. John Cullen, Clinical Head of Orthopaedics, Middlemore Hospital.

15 Study Procedures

15.1 Cases: non-fatal

15.1.1 Case identification through hospitals

All individuals who are admitted to a service other than the Emergency Department at one of the three hospitals during the study period because of an injury sustained as a result of a fall at home need to be interviewed.

Auckland Hospital:

The research nurse will liaise with the Trauma team to identify all new admissions. A trauma round takes place at least six days a week, in the mornings, the research nurse will visit the Trauma Unit on three of those days. Back-up case recruitment will be searched through the admissions data in the Emergency Care Department, and through the Decision Support Team who provide data and information systems. A monthly printout of all discharge codes 'W' = fall, 'Y' = home and 'U' = activity will be provided and using NHI numbers to identify potentially missed cases.

Contacts:

- Rhondda Paice, Trauma Coordinator, rhonddap@adhb.govt.nz
- Ann-Marie Pickering, Nurse Manager, EC Department
- Jo-Anne Benjamin, Data Manager, Decision Support

Middlemore Hospital:

The research nurse will liaise with the Trauma Coordinator three times per week as a back up to recruitment and ISS collection will be used. Main recruitment will be through the daily trauma admissions list which is compiled by Decision Support. The trauma coordinator will provide back up case recruitment with the daily trauma round data and an internally compiled list of falls. A monthly printout of all discharge codes 'W' = fall, 'Y' = home and 'U' = activity will be provided by the Decision Support team to identify potential missed cases using NHI numbers.

Contacts:

Helen Naylor, Trauma Coordinator, hnaylor@middlemore.co.nz

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- Mary McManaway, Nurse Manager, EC Department 021 555 207
- Dianne Wilson, Manager, Decision Support Services, diannew@middlemore.co.nz
- Sandra Oldfield, IT Support, EC Department

North Shore Hospital:

The Trauma Coordinator is main source of case recruitment and will provide data in relation to falls from the trauma registry. The daily presentations to the EC department will be checked three times per week using the admissions data accessed by Waitemata Health computer system. A monthly printout of all discharge codes 'W' = fall, 'Y' = home and 'U' = activity will be provided by the Decision Support team to identify potential missed cases using NHI numbers.

Contacts:

Jodie Orchard, Trauma Coordinator, j.orchard@waitematadhb.govt.nz

15.1.2 Recruitment and interview:

Once individuals are identified, a member of the clinical team will ask them if they are willing to meet the researcher. If they agree to this, the research nurse will approach the participant and give a brief explanation of the study and supply the patient with a written information brochure. The time that the patient requires to consider whether they wish to take part in the study will vary and should be flexible. For participants who agree to take part, written consent must be obtained in accordance with the guidelines in this manual. Following this, a suitable time and place for the interview to take place needs to be determined that is mutually acceptable and takes into account the patients clinical condition and likely length of admission. Usually the interview will be conducted in hospital prior to discharge or by telephone/face-to-face following discharge.

15.1.3 Obtaining Consent

Written consent should be obtained from all non-fatal cases.

For consent to be valid the subject must be sufficiently informed about the study so that they may make an independent choice about whether to participate. Issues to be covered are outlined on the patient information brochures which should be gone through carefully with each person. Do not assume that every person has read the information sheet or that they can read.

The following areas must be covered: *The study:*

- Purpose of the study.
- Who the researchers are.
- How the person gualifies for the study.
- How many subjects are involved.
- Length of study.
- Time commitment for the subject.

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Participation:

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- The supply of information is voluntary.
- The subject can refuse to answer any questions without giving a reason.
- Health care will not be affected by the study or by withdrawing from it.
- Subjects have to right to access their own information.
- Subjects have to right to have questions answered.

Data Collection:

- · Personal information will be kept confidential and stored securely.
- · Computerised information will be password protected.
- Information will only be available to the researchers.
- All reports from the study will be written in a way that no individuals could be identified.

15.2 Cases: fatal

15.2.1 Died after admission to hospital

As per section 15.1 above

15.2.2 Died prior to admission to hospital

Case identification

Regular contact will be made with the Forensic Pathology Department located on the ADHB site, where all Auckland post mortems are conducted. They will provide research staff with the details of cases meeting the study entry requirements.

Contacts:

Nicola Stewart, Departmental Secretary, <u>nstewart@adhb.govt.nz</u>

Data collection:

Data will be accessed from Post Mortem records and entered into the *Post Mortem* record sheet (Appendix Six)

Obtaining Consent

Post Mortem records are in the public domain. No contact will be made with any family members.

15.3 Case/Control Record Keeping

All non-fatal cases will have a consent form, fall questionnaire and medical record abstract. Controls will have a consent form and a fall questionnaire. Fatal cases that were not hospitalised will have a Post Mortem abstract record

In addition to this the research nurse will keep track of all potential cases/controls in a log book (Appendix Seven) and these will contribute to a excel spreadsheet log of all cases/controls and their status. Basic demographic information should be recorded about non-participants in the study, so that any differences from those consenting can be identified.

15.3.1 Log Book instructions

Cases:

Study Number; Name and contact addresses/phone numbers; DOB/age; M/F; Consent Y/N; Medical abstract – ISS and completed date; Questionnaire date and date of data entry; Comments section.

Controls:

Study number; Name and contact addresses/phone numbers; DOB/age; M/F; Consent Y/N; Phone contact -1^{st} , 2^{nd} , 3^{rd} ; Questionnaire date and date of data entry; Comments section.

15.4 Determination of Injury Severity Score [ISS]:

Injury descriptors will be obtained from the case medical record and entered into the *medical audit* form. There are guidelines available in section 17.0 of this manual to assist with recording suitable descriptors. The completed medical abstract forms will then be ISS coded by trained coder at the Auckland City Trauma Service.

15.5 Questionnaire Instructions

Read the questions as they are worded in the questionnaire. Be sure that you understand the point of each question so that it can be read with the correct tone and emphasis. Ask the questions in the order that they are presented, and ask every question that applies to the subject. Take care not to make assumptions about the answers to the questions.

If the question is misheard or misunderstood, repeat the whole question. If necessary give some options, or use probes. The aim is to get the best possible information, while being consistent in your approach to participants. Some people will require more clarification than others, and if the respondents' answers seem illogical it will often be because they have not understood the question fully.

If you are unsure how to code something then write the answer on the questionnaire with as much detail as possible.

15.6 Quality Control

Every 10th questionnaire will be checked by a second data entry person. The paper questionnaire will be compared with the database entry for every question for that participant. Any discrepancies will be recorded on the Study Quality Sheet (Appendix 8) Discrepancies will be checked and where appropriate changes made by the lead study nurse, and a record of any changes made to the data base will be recorded on the Study Quality Sheet.

16 Auckland Falls Study – Questionnaire Manual

Front page

Study number:

The first two digits of the study number are the case hospital e.g. 10 = Auckland City, 20 = Counties Manukau, and 30 = North Shore. Enter 40 for Controls.

The next 3 digits are the respondent study number allocated to the fall/survey [case or control] by the researcher, e.g. 10-001 = Auckland City, respondent number 1 or 40-001 is Control, respondent number 1.

Date of interview:

If the interview occurs over more than one day, record the final day.

Mode of Interview:

Whanau/family present during interview

Details of the proxy respondent

SECTION 1: DEMOGRAPHIC

- 1. Which ethnic group do you belong to? More than one option may apply, but we are interested in the main one[s] that the person identifies with, not all their ancestry. It is important to ask than assume ethnicity.
- 2. Gender

It may be important to ask this question, especially on the phone.

- 3. What is your date of birth? Age group: read all if needed.
- How tall are you? Code in centimeters, or feet and inches. If "unknown" probe for an estimate and indicate on the questionnaire.
- How much do you weigh? Code in kilogram's or stone's and pounds. If "unknown" probe for an estimate and indicate on the guestionnaire.
- SECTION 2: CASES ONLY CIRCUMSTANCES OF FALL
- What was the date the fall occurred? Check that this coincides with admission/medical record.

CONFIDENTIAL This material is the property of the University of Auckland. Do not disclose or use except as authorised in writing by the Research Team 7. What was the day of the week? Check that this coincides with question 6.

- What was the time of the fall? Use 24 hour clock. If the respondent is unsure of the time, probe to establish what hour it was. If it was between 1100 and 1200, then code 1100 on the form.
- 9. Describe how the fall happened? Include the factors that the respondent considers caused or contributed to causing the fall, and what actually happened.
- 10. What height did you fall from? Code in feet or meters

8.

- 11. What activity were you involved in at the time of your fall? Code one only or specify activity.
- 12. Where you carrying something at the time you fell?
- 13. What part of your body hit the ground first?
- 14. Which way did you fall? Code one or specify
- 15 Where did the fall happen? Code one only or specify location.
- 16. Did the fall occur in the home you usually reside/live in?
- 17. What was the condition of the surface you were on at the time wet/slippery? Code as many that apply. Probe if "don't recall".
- 18. What surface did the fall occur on? Code one only or specify.
- 19. What surface did you land on? Code one only or specify
- **20.** What were you wearing on your feet at the time of the fall? Code one or specify. If "unsure", then probe.
- 21. Just prior to the fall did you experience...? Read all.

SECTION 3: PERSONAL HEALTH

General Health:

22. In general, would you say your health is...? Read all options.

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The following questions are about how much time you spent being physically active in the last 7 days.

Walking

23a. During the last 7 days on how many days did you walk at a brisk pace?

A brisk pace is a pace at which you are breathing harder than normal. This includes walking at work, while getting from place to place, at home and at activities that you did solely for recreation, sport, exercise or leisure. Code days if 'none' then skip to question 23c

- b) How much time did you typically spend walking at a brisk pace on each of those days?
- c) Does your state of health now limit you with this activity?

Moderate Physical Activity

Physical Health: Q23-26

Q24a) During the last 7 days (or the 7 days prior to your fall) on how many days did you do *moderate* physical activities?

Moderate' activities make you breathe harder than normal, but only a little - like carrying light loads, bicycling at a regular pace, or other activities like those on this card (Showcard 1 – Moderate Physical Activity). Do not include walking of any kind).

Think only about those activities done for at least 10 minutes at a time. Code, if 'none' skip to question 24c.

- b) How much time did you typically spend on each of these days doing moderate physical activity?
- c) Does your state of health limit you with this activity?

Vigorous Physical Activity

Q25a) During the last 7 days before the fall/survey on how many days did you do vigorous physical activities?

'Vigorous' activities make you breathe a lot harder than normal ('huff' and 'puff'), but only a little - like heavy lifting, digging, aerobics, fast bicycling, or other activities like those on this card (Showcard 2 – Vigorous Physical Activity)).

Think only about those activities done for at least 10 minutes at a time. Code, if 'none' then skip to question 25c.

b) How much time did you typically spend on each of these days doing vigorous physical activity?

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Frequency of Activity

- Q26) Thinking about all your activities over the last 7 days before the fall/survey including brisk walking, on how many days did you engage in:
 - at least 30 minutes of moderate activity (including brisk walking) that
 made you breather a little harder than normal, OR
 - at least 15 minutes of vigorous activity that made you breathe a lot harder than normal ('huff' and 'puff')?

Medical Conditions:

- 27. Do you have any difficulty, even with glasses, reading small print, such as labels on medicine bottles, a telephone book, food labels? Read all, code one, if 'no' or 'a little' skip to Q29. If moderate, great deal, unable or unknown, proceed to question 28.
- 28. Do you have any difficulty, even with glasses, reading a large print book, or a large print newspaper, or numbers on a land line phone? Read all, code one.
- 29. Do you need help from other people or organisations because of an intellectual or physical disability?
- 30. How many hours did you spend at home, or at someone else's home, awake during the last week (Monday to Friday)?

Is this usual? If yes proceed to question 34.

- 31. How many hours do you spend at home awake on average during a normal week (Monday to Friday)?
- 32. How many hours did you spend at home, or at someone else's home, awake during the last weekend (Saturday and Sunday)?

Is this normal? If 'yes' proceed to question 34.

33. How many hours do you spend at home awake on average during the weekend (Saturday and Sunday)?

Smoking:

34. Are you currently a cigarette smoker? If "no", skip to question 36.

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- **35.** On average how many cigarettes do you smoke per day? Read all options. If they don't smoke every day, average out the number over the whole week, then divide by seven and code appropriately.
- **36.** Have you ever smoked cigarettes on a regular basis in the past? What equates to regular? Is this on a daily basis?

Sleep patterns:

- **37.** In the past 24 hours before the fall/survey when did you sleep? This question relates to all episodes of sleep, not just the main sleep, times should be as accurate as possible. For cases, use the day of week question 7, and time of fall question 8, as a time prompt. For controls, use the 24 hours before the time of interview.
- 38. In the past week before the fall/survey, how many sleeps did you have of seven hours duration or more? Code sleeps out of seven.
- **39.** How long do you usually sleep each 24 hours? Include any regular daily sleeps.
- 40. Which of the following best describes your level of alertness in the 15 minutes prior to the fall/survey? Read all and code
- 41. How would you describe this on a scale of 1 to 10, where 1 is tired and 10 is fresh?
- 42. During the past four weeks before the fall/survey have you often been bothered by feeling down, depressed or hopeless? If "no", skip to question 44.
- **43.** If "yes" do you want help with this? Refer to resources.
- 44. During the past four weeks before the fall/survey have you often felt anxious or unduly worried? If "no", skip to question 46.
- 45. If "yes", do you want help with this?

Refer to resources.

46. During the past four weeks before the fall/survey, have you <u>often</u> been bothered by little interest or pleasure in doing things? Code, if "no", skip to question 48.

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Fall history:

- 48. How many falls [previous falls for the cases] have you had that have occurred in the home setting and have required you to seek medical attention in the past 12 months? Code number. If "none", skip to question 50.
- **49.** Describe how and where the fall/s occurred? Brief description of fall event/s. Code after completion of interview.

SECTION 4: WHERE YOU LIVE

50. How long have you lived in this home? Code one only.

Stairs:

- 51. How many sets of stairs/steps do you have in your home [including split levels]? If "none", skip to question 56.
- **52.** How many sets of stairs/steps do you have in your home? If the case fell on the stairs/steps make this 'set 1' for questions 52-55. Include split level. Code number of sets of stairs/steps.
- 53. What is the flooring surface on each set? Code each set separately with a $\sqrt{}$ to indicate surface covering.
- 54. Is there a hand rail on each set of stairs? Code each set separately using a √ to indicate yes/no. Probe on "don't recall".
- 55. In your opinion, is there adequate lighting around each set of stairs? Code each set separately using a $\sqrt{}$ to indicate yes/no.

Kitchen:

- 56. What is the flooring surface in your kitchen?
- 57. Do you have rugs on your kitchen floor? If "no", skip to question 60.
- 58. Are the rugs on your kitchen floor fixed in place or have slip resistance backing?
- 59. In your opinion is the lighting in your kitchen adequate?

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Bathroom:

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- 60. What is the flooring surface in your bathroom? Code all that apply.
- 61. Do you have bath/s in your home? If "no" skip to question 62.
- a) Is there a grab/handrail near the bath (excludes towel rail)?
- b) Do you have a slip resistant mat [e.g. a rubber mat] in your bath/s?
- c) Do you have a slip resistant mat [e.g. a rubber mat beside your bath/s?
- **62.** Do you have a shower/s in your home? If "no", skip to question 63.
- a) Is there a grab/handrail near the shower (excludes towel rail)?
- b) Do you have a slip resistant mat [e.g. a rubber mat] in your shower/s?
- c) Do you have a slip resistant mat [e.g. a rubber mat] outside your shower/s?
- 63. In your opinion is the lighting in your bathroom adequate?

Bedroom:

64. Can you switch a light on easily from your bed at home?

Ladder use:

- 65. How often on average would you use a ladder/stepladder in a home setting in a one year period? If "never", skip to question 67. Probe for "don't recall".
- 66. What activity are you most likely to use a ladder for in the home setting? Code all and specify other.
- 67. Have you used a professional to carry out tasks in the home setting that you haven't felt comfortable doing yourself that involved a ladder in the past 2 years?

If "no", skip to question 69. If "don't recall", probe, then if still no response, skip to question 69.

68. What was the activity?

Code and probe "don't recall".

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Outside the home:

- 69. How many sets of stairs/steps do you have outside your home? If "no", skip to question 74.
- 70. How many stairs are there in each set? Code each set separately and then write in location.
- 71. What is the flooring surface on each set? Put a $\sqrt{}$ in the box or specify "other".
- 72. Is there a hand rail on each of the stairs? Code each set and probe "don't recall".
- 73. In your opinion is there adequate lighting around each set of stairs?

SECTION 5: SOCIAL FACTORS

- 74. Are you on the New Zealand electoral roll [General/Maori]? This question is for cases only.
- 75. In the last 12 months have you personally been forced to buy cheaper food so that you could pay for other things?
- 76. In the last 12 months have you been out of paid work at any time for more than one month? Defined as 'no' for those who are full time care-givers/home-makers.
- 77. In the last 12 months did you yourself get any income on the 12 months ending today from any of these sources? Domestic Purposes Benefit, Emergency maintenance allowance, transitional retirement benefit, sickness/invalids benefit, widow's benefit.
- 78. In the last 12 months have you personally put up with feelings of cold to save heating costs?
- 79. In the last 12 months have you personally made use of special food grants or food banks?
- 80. In the last 12 months have you personally continued wearing shoes with holes because you could not afford replacement?
- 81. In the last 12 months have you personally gone without fresh fruit and vegetables, often, so that you could pay for other things you needed?
- 82. In the last 12 months have you personally received help in the form of food, clothes or money from a community organisation?
- 83. Are you in paid employment? If "no", skip to question 88.

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- 84. What type of paid employment is it? Read all.
- 85. What is your current paid work? Specify role as well as industry. Code after interview.
- 86. What is your usual work pattern? Read all and code.
- 87. Do you work from home?
- 88. How many adults [>18 years] live in the same household as you? Code adults 18 and greater.
- 89. Do any children [<18 years] live in the same household as you? Code children 18 and under.
- **90.** What is your household income before tax [gross] for the 12 months...? Start by asking under or over \$50,000.

Alcohol:

- **91.** Had you had any alcohol in the 24 hours before the fall? If "no", go to question 97. If "don't recall", probe for time in 24 hour period before fall.
- 92. What alcohol did you have in the 24 hours before the fall/survey? Follow standard drinks list as in questionnaire and code number of drinks.
- **93.** How long before the fall/survey did you stop drinking? If time > 6 hours skip to question 97.
- 94. What alcohol did you have to drink in the 6 hours before the fall/survey? Code number of drinks.
- 95. What alcohol did you have to drink in the same 6 hour period the day before the fall/survey? Code number of drinks. If "don't recall", probe around activities in time period. Remind respondent of time of fall working backwards to time period.
- 96. What alcohol did you have to drink in the same 6 hour period one week before the fall/survey [same day of the week]? Probe using time lines/activities if "don't recall".
- **97.** How often do you drink alcohol? If "never"/refused, skip to question 108.
- **98.** How many standard drinks do you have on a typical day when you drink? Standard drinks are defined in questionnaire.

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- 99. How often do you have [6 for men/4 for women] or more drinks on one occasion?
- 100. How often during the last year have you found that you were not able to stop drinking once you had started?
- 101. How often have you failed to do what was normally expected from you because of your drinking?
- 102. How often during the last year have you had a drink first thing in the morning to get yourself going after a heavy drinking session?
- 103. How often during the last year have you had a feeling of guilt or regret after drinking?
- 104. How often during the last year have you been unable to remember what happened the night before because you had been drinking?
- 105. Have you or someone else been injured as a result of your drinking?
- 106. Has a friend, doctor, or other health worker been concerned about your drinking or suggested you cut down?
- 107. During the last 12 months how often did you drive a car or other vehicle when you might have been over the legal limit for alcohol?

Medication Use:

- **108.** Are you currently on any prescription medications? If "no", skip to question 110.
- **109.** What prescription medications are you currently taking? Code drug name, dose, frequency and comments.
- **110.** How often do you take sleeping tablets? If "never" skip to question 112.
- 111. Had you taken any sleeping tablets during the 24 hours before the fall/survey? Specify name, time, dose/number of tablets.
- 112. At the time of the fall/survey were you taking regular medications for depression or anxiety? If "no", skip to question 122. If "yes", specify name, time taken and dose/number of tablets.
- 113. Did you start the medication in the six weeks before the fall/survey?

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Recreational Drug use:

- **114.** Have you ever used recreational drugs? Read out list in questionnaire. If "never", skip to question 117.
- 115. Had you used marijuana in the 3 hours before the fall/survey?
- 116. Had you taken any other recreational drugs in the 3 hours before the fall/survey? Read out list in questionnaire.
- **117.** Have you used any marijuana during the past 12 months? Read out list in questionnaire.
- 118. Have you used any other recreational drugs during the past 12 months?

Read out list in questionnaire.

119. Would you like to be sent a copy of the study results? Check/confirm contact details.

17 Guidelines for Manual Recording of Injury Descriptions

17.1 General

- Check ALL sources of information including ambulance sheet, ED note, nursing records, neuro-obs / trauma sheets, investigation reports (e.g., x-ray / CT / MRI reports), operation and clinical notes and discharge letters.
- Observer reports (e.g., loss of consciousness / KO'd) record if EMS / clinical or other (bystanders / family).
- Photocopy material where information is confusing / cannot be easily recorded otherwise.
- Be as specific and detailed as possible regarding each injury. See specific injury headings.
- Injuries described as "probable", "possible", "impression of" or "rule out" should not be recorded unless substantiated in the medical record.
- Wherever possible, it should be noted which side the injury was in (right, left or bilateral).
- Record blood loss:
- in milliliters
- % blood loss (record body weight if available)
- Complications of treatment / procedures not required (if in doubt, record).

Closed Head Injury / Traumatic Brain Injury

 Use these terms only if there are no details available regarding these specific injuries.

Blunt Chest Injury / Blunt Abdominal Injury

• Use these terms only if there are no details available regarding these specific injuries.

Burns

- degree if burn: 1⁰, 2⁰, 3⁰ (full thickness)
- % total body surface involved
- involvement of face / hand / genitalia
- incineration
- burn amputation

"Crush"

- · degree of destruction
- bilateral?
- degree of obliteration of cavity (e.g., chest)?
- internal organs obliterated / crushed?
- **High Voltage Electric Injury**
 - muscle necrosis
 - cardiac arrest

Hypothermia (Accidental)

degrees Centigrade (rectal temperature)

Inhalation Injury (including unintentional carbon monoxide exposure)

- minor / moderate / severe
- mg % carboxyhaemoglobin

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Internal Organ Injuries

General:

 Record site / organ / involved areas as specifically as possible (e.g. retinal laceration with retinal detachment; tear duct laceration).

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- single / multiple lesions
- bilateral / side of lesion
- minor / major / superficial / large / deep
- Involvement of associated structure: valves / septa / major vessels / ducts / capsules.
- Direct consequences of injury
- air leak / systemic air embolus
- blood loss
- gross faecal contamination (colon; duodenum)
- haemo/pneumo thorax/mediastinum/peritoneum (specify tension pneumothorax)
- tamponade / herniation
- tissue loss

Descriptors:

- abrasion crush = massive destruction
- contusion: minor / severe
- haematoma
- · fracture (e.g., bronchus or larynx: simple or major with separation)
- laceration
- perforation (full thickness)
- complex / transection (complete or incomplete) / rupture / avulsion / tissue loss / amputation
- penetrating injury (be more specific if possible)
- puncture

Special organs – Head

- Record only if injuries verified by X-ray, CT, MRI, surgery, angiography or autopsy. Clinical diagnosis alone is **not** adequate.
- If possible, distinguish between brainstem (hypothalamus, medulla, midbrain, pons), cerebellum, cerebrum and pituitary.
- Specify as much as possible (e.g., medulla rather than brainstem).

Cerebrum / brain / brainstem / cerebellum:

- brain swelling / oedema
- mild / moderate / severe
- compression / absence of ventricles
- compression / absence of brain stem cisterns
- brainstem compression / herniation
- what
- where
- contusion
- single / multiple
- unilateral / bilateral

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- small / superficial / large / massive / extensive
- amount: volume (cc) or diameter (cm)
- midline shift
- diffuse axonal injury (white matter shearing)
- haematoma
 - specify: epidural or extradural / subdural / extradural
 - Epidural or extradural / subdural
 - small / smear / tiny / moderate / large
 - unilateral / bilateral
 - volume (cc)
 - thickness (cm)
 - Intracerebral
 - small / large
 - unilateral / bilateral
 - volume (cc) or diameter (cm)
 - petechial haemorrhages
 - subcortical haemorrhages
 - · infarction / ischaemia
 - haemorrhage
 - intraventricular
 - subarachnoid
 - subpial

Special organs – Neck / Thorax

Pharynx / Retropharyngeal area / Trachea / Main Stem Bronchus / Bronchus:

- contusion / haematoma
- fracture
 - simple vs. major (with separation)
- laceration
 - with / out perforation (full thickness)
 - complex: avulsion / rupture / transection

Salivary gland

• with ductal involvement or transection

Vocal cord(s)

- do not record injury due to intubation
- unilateral vs. bilateral

Oesophagus:

- chemical burn: describe as for laceration
 - perforation / rupture / transection / tissue loss

Heart / Myocardium / Pericardium:

- contusion / haematoma
 - minor / severe
- laceration / rupture / puncture
 - perforation
 - chamber involvement
 - complex / ventricular rupture
 - single / multiple
 - intracardiac valve rupture

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- intra-ventricular or intra-atrial septum laceration / rupture
- tamponade
- herniation

Lung

- contusion
 - unilateral / bilateral
 - association with "flail chest"
 - laceration
 - unilateral / bilateral
 - haemo/pneumothorax
 - haemo/pneumomediastinum
 - tension pneumothorax
 - blood loss > 20% in volume (or in ml)
 - parenchymal laceration with massive air leak
 - systemic air embolus
- Thoracic Cavity: (record only if no specific organ lesions identifiable)
 - haemo/pneumothorax
 - haemo/pneumomediastinum
 - tension pneumothorax
 - blood loss > 20% by volume (or in ml)
 - systemic air embolus

Special organs – Abdomen / Pelvis

Liver:

- capsular / subcapsular / intraparenchymal
- non-expanding (haematoma)
- % surface area
- diameter (cm)
- depth (cm)
- minor / major
- blood loss (% volume or ml)
- major duct / vessel involvement

Pancreas (in addition to general instructions):

- · involvement of head of pancreas
- major duct / vessel involvement

Spleen (in addition to general instructions):

- minor / moderate / major / massive
- · capsular tear
- hilar or segmental parenchymal disruption or destruction
- blood and tissue loss
- stellate

Uterus:

note pregnancy including trimester

Loss of Consciousness (LOC)

- "Concussion":
- record as much anatomical detail as possible
- record if evidence of head injury provided (CT, x-ray, etc)

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- record if diagnosis substantiated by clinical staff (EMS / hospital / other clinical)

• General instructions relating to recording LOC:

- definition: inability to follow commands <u>and</u> no eye opening to any stimulation <u>and</u> no word verbalisation = "coma"
- provide as much anatomical detail relating to head injury as possible
- who reported the LOC (EMS / medical or clinical vs. self- / bystander / others)
- duration of LOC
- status on admission or initial observation at scene:
 - awake (GCS 15)
 - lethargic, stuporous, obtunded/can be aroused by verbal or painful stimuli /GCS 9-14
 - \square unconscious / unresponsive to verbal command or painful stimuli / GCS \leq

8 Specific details:

- associated neurological deficits and their approximate duration: hemiparesis, hemiplegia, weakness, sensory loss, hypaesthesia, visual field defects, aphasia, dysphasia, seizure, central (not peripheral) facial weakness or palsy, deviation of both eyes to same side, unequal pupils, fixed unreactive pupils.
- movements on stimulation:
 - appropriate movements but only upon painful stimulation
 - inappropriate movements (decerebrate, decorticate, flaccid, no response to pain)

Nerve Injury (excluding Spine Injuries)

- specific name of nerve. If not known, record type (e.g., cranial nerve)
- paralysis (total loss of nerve function) vs. paresis (subtotal loss of function)
- · contusion / "stretch" injury
- laceration
- avulsion
- side of lesion / bilateral
- single or multiple nerves
- neurological signs (eg, motor loss with median, radial, ulnar, femoral, tibial and peroneal nerve lacerations)

Special Nerves:

- Optic nerve:
 - specify involvement of intra-orbital or intra-cranial sections

Penetrating Injury

- · site / body region of entry wound
- depth of penetration if recorded
- · descriptions used (e.g., minor, superficial, major)
- amount of tissue loss
- amount of blood loss
- deeper structures involved
- haemo/pneumothorax (chest / abdo)

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Skeletal Injury

Joints:

- contusion
- sprain
- dislocation / separation
- involvement of articular cartilage
- laceration into joint
- ligament involvement
- single / multiple nerve laceration
- massive destruction of bone and cartilage (crush)

Bones:

- fracture
 - closed (simple / undisplaced / diastatic / linear)
 - comminuted (open / compound / depressed / displaced)
 - complex(open with loss of tissue)
 - massive destruction (crush) of bone and cartilage
 - amputation
 - nerve involvement

Special sites - Skull (excluding facial bones: see later)

- fracture
 - note specific bone involved
- base / basilar fracture (ring / hinge fracture)
- compound: open fracture
- complex: open with loss of brain tissue
- degree / extent of depression (cm)
- CSF leak
- <u>clinical signs</u> of basilar skull fracture: perforated tympanic membrane with blood in ear canal / haemotympanum mastoid haematoma (battle signs) CSF otorrhea / rhinorrhea periorbital ecchymosis (raccoon's eyes)

Special sites - Face

- Mandible fracture:
- involvement of body / ramus / subcondylar
- closed vs. open / displaced / comminuted
- Tempero-mandibular joint:
 - sprain vs. dislocation
- Maxilla fracture:
- closed vs. *LeFort* I, II, III (describe if not defined)
- blood loss
- Teeth:
- dislocation / loosened
- fracture
- avulsion
- Zygoma:
 - fracture

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Special sites - Rib cage

contusionfracture

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- number of ribs fractured on each side
- multiple fractures of single rib
- stable chest
- flail (unstable) chest: one side vs. bilateral
- open / displaced / comminuted
- associated haemo-/pneumothorax
- associated lung contusion

Special sites - Spine (See separate category: "Spinal Injury")

Special sites - Upper extremity

Elbow joint:

dislocation: radial head involvement

Humerus:

• fracture: radial nerve involvement

Radius:

• fracture: radial nerve involvement

Ulnar:

- fracture: ulnar nerve involvement
- Finger (specify site in more detail if possible):
 - fracture
 - amputation
 - crush (massive destruction of bone and cartilage)

Special sites - Lower extremity

Ankle joint:

- specify if fibula, tibia, talus, medial or lateral malleolus involved *Hip joint:*
 - specify involvement of acetabulum or femoral head
- Knee joint:
 - · meniscus tear
 - · specify involvement of femur, tibia or patella
- Fibula:
 - contusion
 - peroneal nerve injury / palsy
 - fracture
 - head / neck / shaft
 - lateral malleolus / bimalleolar / trimalleolar

Femur:

- fracture
 - condylar / head / intertrochanteric / neck / shaft / subtrochanteric / supracondylar

Tibia:

- contusion
- fracture

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- condyles (plateau) / intercondyloid spine / medial malleolus / posterior malleolus / shaft
- closed / open / displaced / comminuted

Toe:

• fracture / amputation / crush (massive destruction of bone and cartilage)

Pelvis:

- fracture: specify bone / section (e.g., superior or inferior rami) of involvement
- major deformation/displacement with vascular disruption/major retroperitoneal haematoma (crush)
- blood loss

Symphysis pubis:

• separation = fracture

"Skin Things"

- abrasion
- contusion / bruise
- laceration
- description (minor / major / superficial / deep)
- length of laceration
- involvement of subcutaneous tissue and deeper layers
- blood loss
- <u>special</u>: a skin laceration overlying an open fracture does not need to be recorded separately
- avulsion
 - description (minor / major / superficial / deep)
 - amount (cm²)
 - blood loss
 - special: "total scalp loss" should be recorded as such
- degloving injury (specify more detail if possible)

Spinal Injuries

- Musculoskeletal injury:
 - acute strain with no fracture or dislocation (e.g., whiplash)
- Disc injury:
 - herniation
 - with/out nerve root damage (radiculopathy)

- ruptured disc Vertebral injury:

- dislocation
 - specify site / level: atlanto-axial (odontoid), atlanto-occipital
 - facet joint: unilateral / bilateral
- fracture
- specify each vertebra separately
- specify site of fracture:
- spinous process / transverse process / facet / lamina / pedicle / vertebral body
- vertebral body fracture: specify degree of compression:
- major vs. minor / % loss of anterior height
- presence / absence of cord contusion / laceration / dislocation

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Nerve Injuries

Brachial plexus:

- complete / incomplete plexus injury
- contusion / laceration / avulsion

Spinal cord

- For all spinal cord injuries, record:
 - level of lesion
 - presence / absence of fracture and dislocation
 - record sensory and motor function changes (preservation of some or none?)
- quadriplegia or paraplegia, with/out sensory changes
- contusion / compression (diagnosed by x-ray, CT, myelogram, autopsy)
- incomplete cord syndrome / anterior cord syndrome / central cord syndrome / lateral cord (Brown-Sequard) syndrome
- complete cord syndrome
 - quadriplegia or paraplegia
 - sensation / motor
- laceration
 - complete / transection / crush
 - incomplete

Spinal nerve roots / sacral plexus:

- single / multiple
- contusion / laceration / avulsion (rupture)

Vessel Injury

- specify name of vessel. If not known, record type (e.g. intracranial)
- thrombosis / occlusion
- laceration / segmental loss / perforation / puncture
 - description: minor / major / superficial / circumferential involvement
 - distinguish between complete / incomplete transection where possible
 - open laceration: vessel is bleeding out of the body (externally)
- intimal tear with/out disruption
- traumatic aneurysm
- degree of blood loss
- · associated neurological deficit / stroke, unrelated to head injury
- · associated valve involvement (aortic)
- associated air embolus

18 Appendices

18.1	Appendix One:	Study Questionnaire
18.2	Appendix Two:	Medical Record Abstract
18.3	Appendix Three:	Participant Information Sheet -Cases
18.4	Appendix Four:	Participant Information Sheet -Controls
18.5	Appendix Five:	Consent Form
18.6	Appendix Six:	Post Mortem record
18.7	Appendix Seven:	Log Book
18.8	Appendix Eight:	Study Quality Sheet

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Study number:			
	Auckland Falls Study Questionnaire		
Date of Intervi	iew: (dd/mm/yy)		
Interviewer Na	ame:		
Mode of Inter	view:		
□1.	Face-to-face		
 2.	Telephone		
3.	Combination		
Whanau/fami	ly present during interview:		
□1.	Yes		
 2.	No		
Is this a prox	y interview?		
□1.	Yes		
 2.	No		
For proxy inte	erviews only:		
Reasons for u	use of proxy respondent:		
□1.	Case seriously injured		
 2.	Other (please specify):		
Was the prox	ry with the case when they fell?		
□1.	Yes		
 2.	No		
Relationship	of proxy to the case:		
□1.	Parent		
<u></u> 2.	Spouse Other family		
3. □4.	Friend		
<u>□</u> 5.	Other		
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Study number:

Introduction

Thank you for agreeing to take part in this study.

We would like to ask you:

- some general questions about yourselfabout your general health
- about your home

All of your answers will be confidential. Your participation in the study is voluntary and you can choose not to answer particular questions.

SECTION 1: DEMOGRAPHIC

Which ethnic group do you belong to? (More than 1 box may be ticked) Q1

- 1. New Zealand European
- 2. Māori
- __3. Samoan
- _4. Cook Island Maori
- Tongan 5.
- <u>6</u>. Niuean
- **7**. Chinese
- **8**. Indian
- **9**. Other (such as Dutch, Japanese, Tokelauan) (please specify): _____

Q2 Gender

1. Male

- 2. Female
- What is your date of birth? Q3

	(dd/mm/yy)
Age group:	

∐1.	25 to 30 years
 2.	31 to 35 years
3.	36 to 50 years
4 .	51 to 55 years
5 .	56 to 60 years

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	Study number:					Study number:
Q4	How tall are you?	Q10	What	t height did you fa	all fron	n?
	C Centimetres)			☐ feet o	r	metres
	or (feet) (inches)	Q11	What	t activity were you Going up stairs/s	u invol steps	ved in at the time of your fall?
Q5	How much do you weigh?		2. 3. 4.	Stationary on sta Going up a ladde	airs/step airs/ste er	ps
	(kilograms)		5. 6.	Going down a la Working on a lac	dder dder	
	or (stone) (pounds)		7. 8. 9.	Getting into a ba	bath bower	
	CASES ONLY		□10. □11.	Getting out of a walking inside	shower	r
	SECTION 2: CIRCUMSTANCES OF FALL		□12. □13.	Running inside		
Q6	On what date did your fall occur?		□14. □15	Running outside	e Ac	
	□ - □ - □ (dd/mm/yy)		□16. □16. □17.	Getting into bed In bed		
Q7	On which day of the week did your fall occur?		□18. □19.	Standing still Getting onto the	toilet	
	□1. Monday □2 Tuesday		20. 21.	Getting off the to On the toilet	oilet	
	☐3. Wednesday		22.	Getting into a ch	nair/stoo	ol
	4. Thursday		<u>2</u> 3.	Getting off a cha	air/stool	1
	5. Friday		<u></u> 24. □25	Standing on a ch	00I hair/sto	
	6. Saturday		$\square 23.$	Collided with an	other p	erson
			□ <u>−</u> 0.	Unknown / Don'i	t recall	
Q8	What was the time when the fall occurred?		28.	Other (please sp	pecify):	
	$\square \square - \square \square (24 hour clock)$	Q12	Were	you carrying sor	methin	g at the time you fell?
Q9	Describe how the fall happened:		□ 1.	Yes		
			∠. 3.	NO Unknown / Don'i	t recall	
		Q13	Whic	h part of your bo	dy hit 1	the ground first?
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	Study number:			Study number:
Q14	Which way did you fall? I. Forwards Backwards		5. 6.	Even Uneven
	\Box_3 To the right side		∐/. □0	
	\Box 4 To the left side		o. o	Loose Braken /ahinned
	5. Crumpled		9. □10	France
	6. Unknown / Don't recall			Flayeu
	\Box 7. Other (please specify):			Other (plassa specify):
			ız.	
Q15	Where did the fall happen?			
	1. Living area e.g. dining room, study, rumpus room, office	Q18	What	surface were you on when you fell?
	2. Bedroom		1 .	Concrete
	3. Kitchen		 2.	Tiles: ceramic/ pottery
	4. Bathroom		3 .	Wood
	5. Laundry		4 .	Carpet
	6. Inside stairs/steps		5 .	Glass
	7. Toilet		6.	Brick
	8. Hallway		7 .	Metal
	9. Inside not further specified		8 .	Mat/rug
	10. Outside stairs/steps		9 .	Slate
	11. Deck / balcony		<u> </u>	Lino/Vinyl
	12. Garage/car port		<u> </u>	Cork
	13. Garden shed		<u>1</u> 12.	Grass
	14. Garden		1 3.	Dirt/earth
	□15. Driveway		<u></u> 14.	Asphalt/bitumen
	16. Roof		<u> </u> 15.	Stones/gravel
			<u> </u> 16.	Ladder
	18. Outside pathway		<u> </u>	Roof
	19. Outside, not further specified		1 8.	Unknown / Don't recall
	20. Unknown / Don't recall		1 9.	Other (please specify):
	21. Other (please specify):		14 /1 4	
		Q19	vvnat	Concrete
Q16	Did the fall occur in the home you usually live (reside) in?		⊡ ^{1.}	Tiles: ceramic/ nottery
2.0	\square 1. Yes		□	Wood
	2. No:		o. □4	Carpet
	3. Unknown / Don't recall		□	Glass
			<u>□</u> €.	Brick
Q17	What was the condition of the surface you were on at the time of the fall? (Choose		□°. □7	Metal
	as many as apply). For ladder falls, this question refers to the surface the ladder was on at			Mat/rug
			o. 9	Slate
	\square Wet			Lino/Vinvl
	□ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □		□. <u>.</u> . □11	Cork
	4. Slippery		□12.	Grass
_				
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<i>⊾r</i> 001		2, 50	2000	

Study number:	Study number:
13. Dirt/earth	4. Fair
□14. Asphalt/bitumen	5. Poor
15 Stones/gravel	
	Questions 23 to 26 are about how much time you spent being physically active in the last 7
	days (or the 7 days prior to your fall).
19. Other (please specify):	Walking
Q20 What were you wearing on your feet at the time the fall occurred?	Q23a) During the last 7 days (or the 7 days prior to your fall) on how many days did you
□1. Nothing (bare feet)	walk at a brisk pace? (A bir is base is a pace at which you are breathing harder than
2. Jandals/sandals	normal. This includes walking at work, while getting from place to place, at home and at
Gumboots / work boots	any activities that you did solely for recreation, sport, exercise or leisure).
\Box_4 Casual shoes with high heels	
\Box 5. Casual shoes with medium heels	Think <i>only</i> about brisk walking for at least 10 minutes at a time.
6. Casual shoes with low heels	(days per week)
	None / unknown / don't recall (proceed to Q23c)
9. Stockings or socks only (i.e. with out any outer footwear)	b) How much time did you typically spend walking at a <i>brisk</i> pace on each of those
10. Unknown / don't recall	days?
11. Other (please specify):	
Q21 Just prior to the fall did you experience? (May choose more than one option)	
Symptoms Code Yes No	c) Does your state of health limit you with this activity?
Light headiness / dizziness 1.	
Loss of consciousness 2.	
Loss of eyesight or blurring of vision 3.	□2. No
Your leas suddenly giving way 4.	3. Unknown / don't recall
Unsure of yourself due to darkness 5.	
Unsure of yourself due to illness 6.	Moderate Physical Activity
None of the above 7.	O24a) During the last 7 days (or the 7 days prior to your fall) on how many days did you do
Unknown / don't recall 8.	(244) During the last / days (or the / days prior to your fail) of now many days due you do moderate physical activities? ('Moderate' activities make you breathe harder than
Other (please specify): 9.	normal, but only a little - like carrying light loads, bicycling at a regular pace, or other
	activities like those on this card (Showcard 1 – Moderate Physical Activity). Do not include
	waiking or any kina).
SECTION 3. PERSONAL HEALTH	Think only about those activities done for at least 10 minutes at a time.
These first questions are about your health now and your current daily activities. Please try to	(days per week)
These first questions are about your health now and your current daily activities. Please try to answer every question as accurately as you can.	 (days per week) None / unknown / don't recall (<i>proceed to Q24c</i>)
These first questions are about your health now and your current daily activities. Please try to answer every question as accurately as you can. Q22 In general, would you say your health is?	 (days per week) None / unknown / don't recall (<i>proceed to Q24c</i>) b) How much time did you typically spend walking at a <i>brick</i> page on each of these
These first questions are about your health now and your current daily activities. Please try to answer every question as accurately as you can. Q22 In general, would you say your health is? 1 Excellent	 (days per week) None / unknown / don't recall (<i>proceed to Q24c</i>) b) How much time did you typically spend walking at a <i>brisk</i> pace on each of those days?
These first questions are about your health now and your current daily activities. Please try to answer every question as accurately as you can. Q22 In general, would you say your health is? 1 Excellent 2. Very good	 (days per week) None / unknown / don't recall (<i>proceed to Q24c</i>) b) How much time did you typically spend walking at a <i>brisk</i> pace on each of those days?
These first questions are about your health now and your current daily activities. Please try to answer every question as accurately as you can. Q22 In general, would you say your health is? 1 Excellent 2. Very good 3. Good	 (days per week) None / unknown / don't recall (<i>proceed to Q24c</i>) b) How much time did you typically spend walking at a <i>brisk</i> pace on each of those days? hours hours hours hours

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Study number:	Study number:
c) Does your state of health limit you with this activity?	3. A moderate amount (proceed to question 28)
	\Box 5. Unable to do the activity (proceed to question 28)
\square 1 Yes \square 2 No	6. Unknown (proceed to question 28)
3. Unknown / don't recall	000 De ven here en difficulty even with sleepes medium a lawe wint healt and laws
Vigorous Physical Activity	print newspaper, or numbers on a land line telephone?
Q25a) During the last 7 days before the fall/survey on how many days did you do vigorous physical activities? ('Vigorous' activities make you breathe a lot harder than normal ('huff' and 'puff'), but only a little - like heavy lifting, digging, aerobics, fast bicycling, or other activities like those on this card (Showcard 2 – Vigorous Physical Activity)).	 1. No difficulty 2. A little 3. A moderate amount 4. A great deal
Think only about those activities done for at least 10 minutes at a time.	5. Unable to do the activity
	6. Unknown
None / unknown / don't recall (<i>proceed to</i> Q25 <i>c</i>)	Q29 Do you need help from other people or organisations because of a disability?
b) How much time did you typically spend walking at a <i>brisk</i> pace on each of those	□1. Yes
days?	$\Box^2 = \frac{1}{2} \ln \frac{1}{2} $
	Q30 How many hours did you spend at home, <i>or at someone else's home</i> , awake during the last week (Monday to Friday)?
c) Does your state of health limit you with this activity?	
2. N0 □3. Unknown / don't recall	
	Is this usual?
Frequency of Activity	$\Box 1. \text{Yes (proceed to question 32)}$
Q26 Thinking about all your activities over the last 7 days before the fall/survey	\square 2. NO \square 3 Unknown / don't recall (proceed to question 32)
including brisk walking, on how many days did you engage in:	
 at least 30 minutes of moderate activity (including brisk walking) that made you breather a little harder than normal, OR 	Q31 How many hours do you spend at home awake on average during a usual week (Monday to Friday)?
 at least 15 minutes of vigorous activity that made you breathe a lot harder than normal ('huff' and 'puff')? 	(number of hours)
(days per week)	Q32 How many hours did you spend at home, or at someone else's home, awake during the last weekend (Saturday and Sunday)?
None / unknown / don't recall	(number of hours)
MEDICAL CONDITIONS	Unknown / don't recall
Q27 Do you have any difficulty, even with glasses, reading small print, such as labels on medicine bottles, a telephone book, food labels?	
\square 1. No difficulty (proceed to question 29)	\Box 1. Yes (proceed to question 34)
$\Box 2. \text{A little (proceed to question 29)}$	□2. No
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	Study number:		Study number:
[3. Unknown / don't recall (proceed to question 34)	Q40	Unknown / don't recall Which of the following best describes your level of alertness in the 15 minutes prior
Q33 F (low many hours do you spend at home awake on average during a usual weekend Saturday and Sunday)?		to the fall/ survey? 1. Felt active, wide awake 2. Felt relaxed, awake but not fully alert, responsive
ļ	(number of hours)		3. Felt a little foggy-headed 4. Felt sleepy, would have preferred to lie down, woozy
Q34 <i>I</i>	Are you currently a cigarette smoker? 1. Yes 2. No (proceed to question 36)		 5. Could not stay awake, sleep onset was imminent 6. Unknown / don't recall
[3. Unknown (proceed to question 36)	Q41	How would you describe this on a scale of 1 to 10, where 1 is tired and 10 is fresh?
Q35 (On average, how many cigarettes do you smoke per day?]1. < 10 		Unknown / don't recall
Ĺ	_2. 10-19 _3. 20 - 29 _4 30 - 39	Q42	During the past four weeks before the fall/survey, have you <u>often</u> been bothered by
[5. ≥ 40 6. Unknown / don't recall		□1. Yes
Q36	Have you ever smoked cigarettes on a regular basis in the past? □1 Yes		 2. No (proceed to question 44) 3. Unknown / don't recall (proceed to question 44)
[2. No 3. Unknown / don't recall	Q43	If yes, do you want help with this?
Q37 I	n the past 24 hours before the fall/survey, when did you sleep? (Use the time prompt and 24 hour clock)		☐1. Tes ☐2. Yes, but not today ☐3. No
ę			4. Unknown
ş	Sleep 2:	Q44	During the past four weeks before the fall/survey, have you <u>often</u> felt anxious or unduly worried?
5			1. Yes 2. No (proceed to question 46)
[Total = L L hours L L minutes	Q45	[3. Unknown / don't recall (proceed to question 46)
Q38 	n the past week before the fall/survey, how many sleeps did you have of seven nours duration or more?		□1. Yes
ļ	(out of seven)		☐2. Yes, but not today ☐3. No ☐4. Unknown
Q39 I	Unknown / don't recall fow long do you usually sleep each 24 hours?	Q46	During the past four weeks before the fall/survey, have you <u>often</u> been bothered by
ļ			little interest or pleasure in doing things? 1. Yes 2. No (proceed to question 48)
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	Study number:						Study nu	mber:]-[
Q47	3. Unknown/ don't recall (proceed to question 48) If yes, do you want help with this? 1. Yes 2. Yes, but not today 3. No 4. Unknown	ST/ Q51	AIRS How	many sets (Numb None (p	s of stain per of sets proceed to	s of stairs/s	o you have steps) 56)	in your	home	(includiı	ng split levels)?	
Q48	How many falls (previous falls for the cases) have you had that have occurred in the home setting and have required you to seek medical attention in the past 12 months?	Q52	How	Unknow many stai	n / don't irs/steps	are there	eed to que in each se step make	estion 56, e t? this "set) 1" for gi	Jestions	52-55)	
	No/unknown/don't recall (proceed to question 50)		Set	How ma steps /s in the s	any stairs set?	Location					Codes From Q11	
Q49	Describe how and where the fall/s occurred: Codes:		1									_
	(Codes from question 11)		2									
	Fall 1: Where did it occur?		3									
	(Codes from question 15) Fall 2: How did it occur?		4									
			5									
	Fall 2: Where did it occur?		6									
	Fall 3: How did it occur?		7									
			8									
	Fall 3: Where did it occur?	Q53	What Set	t is the flo Fixed	oring su Wood	rface on e Concrete	ach set? • Cork	Tiles	Lino	Un-	Other: specify	
	Fall 4: How did it occur?		1	carpet						knwn		
			2		2.	3.	4.	5.	6.	7.	8.	
	Fall 4: Where did it occur?		3	1.	2.	3.	4.	5.	6.	7.	8.	
	SECTION 4: WHERE YOU LIVE		4	1.	2.	3.	4.	5.	6.	7.	8.	
Q50	How long have you lived in this home?		5	1.	2.	3.	4.	5.	6.	7.	8.	
			6	1.	2.	3.	4.	5.	6. 🗆	7. 🗆	8.	
	□3. ≤ 1 year □4. 2 to 4 years		7	1.	2.	3.	4.	5. 🗌	6.	7.	8.	
	□5. ≥ 5 years □6. Unknown / don't recall		<u> </u>	1.	2.	3.	4.	5.	6.	7.	8.	
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	8			Study numb	er:		□4 Cork	Study nur	mber:	
	1.	2.[3.	4. 4. 5.	6.0 7.0 8.0		5 Tiles			
Q54	Is there a	a hand rai	on each s	et of stairs?			$\square 6$ Linoleum			
	Set	Yes	No	Don't			7 Unknown / don't recall			
				recall			$\square 8$ Other (please specify):			
	1									
	-	1.	2.	3.		Q57	Do vou have rugs on vour kitch	en floor?		
	2						□1. Yes			
	-	1.	2.	3.			2. No (proceed to question 6))		
	3		2	3			3. Unknown / don't recall (pro	ceed to que	stion 60)	
	4	1.	2.	3.						
	4		2 🗆	3		Q58	Are the rugs on your kitchen flo	or fixed in p	place or hav	e slip resistant backing?
	5	1.00	2.	0.			□1. Yes			
	5		2 🗌	3			□2. No			
	6			0.			3. Unknown / don't recall			
	Ŭ	1.	2.	3.						
	7					Q59	In your opinion, is the lighting i	n your kitch	en adequat	e?
	-	1.	2.	3.			□1. Yes			
	8						2. No			
	-	1.	2.	3.			3. Unknown / don't recall			
~										
Q55	In your o	pinion is	there adeq	uate lighting arou	und each set of stairs?	BAT	HROOM			
Q55	In your o Set	pinion is Yes	there adeq No	uate lighting arou Unknown /	und each set of stairs?	BAT	HROOM	our bathroc	?	
Q55	In your o Set	pinion is Yes	there adeq No	uate lighting arou Unknown / don't recall	und each set of stairs?	BAT Q60	HROOM What is the flooring surface in y	our bathroo	om?	
Q55	In your o Set 1	Yes	there adeq No 2.	uate lighting arou Unknown / don't recall 3.	und each set of stairs?	BAT Q60	HROOM What is the flooring surface in y 1. Carpet fixed 2. Wooden floors	our bathroc	om?	
Q55	In your o Set	Yes	there adeq No 2.	uate lighting arou Unknown / don't recall 3.	und each set of stairs?	BAT Q60	HROOM What is the flooring surface in y 1. Carpet fixed 2. Wooden floors 3. Concrete	our bathroc	om?	
Q55	In your o Set 1 2	Pinion is Yes 1. 1.	there adeq No 2.	uate lighting arou Unknown / don't recall 3.	und each set of stairs?	ВАТ Q60	HROOM What is the flooring surface in y [1. Carpet fixed [2. Wooden floors [3. Concrete [4. Cork	our bathroc	om?	
Q55	In your o Set 1 2 3	Pinion is Yes 1. 1.	there adeq No 2.	uate lighting arou Unknown / don't recall 3.	und each set of stairs?	ВАТ Q60	HROOM What is the flooring surface in y [1. Carpet fixed [2. Wooden floors [3. Concrete [4. Cork [5. Tiles	our bathroc	om?	
Q55	In your o Set 1 2 3	pinion is 1 Yes 1. 1. 1. 1.	there adeq No 2	uate lighting arou Unknown / don't recall 3	und each set of stairs?	ВАТ Q60	HROOM What is the flooring surface in y 1. Carpet fixed 2. Wooden floors 3. Concrete 4. Cork 5. Tiles 6. Linoleum	our bathroo	om?	
Q55	In your o Set 1 2 3 4	pinion is Yes 1. 1. 1. 1.	there adeq No 2. 2. 2. 2. 2. 2.	uate lighting arou Unknown / don't recall 3	und each set of stairs?	ВАТ Q60	HROOM What is the flooring surface in y 1. Carpet fixed 2. Wooden floors 3. Concrete 4. Cork 5. Tiles 6. Linoleum 7. Unknown / don't recall	our bathroc	om?	
Q55	In your of Set	pinion is Yes 1. 1. 1. 1. 1. 1. 1. 1. 1.	there adeq No 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2.	uate lighting arou Unknown / don't recall 3. 3. 3. 3. 3.	und each set of stairs?	ВАТ Q60	HROOM What is the flooring surface in y 1. Carpet fixed 2. Wooden floors 3. Concrete 4. Cork 5. Tiles 6. Linoleum 7. Unknown / don't recall 8. Other (please specify):	our bathroc	om?	
Q55	In your of Set	pinion is Yes 1. 1. 1. 1. 1. 1.	there adeq No 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2.	uate lighting arou Unknown / don't recall 3	und each set of stairs?	ВАТ Q60	HROOM What is the flooring surface in y 1. Carpet fixed 2. Wooden floors 3. Concrete 4. Cork 5. Tiles 6. Linoleum 7. Unknown / don't recall 8. Other (please specify):	our bathroc	om?	
Q55	In your o Set 1 2 3 4 5	pinion is Yes 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.	there adeq No 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2.	uate lighting arou Unknown / don't recall 3. 3. 3. 3. 3. 3. 3. 3. 3. 3.	und each set of stairs?	BAT Q60 Q61	HROOM What is the flooring surface in y 1. Carpet fixed 2. Wooden floors 3. Concrete 4. Cork 5. Tiles 6. Linoleum 7. Unknown / don't recall 8. Other (please specify): Do you have a bath/s in your ho	our bathroo	om?	
Q55	In your of Set 1 2 3 4 5 6	pinion is Yes 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.	there adeq No 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2.	uate lighting arou Unknown / don't recall 3. 3. 3. 3. 3. 3.	und each set of stairs?	BAT Q60 Q61	HROOM What is the flooring surface in y 1. Carpet fixed 2. Wooden floors 3. Concrete 4. Cork 5. Tiles 6. Linoleum 7. Unknown / don't recall 8. Other (please specify): Do you have a bath/s in your ho 1. Yes	our bathroo	om?	
Q55	In your of Set 1 2 3 4 5 6	pinion is Yes 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.	there adeq No 2.	uate lighting arou Unknown / don't recall 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3.	und each set of stairs?	BAT Q60 Q61	HROOM What is the flooring surface in y 1. Carpet fixed 2. Wooden floors 3. Concrete 4. Cork 5. Tiles 6. Linoleum 7. Unknown / don't recall 8. Other (please specify): Do you have a bath/s in your ho 1. Yes 2. No (proceed to question 62)	our bathroo me?	om?	
Q55	In your of Set 1 2 3 4 5 6 7	pinion is Yes 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.	there adeq No 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2.	uate lighting arou Unknown / don't recall 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3.	und each set of stairs?	ВАТ Q60 Q61	HROOM What is the flooring surface in y 1. Carpet fixed 2. Wooden floors 3. Concrete 4. Cork 5. Tiles 6. Linoleum 7. Unknown / don't recall 8. Other (please specify): Do you have a bath/s in your ho 1. Yes 2. No (proceed to question 62 3. Unknown / don't recall (proceed)	me?	om?	
Q55	In your of Set 1 2 3 4 5 6 7	pinion is Yes 1.	there adeq No 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2.	uate lighting arou Unknown / don't recall 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3.	und each set of stairs?	ВАТ Q60 Q61	HROOM What is the flooring surface in y 1. Carpet fixed 2. Wooden floors 3. Concrete 4. Cork 5. Tiles 6. Linoleum 7. Unknown / don't recall 8. Other (please specify): Do you have a bath/s in your ho 1. Yes 2. No (proceed to question 62 3. Unknown / don't recall (proceed)	me?	om? stion 62)	
Q55	In your of Set 1 2 3 4 5 6 7 8	pinion is Yes 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.	Image: No Image: No <thimage: no<="" th=""> Image: No <thimage: no<="" th=""> Image: No <th< th=""><th>uate lighting arou Unknown / don't recall 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3.</th><th>und each set of stairs?</th><th>ВАТ Q60 Q61</th><th>HROOM What is the flooring surface in y 1. Carpet fixed 2. Wooden floors 3. Concrete 4. Cork 5. Tiles 6. Linoleum 7. Unknown / don't recall 8. Other (please specify): Do you have a bath/s in your ho 1. Yes 2. No (proceed to question 62 3. Unknown / don't recall (proceed) Question</th><th>me? 2) Ceed to ques</th><th>stion 62)</th><th>Unknown/don't recall</th></th<></thimage:></thimage:>	uate lighting arou Unknown / don't recall 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3.	und each set of stairs?	ВАТ Q60 Q61	HROOM What is the flooring surface in y 1. Carpet fixed 2. Wooden floors 3. Concrete 4. Cork 5. Tiles 6. Linoleum 7. Unknown / don't recall 8. Other (please specify): Do you have a bath/s in your ho 1. Yes 2. No (proceed to question 62 3. Unknown / don't recall (proceed) Question	me? 2) Ceed to ques	stion 62)	Unknown/don't recall
Q55	In your of Set 1 2 3 4 5 6 7 8	pinion is Yes 1.	Image: state with the state withe state with the state with the state with the state wit	uate lighting arou Unknown / don't recall 3.	und each set of stairs?	ВАТ Q60 Q61	HROOM What is the flooring surface in y 1. Carpet fixed 2. Wooden floors 3. Concrete 4. Cork 5. Tiles 6. Linoleum 7. Unknown / don't recall 8. Other (please specify): Do you have a bath/s in your ho 1. Yes 2. No (proceed to question 62 3. Unknown / don't recall (proceed) Question 61a. Is there a grab bar/handrail	me? 2) Ceed to ques Yes	stion 62)	Unknown/don't recall
Q55	In your of Set 1 2 3 4 5 6 7 8	pinion is Yes 1.	Image: No Image: No <thimage: no<="" th=""> Image: No <thimage: no<="" th=""> Image: No <th< th=""><th>uate lighting arou Unknown / don't recall 3.</th><th>und each set of stairs?</th><th>ВАТ Q60 Q61</th><th>HROOM What is the flooring surface in y 1. Carpet fixed 2. Wooden floors 3. Concrete 4. Cork 5. Tiles 6. Linoleum 7. Unknown / don't recall 8. Other (please specify): Do you have a bath/s in your ho 1. Yes 2. No (proceed to question 62 3. Unknown / don't recall (proceed to question G1a. Is there a grab bar/handrail near the bath (excludes towel</th><th>me?</th><th>stion 62)</th><th>Unknown/don't recall</th></th<></thimage:></thimage:>	uate lighting arou Unknown / don't recall 3.	und each set of stairs?	ВАТ Q60 Q61	HROOM What is the flooring surface in y 1. Carpet fixed 2. Wooden floors 3. Concrete 4. Cork 5. Tiles 6. Linoleum 7. Unknown / don't recall 8. Other (please specify): Do you have a bath/s in your ho 1. Yes 2. No (proceed to question 62 3. Unknown / don't recall (proceed to question G1a. Is there a grab bar/handrail near the bath (excludes towel	me?	stion 62)	Unknown/don't recall
KITC	In your of Set 1 2 3 4 5 6 7 8 8	pinion is Yes 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.	Image: state of the s	uate lighting arou Unknown / don't recall 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3.	und each set of stairs?	ВАТ Q60 Q61	HROOM What is the flooring surface in y 1. Carpet fixed 2. Wooden floors 3. Concrete 4. Cork 5. Tiles 6. Linoleum 7. Unknown / don't recall 8. Other (please specify): Do you have a bath/s in your ho 1. Yes 2. No (proceed to question 62 3. Unknown / don't recall (proceed to question G1a. Is there a grab bar/handrail near the bath (excludes towel rail)?	me? Yes 1.	stion 62)	Unknown/don't recall
KITC Q56	In your of Set 1 2 3 4 5 6 7 8 8 HEN What is t	pinion is : Yes 1.	Image: symbol with the relation of the	uate lighting arou Unknown / don't recall 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3.	und each set of stairs?	ВАТ Q60 Q61	HROOM What is the flooring surface in y 1. Carpet fixed 2. Wooden floors 3. Concrete 4. Cork 5. Tiles 6. Linoleum 7. Unknown / don't recall 8. Other (please specify): Do you have a bath/s in your ho 1. Yes 2. No (proceed to question 62 3. Unknown / don't recall (proceed to question 61a. Is there a grab bar/handrail near the bath (excludes towel rail)? 61b. Do you have a slip	me? Yes 1. 1.	stion 62) No 2.	Unknown/don't recall
KITC Q56	In your of Set 1 2 3 4 5 6 7 8 8 HEN What is t 1. C	pinion is Yes 1.	there adeq No 2. 3.	uate lighting arou Unknown / don't recall 3.	und each set of stairs?	ВАТ Q60 Q61	HROOM What is the flooring surface in y 1. Carpet fixed 2. Wooden floors 3. Concrete 4. Cork 5. Tiles 6. Linoleum 7. Unknown / don't recall 8. Other (please specify): Do you have a bath/s in your hot 1. Yes 2. No (proceed to question 62 3. Unknown / don't recall (proceed to question 61a. Is there a grab bar/handrail near the bath (excludes towel rail)? 61b. Do you have a slip resistant mat (e.g. a rubber mat) or surface in your bath/s?	me? Yes 1. 1. 1.	stion 62) No 2. 2.	Unknown/don't recall
KITC Q56	In your of Set 1 2 3 4 5 6 7 8 8 What is t 1. C 2. W	pinion is Yes 1.	there adeq No 2. 3.	uate lighting arou Unknown / don't recall 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3.	und each set of stairs?	BAT Q60 Q61	HROOM What is the flooring surface in y 1. Carpet fixed 2. Wooden floors 3. Concrete 4. Cork 5. Tiles 6. Linoleum 7. Unknown / don't recall 8. Other (please specify): Do you have a bath/s in your ho 1. Yes 2. No (proceed to question 62 3. Unknown / don't recall (proceed to question 61a. Is there a grab bar/handrail near the bath (excludes towel rail)? 61b. Do you have a slip resistant mat (e.g. a rubber mat) or surface in your bath/s? 61c. Do you have a slip	me? Yes 1. 1. 1. 1. 1. 1. 1. 1. 1. 1	stion 62) No 2. 2. 2.	Unknown/don't recall □3. □3. □3.
KITC Q56	In your of Set 1 2 3 4 5 6 7 8 What is t 1. Ca 2. W 3. Ca	pinion is Yes 1. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.	there adeq No 2. 3.	uate lighting arou Unknown / don't recall 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3.	und each set of stairs?	ВАТ Q60 Q61	HROOM What is the flooring surface in y 1. Carpet fixed 2. Wooden floors 3. Concrete 4. Cork 5. Tiles 6. Linoleum 7. Unknown / don't recall 8. Other (please specify): Do you have a bath/s in your ho 1. Yes 2. No (proceed to question 62 3. Unknown / don't recall (proceed to question 61a. Is there a grab bar/handrail near the bath (excludes towel rail)? 61b. Do you have a slip resistant mat (e.g. a rubber mat) or surface in your bath/s? 61c. Do you have a slip	me? Yes 1. 1. 1.	stion 62) No 2. 2. 2. 2. 2. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3.	Unknown/don't recall 3. 3. 3.

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	Study n	umber:				Study	number:	
resistant mat (e.g. a rubber mat) beside your bath/s? Do vou have a shower/s in vour	home?				☐5. G ☐6. U ☐7. O	arden maintenance nknown / don't recall ther <i>(please specify):</i>		
□1. Yes	21			Q67	Have yo haven't	u used a professional to car felt comfortable doing yours	ry out tasks in the hom elf that involved a ladd	e setting that you ler in the past 24
2. No (proceed to question 60	3)	instian 62)			months?	•		
	Yes	No	Unknown/don't recall		□1. Ye	es		
62a is there a grab bar/bandrail					□2. N	o (proceed to question 69)		
near the shower (excludes towel rail)?	L.	z.	jo.		_3. U	nknown / don't recall (proceed to	question 69)	
62b. Do you have a slip	□1.	□2.	□3.	Q68	What wa	s the activity?	ting/pointing	
or surface in your shower/s?					□1. IVI □2 W	antenance work e.g. repair spour	ing/painting	
62c. Do you have a slip	□1.	 2.	3.		□ <u>-</u> □3. W	/indow cleaning		
resistant mat (e.g. a rubber mat)					4. G	arden maintenance		
beside your showen's?						nknown / don't recall		
 EDROOM Can you switch a light on easily your bed) 	from you	r bed at hor	ne? (e.g. from sitting in or on	Q69		ny sets of stairs/steps do you h (Number of sets of stairs/steps) one (proceed to question 74) nknown / don't recall (proceed to	ave outside your home? question 74)	
☐1. Yes ☐2. No ☐2. Unknown (den't recoll				Q70	How mai	ny stairs are there in each set?		
					Set	How many steps /stairs in the set?	Location	
How often on average would yo	ou use a la	adder/stepla	dder in a home setting in a one		1			
year period?	n 67)				2			
☐2. > once a month ☐3. 1 to 6 times a year					3			
4. 7 to 12 times a year					4			
5. Unknown / don't recall					5			-
6 What activity are you most likely	y to use a	ladder for i	n the home setting?		6			_
					Ĩ			

- 2. DIY activities, e.g. painting
- 3. Cleaning
- 4. Changing a light bulb

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Q71 What is the flooring surface on each set?

Set	Wood	Concrete	Tiles	Unknown / don't recall	Other: specify
1	1.	2.	3. 🗌	4.	5.
2	1.	2.	3.	4.	5.
3	1.	2.	3.	4.	5.
4	1.	2.	3. 🗌	4.	5.
5	1.	2.	3.	4.	5.
6	1.	2.	3.	4.	5.
7	1.	2.	3.	4.	5.
8	1.	2.	3.	4.	5.

Q72 Is there a hand rail on each set of stairs?

Set	Yes	No	Unknown / don't recall
1	1.	2.	3.
2	1.	2.	3.
3	1.	2.	3.
4	1.	2.	3.
5	1.	2.	3.
6	1.	2.	3.
7	1.	2.	3.
8	1.	2.	3.

 Q73
 In your opinion is there adequate lighting around each set of stairs?

 Set
 Yes
 No
 Unknown / don't



			recall
1	1.	2.	3.
2	1.	2.	3.
3	1.	2.	3.
4	1.	2.	3.
5	1.	2.	3.
6	1.	2.	3.
7	1.	2.	3.
8	1.	2.	3.

SECTION 5: SOCIAL FACTORS

Q74 Are you on the New Zealand electoral roll (General/Māori)? <u>This question is for cases only</u>

- 1. Yes
- 2. No
- 3. Unknown / don't recall

Q75 In the last 12 months have you personally been forced to buy cheaper food so that you could pay for other things?

- 1. Yes
- 2. No
- Q76 In the last 12 months have you been out of paid work at any time for more than one month? (Note defined as "no" for those who are full time care-givers/home makers)
 - □1. Yes
 - 2. No
- Q77 In the last 12 months did you yourself get any income on the 12 months ending today from any of these sources?

Domestic Purposes Benefit, Emergency maintenance allowance, transitional retirement benefit, sickness/invalids benefit, widow's benefit.

<u>ш</u> .	165
<u>2</u> .	No

Q78 In the last 12 months have you personally put up with feelings of cold to save heating costs?

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	Study number:		Study number:	
	□1. Yes		□1. Yes	
	□2. No		2. No	
Q79	In the last 12 months have you personally made use of special food grants or food banks?	Q88	How many other adults (≥18 years) live in the same household as you?	
	∐1. Yes □2. No		(number of adults)	
Q80	In the last 12 months have you personally continued wearing shoes with holes because you could not afford replacement?		None Unknown / don't recall	
	□1. Yes □2. No	Q89	Do any children (<18 years of age) live in the same household as you?	
Q81	In the last 12 months have you personally gone without fresh fruit and vegetables, often, so that you could pay for other things you needed? \Box_1 yes		Inumber of children) None Inknown / don't recall	
	□1. 103 □2. No	Q90	What is your household income before tax (gross) for the past 12 months?	
Q82	In the last 12 months have you personally received help in the form of food, clothes or money from a community organisation?		□1. Less than \$15,000 □2. \$15,001 - \$25,000	
	□1. Yes □2. No		□3. \$25,001 - \$35,000 □4. \$35,001 - \$70,000 □6. \$70,001 - \$100,000	
Q83	Are you in paid employment?			
	2. No (proceed to question 88)		9. Unknown / don't recall	
Q84	What type of paid employment is it?	ALC	CHOL	
	□1. Full time	Q91	Had you had any alcohol in the 24 hours before the fall/survey?	
			1. Yes	
Q85	What is your current paid work?		3. Unknown / don't recall (proceed to question 97)	
Q86	What is your usual work pattern?	Q92	What alcohol did you have to drink in the 24 hours before the fall/survey?	
	□1 Davtime with no shifts		Standard drinks are defined as:	
	\square 2. Rotating shift with nights		1 can/small bottle/handle (of beer) = 1 drink	
	3. Rotating shift without nights		1quart bottle of beer = 2 drinks	
	4. Permanent nights		1 jug of beer = 3 drinks 1 flagon /peter of beer = 6 drinks	
	5. Irregular or variable		1 glass of wine/sherry = 1 drink	
	6. Other work pattern (please specify):		1 bottle of wine = 6 drinks	
			1 double nip of spirits = 1 drink 1 ready-to-drink = 1 drink	
Q87	Do you work from home?		NB for low alcohol drink ½ the number of drinks	
Falls Q 27 th Jur	Jestionnaire version 12.doc 21 Je 2005	Falls C 27 th Ju	luestionnaire version 12.doc ine 2005	22

	Study number:		Study number:
	Image:		1 flagon /peter pf beer = 6 drinks 1 glass of wine/sherry = 1 drink 1 bottle of wine = 6 drinks 1 double nip of spirits = 1 drink 1 ready-to-drink = 1 drink
Q93	How long before the fall/survey did you stop drinking?		NR for low alcohol drink 1/ the number of drinks
	D hours D minutes 1. Unknown / don't recall		(number of drinks)
	If time > 6 hours, proceed to question 97		Unknown / don't recall
094	What alcohol did you have to drink in the 6 hours before the fall/survey?	Q99	How often do you have (for men have 6 / for women have 4) or more drinks on one occasion?
Q34			2. Less than monthly
	(number of drinks)		3. Monthly
	Unknown / don't recall		4. Weekly
095	What alcohol did you have to drink in the same 6 hour period the day before the		5. Daily or almost daily
600	fall/survey?		6. Unknown / don't recall
	L (number of drinks)	Q100	How often during the last 12 months have you found that you were not able to stop
	Unknown / don't recall		drinking once you had started?
			2. Less than monthly
Q96	What alcohol did you have to drink in the same 6 hour period one week before the		3. Monthly
			4. Weekly
	(number of drinks)		5. Daily or almost daily
	Unknown/don't recall		b. Unknown / don't recail
097	How often do you drink alcohol?		
Q31		Q101	How often during the last 12 months have you failed to do what was normally
	1. Never (proceed to question 108)		1. Never
	2. Monthly or less		2. Less than monthly
	\Box 2 to 4 times a month \Box		3. Monthly
	\Box 5. 4 to 5 times a week		4. Weekly
	6. Daily or almost daily		5. Daily or almost daily
	7. Unknown / don't recall (proceed to question 108)		6. Unknown / don't recall
	8. Refused		
Q98	How many standard drinks do you have on a typical day when you drink? Standard drinks are defined as:	Q102	 How often during the last 12 months have you had a drink first thing in the morning to get yourself going after a heavy drinking session? 1. Never
	1 can/small bottle/handle (of beer) = 1 drink		2. Less than monthly
	1 quart bottle of beer = 2 drinks		3. Monthly
	i jug oi beer = 3 ullilks		∐4. Weekly
Falls Q 27 th Jui	uestionnaire version 12.doc 23 ne 2005	Falls Qu 27 th Jun	Questionnaire version 12.doc 24 Ine 2005 24

Study number:	Study number:					
□5. Daily or almost daily	□1. Yes					
	$\square 2$ No (proceed to guestion 110)					
	$\square 3 \qquad \text{Unknown / don't recall (proceed to guestion 110)}$					
	0109 What prescription medications are you currently taking?					
drinking?	No Drug name if Action if name not dose Frequency Comments					
□1. Never	known known i known					
2. Less than monthly	1.					
3. Monthly	2.					
	3.					
5. Daily or almost daily	4					
6 Unknown / don't recall	5. 6.					
7 Refused	□ None					
Q104 How often during the last 12 months have you been unable to remember what						
happened the night before because you had been drinking?	Q110 How often do you take sleeping tablets?					
1. Never	1. Never (proceed to question 112)					
2. Less than monthly	2. Less than once a month					
3. Monthly	3. 2 to 4 times a month					
4. Weekly	4. 5 to 15 times a month					
5. Daily or almost daily	5. At least every second day					
6. Unknown / don't recall	6. Unknown / don't recall (<i>proceed to question 112</i>)					
7. Refused						
Q105 Have you or someone else been injured as a result of your drinking?	Q111 Had you taken any sleeping tablets during the 24 hours before the fall/survey?					
1. Yes, but not in the last 12 months						
2. Yes, during the last 12 months	2. No					
□3. No	3. Unknown / don't recall					
4. Unknown / don't recall	Name of tablets:					
_5. Refused						
	Time taken:					
Q106 Has a friend, doctor, or other health worker been concerned about your drinking or suggested you cut down?	Dose					
1. Yes, but not in the last 12 months	Number of tablets:					
2. Yes, during the last 12 months	O112 At the time of the fall/survey were you taking regular medications for depression or					
3. No	anxiety?					
4. Unknown / don't recall	1. Yes (please specify below)					
5. Refused	\Box 2. No (proceed to question 114)					
	3. Unknown / don't recall (proceed to question 114)					
Q107 During the last 12 months how often did you drive a car or other vehicle when you might have been ever the legal limit for alcohol?	Name of tablets:					
	Time taken:					
	Dase					
MEDICATION USE	Q113 Did you start the medication in the six weeks before the fall/survey?					
Q108 Are you currently on any prescription medications?						
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	2, 3010 2003					
Study number:		-				
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<u></u>	No
Z .	110

3. Unknown / don't recall

RECREATIONAL DRUG USE

Q114 Have you ever used recreational drugs?

(This includes hash, hash oil, cannabis, grass, pot "smoking dope", speed (amphetamines), datura, LSD (acid), heroin, morphine, methadone, cocaine, ecstasy, amyl nitrate (rush, poppers, ram), solvents (glue, gas, plastics), mushrooms, P, "party pills", "herbal highs" and others).

- 1. Yes
- 2. Never (proceed to question 117)
- 3. Unknown / don't recall

Q115 Had you used marijuana in the 3 hours before the fall/survey?

- (This includes hash, hash oil, cannabis, grass, pot "smoking dope")
 - □1. Yes
 - 2. No
 - 3. Unknown / don't recall

Q116 Had you taken any other recreational drugs in the 3 hours before the fall/survey?

- (This includes speed (amphetamines), datura, LSD (acid), heroin, morphine, methadone, cocaine, ecstasy, amyl nitrate (rush, poppers, ram), solvents (glue, gas, plastics), mushrooms, P, "party pills, "herbal highs" and others)
 - 1. Yes
 - 2. No
 - 3. Unknown / don't recall

Q117 Have you used any marijuana during the past 12 months?

- (This includes hash, hash oil, cannabis, grass, pot "smoking dope")
- □1. No
- 2. Less than once a month
- 3. Once a week to once a month
- 4. Several times a week
- 5. Every day
- 6. Unknown / don't recall

Q118 Have you used any other recreational drugs during the past 12 months?

(This includes speed (amphetamines), datura, LSD (acid), heroin, morphine, methadone, cocaine, ecstasy, amyl nitrate (rush, poppers, ram), solvents (glue, gas, plastics), mushrooms, P, "party pills, "herbal highs" and others)

- □1. No
- 2. Less than once a month
- 3. Once a week to once a month
- 4. Several times a week
- 5. Every day
- 6. Unknown / don't recall

Q119 Would you like to be sent a copy of the study results?

1. Yes



2. No

Thank you for taking the time to answer these questions.

					Study	Number
--	--	--	--	--	-------	--------

Auckland	Falls Injury Study	Medical Record Abstract			
Ethnicity as s	tated in medical record:	Abstractor's Initia	s		
н	ospital Sticker (if available)	Date Completed			
121.	National Hospital Index (NHI)	-			
122.	Date of Birth				
Admi 123.	ssion Data / Circumstances of Injury Date of injury (dd/mm	/ h/yy)			
124.	Time of Injury (24 hr clock)				
125.	Hospital Admitted to (10=APH, 20=MMH,30=NSH, 40 = other	, 50 not admitted)			
126.	Date of Arrival to hospital	(dd/mm/yy)			
127.	Time of Arrival to hospital	(24 hr clock)			
128.	Alcohol suspected (1=No, 2=Yes, No impairment, 3= Ye	es, with impairment)			
129.	Blood alcohol taken (1=yes, 2=no, 3= unknown)				
130.	Blood Alcohol Concentration (in mm	ol/L; DK=999)			
Phys	iology on Admission				
131.	Revised Trauma Score				
Disch	arge Data				
132.	Date of Discharge/death	(dd/mm/yy)			
133.	Total Hospital Days				
134.	Total ICU Days				
135.	Disposition (1=home, 2= other acute hospital, 3 :	= rehab/unit, 4=morg	gue, 5 = other)		
Medical Rec	ord Injury Description		AIS Severity Body Score Region*		
136.	Injury #1				

		Study Number
137.	Injury #2	
138.	Injury #3	
139.	Injury #4	
140.	Injury #5	
141.	Injury #6	
142.	Injury #7	
143.	Injury #8	
* AIS Body	Regions: 1=Head/Neck 2=Face 3=Chest 4=Abdomen 5=Lower Limbs 6=Upper Limbs 7=External)	
144.		ISS
NZHIS Cod	ling	
145.	External Cause of injury code	E
146.	Place of occurrence	Y
147.	Activity at time	U
ACC	C Data	
148.	ACC documenation completed	
	1. Yes	
	□2. No	

				Study Nu	mber
149.	ACC form injury descriptor	Injury #1			
150.	ACC form injury descriptor	Injury #2			
151.	ACC form injury descriptor	Injury #3			-
152.	ACC form injury descriptor	Injury #4			-
153.	ACC form injury descriptor	Injury #5			-
154.	ACC form injury descriptor	Injury #6			-
155.	ACC form injury descriptor	Injury #7			_
156.	ACC form injury descriptor	Injury #8			-
157.	ACC form mechanism of inj	ury			-
					_
 158.	Co-morbidities:				_
 159.	Disabilities:				_

discharged from hospital, to find out if you would like to participate in the study. Before making your decision, please feel free to talk with your whanau/family and friends about taking part in the study.

If you are willing to take part the researcher will arrange to interview you in hospital or at home - whichever you prefer. The interview will take about 30 minutes to complete.

If you agree to take part, you will be free to withdraw from the study at any time without giving any reason.

Who should I contact if I have further questions?

Bridget Kool, Principal Researcher, ph 09 373 7599 extension 83871; mobile 021 524 802; email: b.kool@auckland.ac.nz

Cherie Lovell, Study Research Nurse; phone: 09 373 599 Extension 87840; mobile 021 203 6532; email: c.lovell@auckland.ac.nz

North Shore Hospital: Jane Sherard, Research Advisor - Maori, Nga Kai Taataki; Phone: 486-1491 extension 2553

Auckland City Hospital: Mata Forbes, Mäori Health Services Coordinator / Advisor. Phone: 307-4949 extension 23939; Mobile 021 348 432

Middlemore Hospital: Kerry Hiini, member of the Maori Research

Falls PIS cases V6.doc

Introduction

You are invited to take part in the Auckland Falls Study. This is a research study which will look at risk factors for serious falls occurring in Auckland in the home setting in people aged 25 to 60 years. The findings of this study will help to prevent injury and disability due to fall injury in New Zealand.

Taking part is completely voluntary (your choice) and if you decide you do not wish to take part, it will not affect your continuing healthcare in any way.

He tono tēnei ki ā koe kia whakaae mai koe kia uru mai ki tēnei mahi rangahau e kīa nei ko te Rangahau Hunga Hingahinga kei Tāmakimakaurau. He rangahau tēnei hei tirotiro i ngā āhuatanga o te hunga e kaha nei te hingahinga kei Tāmakimakaurau nei, arā kei o rātou kāinga, mo te hunga i waenganui i te 25 ki te 60 tau. Ko ngā hua ka puta mai i tēnei mahi rangahau, kia mõhio ai tātou hei a pēhea te tiaki i a tātou kia kore ai tātou e whara ā puta noa i Aotearoa.

Kei ā koe anō te tikanga mehemea e hiahia ana koe te uru mai, ā ki te kore, ko taua āhua rā anō to mātou kaha ki te tiaki i ā koe.

Why are you being asked?

In New Zealand falls are the leading cause of injury hospitalisation, and a leading cause of injury death. The home is the most common place where injuries occur that lead to someone being hospitalised in New Zealand. This study is being Review Committee; Mobile: 021 622 334

If you have any queries or concerns regarding your rights as a participant in this study you may wish to contact a Health and Disability Advocate, telephone (Northland to Franklin) 0800 555 050.

This study has received ethical approval from the Northern X Ethics Committee.

Thank you for making the time to read about, and consider taking part in this study.

Principal Investigator team: Dr Shanthi Ameratunga, University of Auckland

Bridget Kool, University of Auckland

Dr Jennie Connor, University of Auckland



June 27, 2005

conducted to find out more about falls in the home so that we can find ways to prevent them.

What is this study about?

In this study information from people who have recently had a fall in the home setting that has resulted in them being admitted to hospital will be compared with a randomly selected group of people from the general community. This will show any differences between those having a fall and those chosen by chance. This type of study is called a case-control study.

The Auckland Falls Study is being run by researchers from the Injury Prevention Research Centre at the University of Auckland. The study is funded by the Accident Compensation Corporation.

Why have I been chosen?

Because you are 25 to 60 years of age and have recently had a serious fall in the home.

Risks & benefits

It is anticipated that there will be no adverse events for people taking part in this research. In the unlikely event of any physical injury as a result of your participation in this study, you may be covered by ACC. If you have any questions about this contact your nearest ACC office.

Confidentiality

No material which could personally identify you will be used in any reports on this study. Information from the



Auckland Falls Study

Participant Information Sheet

for people admitted to hospital as a result of a fall

A study investigating risk factors for serious falls in the home in the working age population

Injury Prevention Research Center University of Auckland

study will be kept for 10 years in secure storage that is accessible only to the principal investigator and lead researcher.

Under no circumstances will information you provide be shared with the police, the Accident Compensation Corporation (ACC) or any other third parties.

What does the study involve? If you decide to take part all you will be asked to do is:

- Answer some questions about yourself, the fall episode, and your home
- Provide consent for us to review your medical record
- Agree to be contacted by a researcher at a later date if required

If I need an interpreter, can one be provided?

Yes, interpreter services are available if requested. Please ask your study research nurse.

Can I get to see the results of the study?

If you would like to be sent a summary of the study results please let the study researcher know when she asks you that question during the interview. A summary of the results will be available on the acc website in august 2007 (www.acc.co.nz)

What will happen now?

A trained researcher will visit you in the next day or so we will telephone you at home soon after you have been or family and friends about taking part in the study.

If you are willing to take part the researcher will arrange to interview you on the telephone or at home - whichever you prefer. The interview will take about 20 minutes to complete.

If you agree to take part, you will be free to withdraw from the study at any time without giving any reason.

Who should I contact if I have further questions?

Bridget Kool, Lead Researcher, ph 09 373 7599 extension 83871; mobile 021 524 802; email: b.kool@auckland.ac.nz

Cherie Lovell, Study Research Nurse; phone: 09 373 599 extension 87840; mobile 021 203 6532; email: c.lovell@auckland.ac.nz

North Shore Hospital: Jane Sherard, Research Advisor - Maori, Nga Kai Taataki; Phone: 486-1491 extension 2553

Auckland City Hospital: Mata Forbes, Mäori Health Services Coordinator / Advisor. Phone: 307-4949 *extension* 23939; Mobile 021 348 432

Middlemore Hospital: Kerry Hiini, member of the Maori Research Review Committee; Mobile: 021 622 334

If you have any queries or concerns regarding your rights as a participant

Falls PIS controls V6.doc

in this study you may wish to contact a Health and Disability Advocate, telephone (Northland to Franklin) 0800 555 050.

This study has received ethical approval from the Northern X Ethics Committee.

Thank you for making the

time to read about, and

consider taking part in this

study.

Principal Investigator team:

Bridget Kool, University of Auckland

Dr Jennie Connor, University of

Dr Shanthi Ameratunga, University of Auckland

Auckland



Auckland Falls Study

Participant Information Sheet

for the comparison group

A study investigating risk factors for serious falls in the home in the working age population

Injury Prevention Research Center University of Auckland

Introduction

You are invited to take part in the Auckland Falls Study. This is a research study which will look at risk factors for serious falls occurring in Auckland in the home setting in people aged 25 to 60 years. The findings of this study will help to prevent injury and disability due to fall injury in New Zealand.

Taking part is completely voluntary (your choice).

He tono tēnei ki ā koe kia whakaae mai koe kia uru mai ki tēnei mahi rangahau e kīa nei ko te Rangahau Hunga Hingahinga kei Tāmakimakaurau. He rangahau tēnei hei tirotīro i ngā āhuatanga o te hunga e kaha nei te hingahinga kei Tāmakimakaurau nei, arā kei o rātou kāinga, mo te hunga i waenganui i te 25 ki te 60 tau. Ko ngā hua ka puta mai i tēnei mahi rangahau, kia mõhio ai tātou hei a pēhea te tiaki i a tātou kia kore ai tātou e whara ā puta noa i Aotearoa.

Kei ā koe te tikanga mehemea ka uru mai koe, kāhore raini.

Why are you being asked?

In New Zealand falls are the leading cause of injury hospitalisation, and a leading cause of injury death. The home is the most common place where injuries occur that lead to someone being hospitalised in New Zealand. This study is being conducted to find out more about falls in the home so that we can find ways to prevent them.

What is this study about?

In this study information from people who have recently had a fall in the home setting that has resulted in an admission to hospital will be compared with a randomly selected group of people from the general community. This will show any differences between those having a fall and those chosen by chance. This type of study is called a case-control study.

June 27, 2005

The Auckland Falls Study is being run by researchers from the Injury Prevention Research Centre at the University of Auckland. The study is funded by the Accident Compensation Corporation.

Why have I been chosen?

You have been randomly (by chance) chosen from the electoral roll as part of the "comparison" group for the study. The information you provide and others randomly selected will serve as a basis of comparison with people in the same age group (25 to 60 years) as you who have had a serious fall in their home.

Risks & benefits

It is anticipated that there will be no adverse events for people taking part in this research. In the unlikely event of any physical injury as a result of your participation in this study, you may be covered by ACC. If you have any questions about this contact your nearest ACC office.

Confidentiality

No material which could personally identify you will be used in any reports

on this study. Information from the study will be kept for 10 years in secure storage that is accessible only to the principal investigator. Under no circumstances will information you provide be shared with the police, the Accident Compensation Corporation (ACC) or any other third parties.

What does the study involve?

If you decide to take part all you will be asked to do is:

- Answer some questions about yourself, and your home
- Agree to be contacted by a researcher at a later date if required

If I need an interpreter, can one be provided?

Yes, interpreter services are available if requested. Please ask your study research nurse.

Can I get to see the results of the study?

If you would like to be sent a summary of the study results please let the study researcher know when she asks you that question during the interview. A summary of the results will be available on the acc website in august 2007 (www.acc.co.nz)

What will happen now?

In the next few days a trained researcher will telephone you at home in order to find out if you would like to participate in the study. Before making your decision, please feel free to talk with your whanau **Auckland Falls Study**

Consent Form - Case

The University of Auckland Private Bag 92019 Auckland New Zealand

THE UNIVERSITY OF AUCKLAND

85 Park Road, Grafton www.health.auckland.ac.nz

Telephone: 64 9 373 7599 extn 83871 Facsimile: 64 9 373 7503 Email: b.kool@auckland.ac.nz

Risk factors for serious falls in the home in the working age population.

REQUEST FOR INTERPRETER					
	C	Circle one	•		
English	I wish to have an interpreter.	Yes	No		
Maori	E hiahia ana ahau ki tetahi kaiwhakamaori/kaiwhaka pakeha korero.	Ae	Kao		
Samoan	Ou te mana'o ia i ai se fa'amatala upu.	loe	Leai		
Tongan	Oku ou fiema'u ha fakatonulea.	lo	Ikai		
Cook Island	Ka inangaro au i tetai tangata uri reo.	Ae	Kare		
Niuean	Fia manako au ke fakaaoga e taha tagata fakahokohoko kupu.	E	Nakai		

I have read and I understand the information sheet dated 27th of June 2005 for volunteers taking part in the study designed to find out more about falls of a serious nature that occur in and around the home.

I have had the opportunity to discuss this study. I am satisfied with the answers I have been given.

I have had the opportunity to use whanau support or a friend to help me ask questions and understand the study.

I understand that taking part in this study is voluntary (my choice) and that I may withdraw from the study at any time and this will in no way affect my continuing and/or future health care.

I understand that my participation in this study is confidential and that no material which could identify me will be used in any reports on this study.

I am aware that the exception to confidentiality will be if the interviewer has significant concerns about the safety of myself or others.

I understand the compensation provisions for this study.

I have had time to consider whether to take part.

I agree to allow the study research nurse to review my relevant medical records for the sole purpose of checking the accuracy of the information recorded for the study. YES/NO

I wish to receive a copy of the results when they become available in late 2007. YES/NO

I this study.	(full name) hereby consent to take part in
Signed	Date
Phone	
Project explained by	

Project role ______ Date _____

Contacts:

Lead Researcher: Bridget Kool Research Fellow Section of Epi/Biostats University of Auckland Phone: 09 373 7599 extension 83871 Email: <u>b.kool@auckland.ac.nz</u> Study Research Nurse: Cherie Lovell Phone: 09 373 7599 extension 87840 Mobile: 021 2036 532 Email: <u>c.lovell@auckland.ac.nz</u>

The signed Research Consent Document will be retained in the Study Master File

Tick this box	ot if you do not wish to participate in this study, and plea	ise
return this form	in the pre paid envelope.	

Name ___

1/2

Auckland Falls Study

Consent Form - Control

FACULTY OF HEDICAL AND HEALTH SCIENCES The University of Auckland Private Bag 92019 Auckland New Zealand 85 Park Road, Grafton www.health.auckland.ac.pz

THE UNIVERSITY OF AUCKLAND

Telephone: 64 9 373 7599 extn 83871 Facsimile: 64 9 373 7503 Email: b.kool@auckland.ac.nz

Risk factors for serious falls in the home in the working age population.

REQUEST FOR INTERPRETER					
	(Circle one	•		
English	I wish to have an interpreter.	Yes	No		
Maori	E hiahia ana ahau ki tetahi kaiwhakamaori/kaiwhaka pakeha korero.	Ae	Kao		
Samoan	Ou te mana'o ia i ai se fa'amatala upu.	loe	Leai		
Tongan	Oku ou fiema'u ha fakatonulea.	lo	Ikai		
Cook Island	Ka inangaro au i tetai tangata uri reo.	Ae	Kare		
Niuean	Fia manako au ke fakaaoga e taha tagata fakahokohoko kupu.	E	Nakai		

I have read and I understand the information sheet dated 27th of June 2005 for volunteers taking part in the study designed to find out more about falls of a serious nature that occur in and around the home.

I have had the opportunity to discuss this study. I am satisfied with the answers I have been given.

I have had the opportunity to use whanau support or a friend to help me ask questions and understand the study.

I understand that taking part in this study is voluntary (my choice) and that I may withdraw from the study at any time and this will in no way affect my continuing and/or future health care.

I understand that my participation in this study is confidential and that no material which could identify me will be used in any reports on this study.

I am aware that the exception to confidentiality will be if the interviewer has significant concerns about the safety of myself or others.

I understand the compensation provisions for this study.

I have had time to consider whether to take part.

I wish to receive a copy of the results when they become available in late 2007. $$\rm YES/NO$$

I	(full name) hereby consent to take part in
Signed	Date
Phone	
Project explained by	
Project role	
Signature	Date

Contacts:

Lead Researcher: Bridget Kool Research Fellow Section of Epi/Biostats University of Auckland Phone: 09 373 7599 extension 83871 Email: <u>b.kool@auckland.ac.nz</u> Study Research Nurse: Cherie Lovell Phone: 09 373 7599 extension 87840 Mobile: 021 2036 532 Email: <u>c.lovell@auckland.ac.nz</u>

The signed Research Consent Document will be retained in the Study Master File

Tick this box \square if you do not wish to participate in this study, and please return this form in the pre paid envelope.

Name _____

1/2

					Study	Number
--	--	--	--	--	-------	--------

Auckland	Falls Injury Study	Medical Record Abstract						
Ethnicity as s	tated in medical record:	Abstractor's Initial	ls					
Н	ospital Sticker (if available)	Date Completed						
121.	National Hospital Index (NHI)							
122.	Date of Birth							
Admi 123.	ssion Data / Circumstances of Injury Date of injury (dd/mm	/ n/yy)						
124.	Time of Injury (24 hr clock)							
125.	Hospital Admitted to (10=APH, 20=MMH,30=NSH, 40 = other	, 50 not admitted)						
126.	Date of Arrival to hospital	(dd/mm/yy)						
127.	Time of Arrival to hospital	(24 hr clock)						
128.	Alcohol suspected (1=No, 2=Yes, No impairment, 3= Ye	es, with impairment)						
129.	Blood alcohol taken (1=yes, 2=no, 3= unknown)							
130.	Blood Alcohol Concentration (in mmo	ol/L; DK=999)						
Physi	iology on Admission							
131.	Revised Trauma Score							
Disch	arge Data							
132.	Date of Discharge/death	(dd/mm/yy)						
133.	Total Hospital Days							
134.	Total ICU Days							
135.	Disposition (1=home, 2= other acute hospital, 3 =	= rehab/unit, 4=morg	gue, 5 = other)					
Medical Rec	ord Injury Description		AIS Severity Body Score Region*					
136.	Injury #1							

		Study Number
137.	Injury #2	
138.	Injury #3	
139.	Injury #4	
140.	Injury #5	
141.	Injury #6	
142.	Injury #7	
143.	Injury #8	
* AIS Body	Regions: 1=Head/Neck 2=Face 3=Chest 4=Abdomen 5=Lower Limbs 6=Upper Limbs 7=External)	
144.		ISS
NZHIS Cod	ling	
145.	External Cause of injury code	E
146.	Place of occurrence	Y
147.	Activity at time	U
ACC	C Data	
148.	ACC documenation completed	
	1. Yes	
	□2. No	

				Stud	y Number
149.	ACC form injury descriptor	Injury #1			
150.	ACC form injury descriptor	Injury #2			
151.	ACC form injury descriptor	Injury #3			
152.	ACC form injury descriptor	Injury #4			
153.	ACC form injury descriptor	Injury #5			
154.	ACC form injury descriptor	Injury #6			
155.	ACC form injury descriptor	Injury #7			
156.	ACC form injury descriptor	Injury #8			
 157.	ACC form mechanism of inj	jury			
 158.	Co-morbidities:				
 159.	Disabilities:				

	For	n 1.0 Cas	se Partic	cipant Reg	ister	H	lospital:		
Study Number	Name and Contact Addresses/ Phone Numbers	DOB/ Age	M/F	Consent Y/N	Medical Abstract		Questionnaire		Comments
	Numbers				ISS	Com	Date	Ent	
_									

Form 2.0 Control Participant Register

Form 2.0 Control Participant Register											
Study Number	Name and Contact Addresses/ Phone Numbers	DOB/ Age	M/F	Date Sent	Con- sent Y/N	Phone Contact Date		Questionnaire		Comments	
						1 st	2 nd	3 rd	Date	Ent	

Auckland Falls Study:

Data Quality Check

Date	Study ID	Data issues (y/n)	Action taken	Initials of checker
				1