

Work-related slip, trip and fall injuries in New Zealand

Injury Prevention Research Unit

**Bronwen McNoe
John Langley
Tim Driscoll
Anne-Marie Feyer**

2005

**Department of Preventive & Social Medicine
Dunedin School of Medicine
University of Otago
PO Box 913
Dunedin
New Zealand**

For further information visit our website: www.otago.ac.nz/ipru/Statistics/Statistics.html

Injury Prevention Research Unit
Department of Preventive and Social Medicine
Dunedin School of Medicine
University of Otago
PO Box 913
DUNEDIN

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Executive summary

Introduction

International literature suggests that falls contribute to a sizeable proportion of work-related injury and death. In New Zealand there is little documented work on the extent and nature of these events.

Aims

The study aimed to describe, the epidemiology of work-related injuries from slips, trips and falls in New Zealand and to determine the feasibility of deriving reliable estimates of the incidence of work-related injuries from slips, trips and falls.

Methods

Fatal falls were identified from databases created by prior studies namely, The New Zealand Work-Related Fatal Injury Study (WRFIS) and the Fatal Work-Related Traffic Study (WRFTS).

Non fatal falls were identified by a combination of references to relevant fields on the hospital file (ICD-10 activity code) and where it existed a matched Accident Compensation Corporation (ACC) compensation file.

Results

For the period 1985-1994 there were 135 deaths that resulted from a work-related slip, trip or fall, which is about 14 cases annually. This is a rate of 0.9 per 100,000 workers and represents approximately 15% of all work-related fatal injuries that occurred during that period. Workers affected were predominantly men, most commonly in their 30's. This is possibly a reflection of the occupational groups where fall injuries most frequently occur. "Construction" and "Agriculture, farming and fishing" (primarily fishing) were particular problem areas with mortality rates of 4.6 and 2.5 per 100,000 workers respectively.

For 2001 it was estimated that there were 1016 work-related falls which resulted in hospitalization. Using the New Zealand Health Information Service (NZHIS) database, 717 (70.6%) work-related fall cases were identified. There was concordance with the ACC work indicator for 558 of these cases. The ACC indicator, identified an additional 298 work-related fall cases. Given the restrictions on methods for identifying falls this is likely to be an underestimate.

Conclusions

Work-related falls represent a significant portion of the work-related fatal injury problem in New Zealand. It is feasible through matching to derive an estimate of the incidence of non-fatal events and the process yields useful information on the circumstances of these events. Given the significance, the inability to routinely and reliably identify work-related fatal and serious non-fatal falls is a major shortcoming of existing national information systems.

1. Background

This study was as a result of a successful bid in response to a call for projects relating to slips, trips and falls from the Joint Research Portfolio between the Accident Compensation Corporation and the Health Research Council of New Zealand.

The study aims to describe, in-depth for the first time, work-related injuries from slips, trips and falls in New Zealand. The only scientific study that has been conducted in New Zealand on this topic, looked at falls from buildings and other fixed structures. It reported that approximately 15-25% of all the identified fall cases, 25-30% of falls from roofs and 85-90% of falls from scaffolds were work-related¹.

International literature suggests that falls contribute to a sizeable proportion of work-related injury and death. Studies in the United States and Britain suggest that work-related falls are the second leading cause of work-related deaths and serious injury^{2 3 4}.

The relative contribution of slips, trips and falls to all occupational injury varies depending on the “type of fall”, whether all injury or simply fatalities are counted, and whether the studies are population based.

In Australia between 1989 and 1992 falls represented 12% of all work-related deaths with a rate of 0.67 deaths per 100,000 workers per year⁵. The National Safety Council² in the United States found that 12% of worker fatalities in 1992 resulted from falls⁶. Another study in the United States found 9% of all work-related deaths were due to falls³. In West Germany falls were the leading cause of occupational fatalities, contributing to 35% of work-related deaths^{6 7}. The definition of fall varied considerably between the studies.

Studies reporting on non-fatal injuries resulting from occupational falls are more numerous than those of fatal injury. In the United States one study found that falls accounted for 21% of occupational disabling injury³, and another that 17% of all work-related injuries were due to falls^{2 6}. In Sweden, a study based on insurance data demonstrated that falls accounted for 22% of all occupational incidents. In the United Kingdom one study found that 18% of all occupational incidents involving an absence from work for greater than three days were related to slips trips or falls⁸, another found 35% of major occupational injuries were caused by slips, trips or falls^{9 10}. A review of literature on falls in Nordic countries found that between 13% and 29% of falls were occupational¹¹. In contrast, a West German study found that only 2% of all reported injuries involving more than three lost work days were fall related^{6 7}. Again this difference is probably due to definitional differences and varying methods of case ascertainment.

A number of studies on work related falls are based around specific types of occupational falls, such as those involving ladders¹², trucks¹³, while walking on stairways^{14 15} and within specific occupations and industries; construction^{12 16 17 18}, farming¹⁹, mail delivery²⁰, commercial fishing²¹, Armed Services²², and nurses²³.

In summary falls have been estimated to account from 9-35% of all work-related fatalities, and 2-29% of all non-fatal occupational injury.

2. Aims

- To describe the epidemiology of work-related fatal injury due to slips, trips and falls using the work-related fatal injury study database.
- To determine numbers and rates of fatal slip, trip and fall injury by gender, age, ethnicity, employment status, occupation, and industry and time of day, and
- To describe precursor and contributory factors immediately prior to the slip, trip or fall event.
- To determine the feasibility of deriving a reliable estimate of the incidence of work-related slips, trips and falls which result in public hospital inpatient treatment.

3. Methods

3.1. Fatal falls

The New Zealand Work-Related Fatal Injury Study (WRFIS) and the Work-Related Fatal Traffic Study (WRFTS) created a dataset extracted from the coroner's records for all work-related fatal injuries in New Zealand over the decade 1985-1994. The methods for these studies and study results are reported elsewhere^{24 25}. This dataset provides a uniquely rich and complete source of information on fatal injuries in New Zealand during that period, with much better capture of cases than all other routine sources combined. This dataset was used as the basis for identifying fatal work-related slips, trips and falls.

Inclusion criteria

To allow comparison of New Zealand data with that collected in Australia, criteria and definitions in this study were consistent with those used in an Australian study "Work-related traumatic fatalities in Australia, 1989 to 1992" which included a publication on work-related falls⁵. The only difference was that the Australian study included falls of one metre or more, whereas this study includes all slips, trips and falls (hereafter referred to as falls) from any height that resulted in a fatality.

Potential cases were identified from the fatality dataset by one or more of three methods:

- A mechanism code of "falls from a height" or "falls on the same level"
and/or
- Examination of the text description of the event for one of the following words - trip, tripped, stumble, fall, fell, knocked, overbalanced, balance, thrown, swept, slipped, pushed, overboard
and/or
- An External Cause Code of E880 to E888 (falls).

The text description of what happened for each of the potential cases identified were reviewed for inclusion in the final analysis. Variables already coded in the fatal dataset were used in addition to a number of variables applicable to falls (height of fall, origin of fall, safety equipment used (e.g. safety harness)) and a qualitative description of the fall event.

Persons included in this analysis were workers fatally injured as the result of a fall in the course of their work duties. This included workers who:

- Fell and sustained fatal injuries when they struck something (e.g. the ground);
- Fell and were exposed to another fatal hazard as a result of the fall (e.g. drowning after falling into water, being run over by a tractor, or being asphyxiated after falling and being exposed to a harmful atmosphere);
- Fell from an animal (all such incidents involved horses) and suffered fatal injuries when hitting the ground or were struck by the animal or another animal;
- Fell from ground level into a hole or trench;

- Fell from a vehicle, as long as the fall did not occur as part of a motor vehicle crash (i.e. falls while boarding or alighting from a vehicle or off the back of a truck (including a moving truck) were included)).

Excluded were workers who:

- Were exposed to a fatal hazard (usually electricity) and subsequently fell, but were dead prior to the fall;
- Fell in or from a vehicle involved in a motor vehicle collision.

The regional area in which the incident occurred was determined from the coronial inquest location. The working population of that regional area was obtained from Statistics New Zealand²⁶ for 2004. Details about regional location of the working population was not available for 13% of the population.

Rates

Population rates were calculated using census data as the denominator. The data were specific for gender, age group, occupation and industry. Census data were available for 1986, 1991 and 1996. The population in the intervening years was determined by interpolation using a linear function for the inter-census years to span the time frame 1985-1994. The numbers of workers in each level was summed over time to give an estimate of person-years at risk.

For some groups, the rates are based on low numbers in the numerator and so may not be stable. Therefore, caution should be applied when interpreting differences between such rates.

3.2 Non fatal falls

Serious work-related injuries that are not fatal are likely to result in hospital admission. Late in 1999, NZHIS introduced ICD-10 for the purpose of coding all public hospital discharges. The ICD-10 external cause codes allows for the identification of work-related events via the activity code “while working for income”. However, the reliability of coding of activity for hospital inpatients is not known. Consequently the Accident Compensation Corporation Workers Compensation database was used via linkage to provide alternative information on work-relatedness of falls. Both medical only and entitlement claims for 2001 were used for this matching.

For a case to be selected it had to be coded as a “fall” in the 2001 hospital database. The codes used to select falls were W01-W19. In addition it had to also meet one of the following criteria

- a. the hospital file had an activity code of “while working for income”.
- b. The “at work” variable on the ACC file was coded “yes”.
- c. The claimant appeared in the ACC self employed or employer accounts.

Conflicts between a. b. and c. were ignored as there was no reliable method of determining which was correct.

Appendix 1 contains the various descriptors for the ICD WO1-W19 codes. Two points are worthy of note. First, the exclusions show that not all falls are included. Second diving and or jumping into water causing injury other than drowning or submersion is included.

For the potential cases extracted, the text description (provided to ACC by the claimant) about the injury event was reviewed. As with the fatal dataset, falls that occurred as the result of a medical condition were excluded. Where it appeared that the event was probably not work-related (e.g. a librarian snowboarding), the case was excluded. The final dataset is therefore very likely to be a conservative estimate of the actual number of work-related falls. Information on the circumstances of the injury was gathered from both ACC and NZHIS datasets. For the purposes of this report, where variables were collected in both datasets (e.g. age), the NZHIS variable was used for the production of the results.

Rates

Population rates were calculated using census data (2001) as the denominator. It is specific for gender, age group, occupation and industry. Rates for regional areas was calculated using Statistics New Zealand Data obtained in 2004 from their website.

4. Results

4.1. Fatal falls

For the period 1985-1994 there were 135 deaths that resulted from a work-related slip, trip or fall, which is about 14 cases annually. This is a rate of 0.9 per 100,000 workers and represents approximately 15% of all work-related fatal injuries that occurred during that period. With the exception of two cases, most of the incidents involved one fatality.

4.1.1. Year of death

The number and rate of deaths due to work-related falls declined over the decade covered by the study. The rate has generally declined over time. The highest rate was observed in 1985 and 1988 (1.2 per 100,000 workers per year) and the lowest rate in 1990, 1991, 1993 and 1994 (0.7 per 100,000 workers per year) (Table 1, Figures 1 and 2).

Table 1: Year of death of workers fatally injured as a result of work-related falls. Number, percent and rate – New Zealand 1985-1994

	Number	Percent	Rate (per 100,000 working persons)	95 % CI
85	19	14.1	1.2	0.8-1.9
86	16	11.9	1.1	0.7-1.7
87	13	9.6	0.9	0.5-1.5
88	17	12.6	1.2	0.7-1.9
89	15	11.1	1.0	0.6-1.7
90	10	7.4	0.7	0.4-1.3
91	9	6.7	0.6	0.3-1.2
92	15	11.1	1.0	0.6-1.7
93	11	8.1	0.7	0.4-1.3
94	10	7.4	0.7	0.4-1.2
Total	135	100.0	0.9	0.8-1.1

Figure 1: Year of death of workers fatally injured as a result of work-related falls. Number – New Zealand 1985-1994

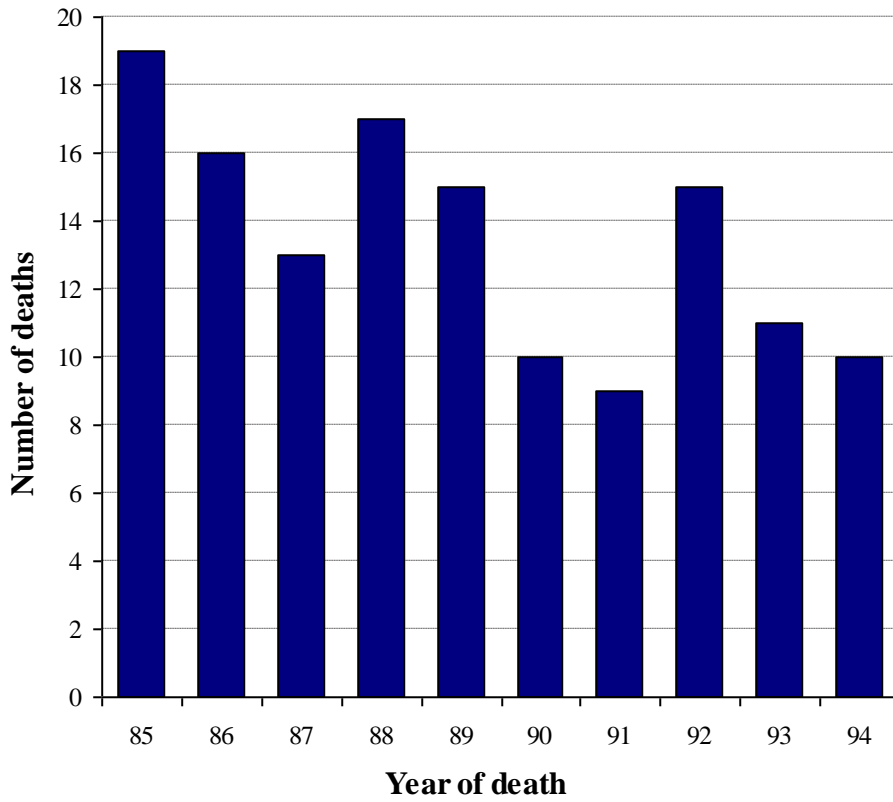
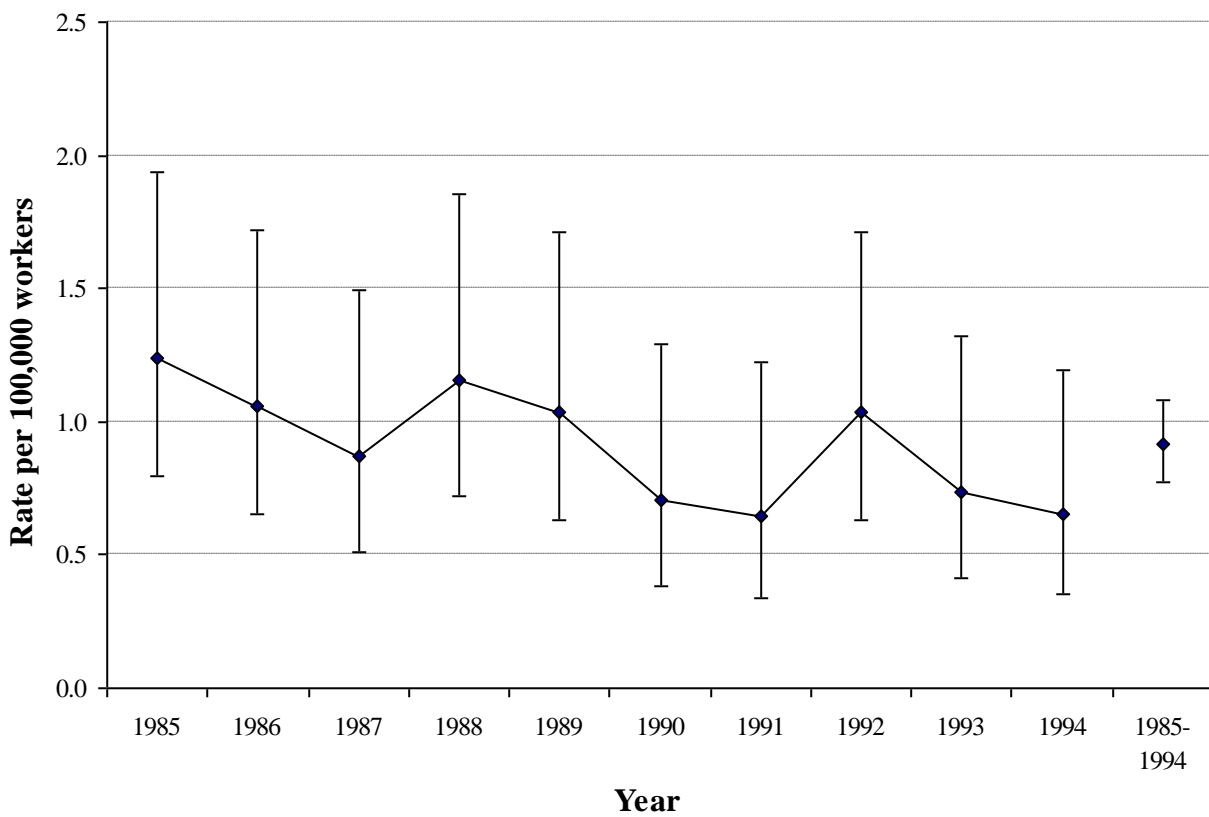


Figure 2: Year of death of workers fatally injured as a result of work-related falls. Rate – New Zealand 1985-1994



4.1.2. Age group

The highest number of fatalities occurred in 35-39 year age groups (Figure 3, Table 2). About half of the fatalities (51%) occurred to workers aged between age 30 and 49. The lowest frequencies were in the older age groups. The median age was 39 years.

The age specific rate remained relatively constant with increasing age until the later working years. The rate in the 65+ group being four times that in the 15 to 19 year old age group (Table 2, Figure 4).

Figure 3: Age of workers fatally injured as a result of work-related fatal slip, trip and fall injuries (age 15-84): 1985-1994

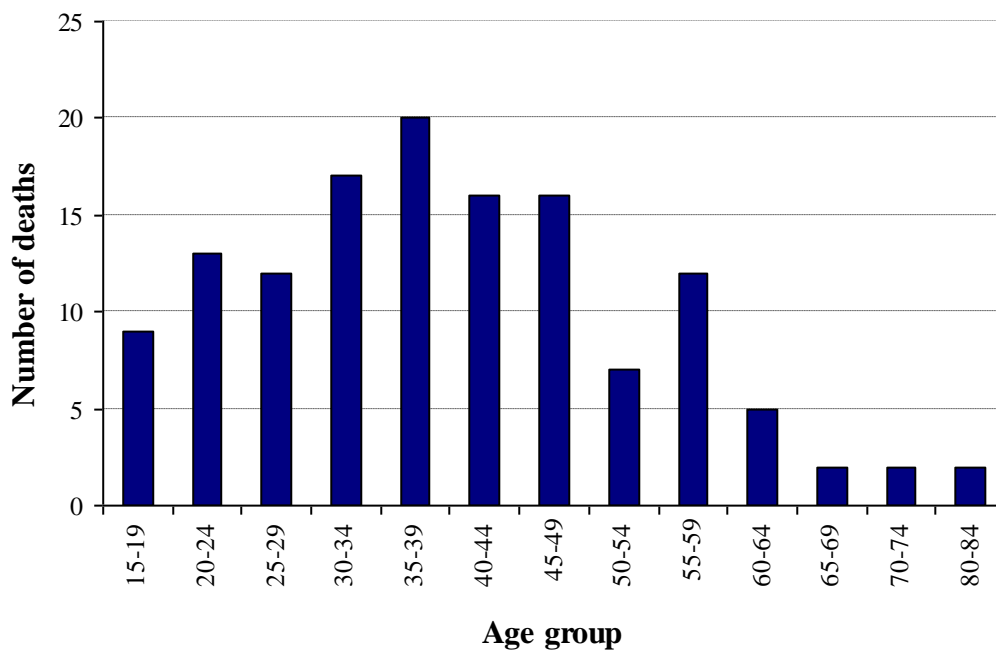
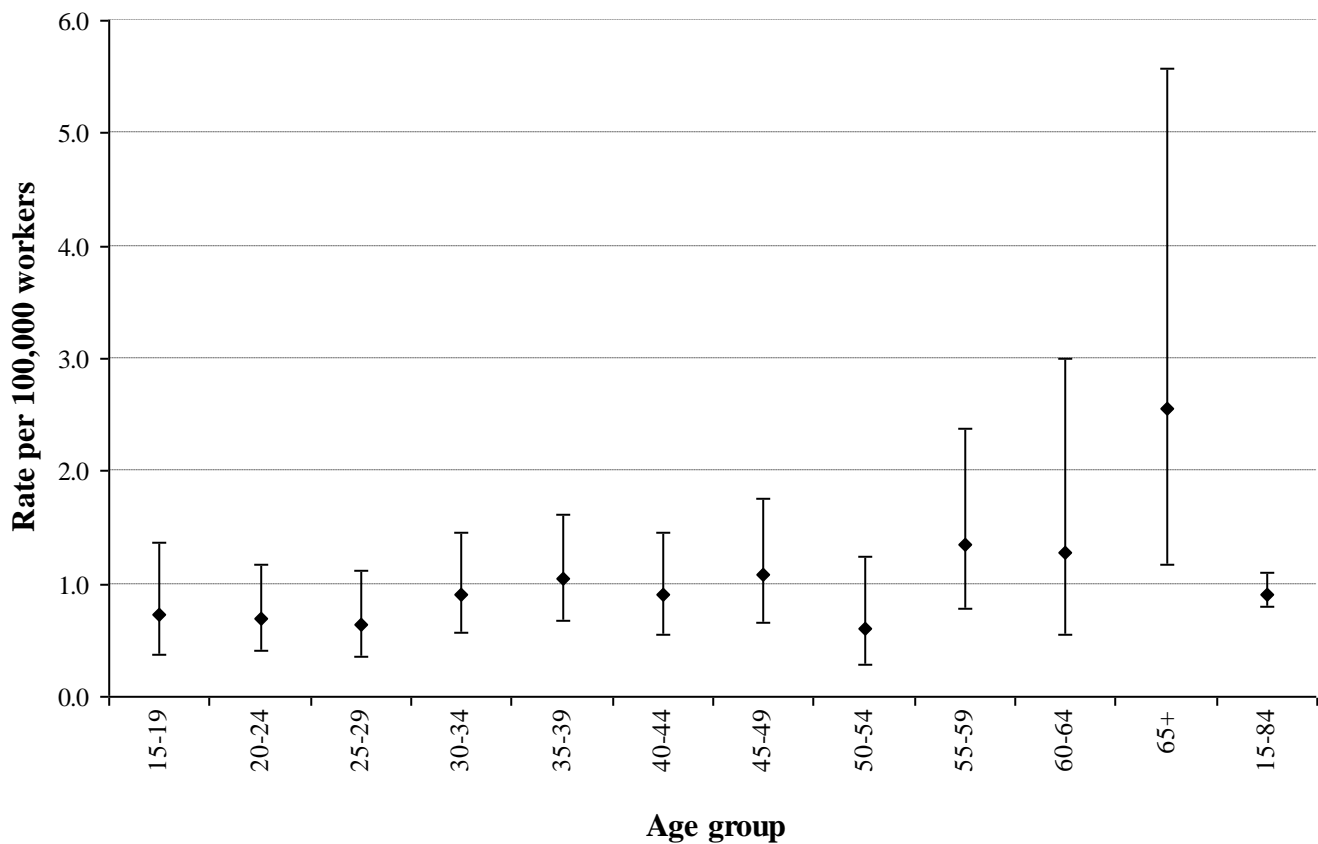


Table 2: Age of workers fatally injured as the result of a work-related fall. Number, percent and rate – New Zealand 1985-1994

	Number	Percent	Rate	
			(per 100,000 working persons)	95% CI
15-19	9	6.7	0.7	0.4-1.4
20-24	13	9.6	0.7	0.4-1.2
25-29	12	8.9	0.6	0.4-1.1
30-34	17	12.6	0.9	0.6-1.4
35-39	20	14.8	1.0	0.7-1.6
40-44	16	11.9	0.9	0.6-1.5
45-49	16	11.9	1.1	0.7-1.8
50-54	7	5.2	0.6	0.3-1.2
55-59	12	8.9	1.4	0.8-2.4
60-64	5	3.7	1.3	0.5-3.0
65+	6	4.4	2.6	1.2-5.6
Unknown	2	1.5	-	-
Total	135	100.0	0.9	0.8-1.1

Figure 4: Age of workers fatally injured as the result of a work-related fall. Rate and 95% confidence interval – New Zealand 1985-1994



4.1.3. Gender

The majority of the fatally injured workers were male (n=130, 96%) (Table 3). The rate for males was 1.5 per 100,000 workers about 15 times greater than the rate for females (0.1 per 100,000 workers). Work-related falls made up approximately the same proportion of work-related deaths in males as in females.

Table 3: Gender of workers fatally injured as the result of work-related falls. Number, percent and rate – New Zealand 1985-1994

	Number	Percent	Rate	
			(per 100,000 working persons)	95% CI
Male	130	96.3	1.5	1.3 - 1.8
Female	5	3.7	0.1	0.0 - 0.2
Total	135	100.0	0.9	0.8 - 1.1

4.1.4. Ethnic origin

Coronial files do not consistently report the ethnicity of the worker. To complement information available from coronial files, a secondary source of ethnicity was utilised - the New Zealand Health Information Service (NZHIS) Mortality Database.

Approximately one fifth of fatally injured workers were of Maori (14.1%) or Polynesian (7.4%) extraction (Table 4). The remaining cases were largely categorised in the 'Other' category which predominantly is comprised of persons of European extraction.

Table 4: Ethnicity of workers fatally injured as the result of work-related falls. Number, percent – New Zealand 1985-1994

	Number	Percent
Other	103	76.3
Maori	19	14.1
Polynesian	10	7.4
Asian	3	2.2
Total	135	100

4.1.5. Regional area

For some regions, the rates are based on low numbers in the numerator and so will not be stable. The rates varied markedly between regions, even where the number of cases was considerable (Table 5). For example, Otago had two and a half times the rate of work related falls (18.2 per 100,000 worker years) of Auckland (7.3 per 100,000 worker years), and three times the rate of Canterbury and Wellington.

Table 5: Regional Council where inquests were held for workers who were fatally injured as a result of a work-related fall. Number, percent, rate – New Zealand 1985-1994

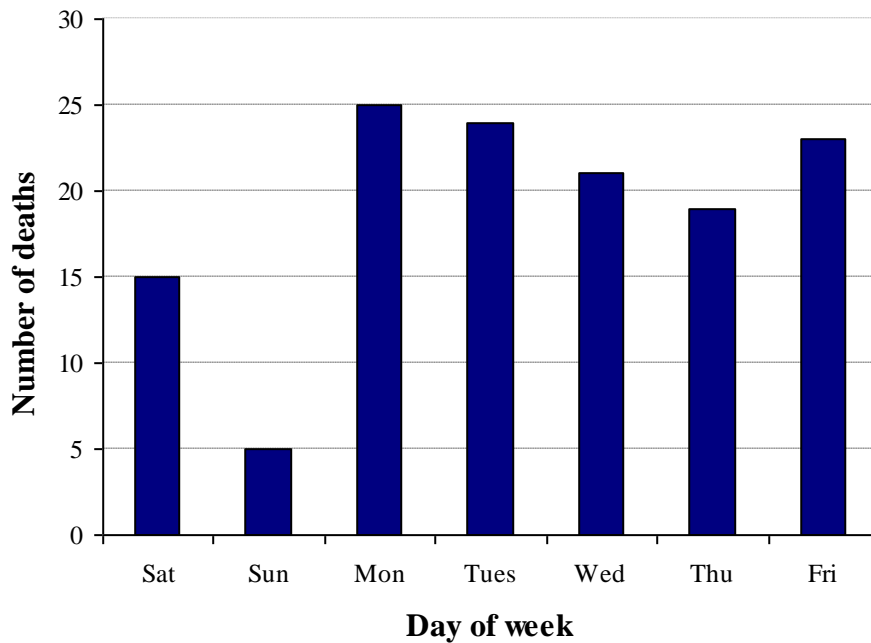
	Number	Percent	Rate	95% CI
Gisborne	5	3.7	33.3	14.2 - 77.9
West Coast	4	3.0	32.7	12.7 - 84.0
Taranaki	8	5.9	19.5	9.9 - 38.4
Otago	14	10.4	18.2	10.9 - 30.6
Northland	7	5.2	14.9	7.2 - 30.7
Manawatu/Wanganui	11	8.1	13.0	7.2 - 23.2
Hawkes Bay	6	4.4	10.8	5.0 - 23.6
Southland	4	3.0	9.9	3.9 - 25.5
Waikato	12	8.9	8.9	5.1 - 15.6
Auckland	34	25.2	7.3	5.2 - 10.2
Canterbury	12	8.9	5.9	3.4 - 10.3
Nelson/Tasman	2	1.5	5.9	1.6 - 21.5
Wellington	11	8.1	5.8	3.3 - 10.4
Bay of Plenty	3	2.2	3.6	1.2 - 10.5
Marlborough	0	0.0	0.0	0.0 - 22.9
Chatham Islands	2	1.5	population not available	
Total	135	100.0	0.9	0.8 - 1.1

4.1.6 Temporal patterns

Day of week

Incidents usually occurred on weekdays, with the distribution being spread reasonably evenly between Monday and Friday (Figure 5). Only 16% of workers were fatally injured outside the traditional working week.

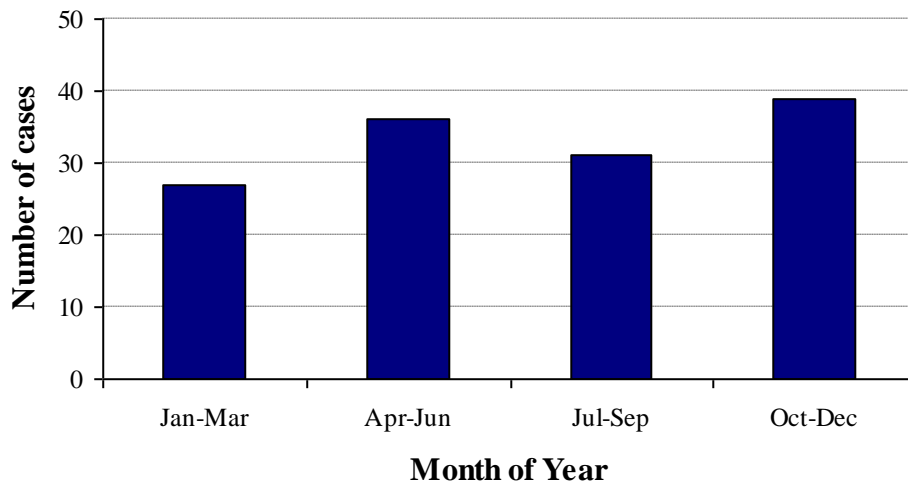
Figure 5: Day of the week that workers were fatally injured as the result of a work-related fall. Number – New Zealand 1985-1994



Month of the year

There was no marked variation between the months of the year (Figure 6).

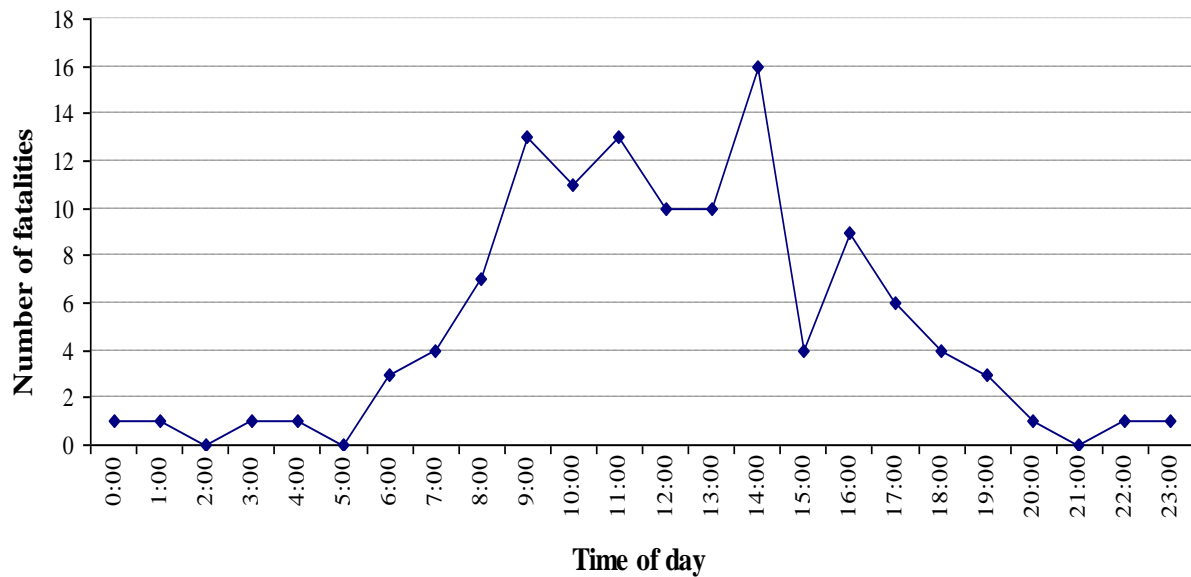
Figure 6: Month of the year that workers were fatally injured as the result of a work-related fall. Number – New Zealand 1985-1994



Time of day

The majority of fall incidents occurred during traditional work hours (Figure 7).

Figure 7: Time of incident when workers were fatally injured as a result of work-related falls - New Zealand 1985-1994^{1,2}



- 1 There were two incidents that involved more than one fatality - for this figure the time of the incident for multiple fatalities was counted once only.
- 2 There were thirteen incidents where the time of incident was not known within an hour of it occurring. These incidents are not represented in this figure.

4.1.7 Agencies of injury and incident

Agencies of injury/incident

The agency of injury is defined as the object, substance or physical condition that made contact with the person to directly cause the injury. It may not have been the agency responsible for the incident. The agency of incident is described as the object, substance or physical conditions which was responsible for, or that was closely involved in the occurrence of the incident. Up to three agencies of incident were coded for each case. For example “*Plumber/roofer putting down roofing paper on a roof. A gust of wind lifted a sheet of iron and caught the worker knocking him from the roof to the ground below*”. The agency of injury in this case is the ground, and the agencies of incident are the wind and the roofing iron.

Table 6 summarises the agencies of injury and incident. The most common agencies of injury were the outdoor environment, the indoor environment. Traffic and ground surfaces predominated in these two categories (n=40). The most common agencies of incident were the outdoor environment, other non-powered equipment, human agencies, conveyors and lifting plants and other materials and objects.

Table 6: Agency of injury and incident – fatal work-related falls - New Zealand 1985-1994

	Agency of		TOTAL
	Injury	Incident*	
Machinery and fixed plant			
Conveyors and Lifting Plant (<i>e.g. escalator, mechanical power transfer mechanisms</i>)	5	18	23
Other Plant and Equipment (<i>e.g. stand alone machinery, stand alone machinery</i>)	1	4	5
Mobile Plant and Transport			
Self propelled plant (<i>e.g. graders, graders</i>)	1	1	2
Other Mobile Plant (<i>e.g. ploughs, tractor</i>)	4	5	9
Road Transport (<i>e.g. trail bikes, trucks</i>)	1	4	5
Rail transport (<i>e.g. locomotives, locomotives</i>)	2	1	3
Water Transport (<i>e.g. motorised craft, motorised craft</i>)	4	7	11
Powered equipment, tools and appliances			
Garden and outdoor powered equipment (<i>e.g. chainsaws, na</i>)	1	0	1
Non Powered handtools, appliances and equipment			
Fastening, packing and packaging equipment (<i>e.g. wire and metal strapping, rope</i>)	1	8	9
Furniture and fittings (<i>e.g. skylights, sawhorse</i>)	1	3	4
Other non powered equipment (<i>e.g. vehicle wheels, ladders</i>)	3	33	36
Chemicals and chemical products			
Chemical products (<i>e.g. plastic materials, resins, na</i>)	1	0	1
Materials and Substances			
Non metallic minerals and substances (<i>e.g. bricks, rocks</i>)	2	2	4
Other materials and objects (<i>e.g. trees felled, dressed timber</i>)	5	17	22
Other substances (<i>e.g. water, water</i>)	21	3	24
Environmental Agencies			
Outdoor environment (<i>e.g. traffic and ground surface, oily surfaces</i>)	50	47	97
Indoor environment (<i>e.g. stairways, steps</i>)	29	8	37
Animal Human and Biological Agencies			
Live four legged animals (<i>e.g. horses, horse</i>)	1	6	7
Human agencies (<i>e.g. na, condition of affected person</i>)	0	20	20
Agency not apparent	2	7	9
Total	135	194	329

* up to three agencies of incident were coded per case

** examples are one each for incident and injury respectively

4.1.8 Alcohol and drug use

Information was recorded on blood alcohol concentrations in 39 (29%) of the 135 falls. Of these 39 cases, 30 had a BAC of zero. In three cases a low level of alcohol (less than 5mg/100ml blood) was detected but there was no suggestion that this contributed to the incident. There were eight cases where the worker was clearly intoxicated at the time of the incident (BAC over 120mg/100ml blood), and a further two cases where circumstantial evidence suggested they were intoxicated but no BAC was recorded. Of the intoxicated cases, five occurred onboard boats, primarily in the fishing industry.

Drug use did not appear to contribute to any of the falls. There were two workers who had used cannabis within a few hours prior to death. It was not possible to establish whether or not this contributed to the falls. There was one worker who was taking drugs to treat epilepsy, but it was the epilepsy which was the cause of the fall rather than the drug.

4.1.9 Survival time of workers

Slightly over half (55%) of fatally injured workers died at the site of injury. The majority of individuals (67%) were found within five minutes of the incident occurring, and a further 10% within the first hour.

4.1.10. Mechanism of incident

The mechanism of the incident describes the physical event that best describes the circumstances of the fatal incident. About a third of incidents involved mechanisms other than a fall (Table 7). These mechanisms either occurred after the fall had resulted in the worker being placed in a hazardous environment, or were mechanisms that caused the worker to fall. The most common of these other mechanisms was drowning (14.8%). For example, a fisherman on board a boat fell overboard and drowned.

Table 7: Mechanism of incidents involving fatal work-related slips, trips and falls – New Zealand 1985-1994

	Number	Percent
Fall from height - only mechanism	92	68.1
Other mechanism in addition to fall from a height		
Drowning	20	14.8
Being Hit by Moving Object	8	5.9
Being Trapped Between Stationary and Moving Objects	6	4.4
Being Trapped By Moving Machinery	3	2.2
Being Hit by Falling Objects	2	1.5
Standing on an Object	1	0.7
Being Hit by an Animal	1	0.7
Exposure to Mechanical Vibration	1	0.7
Hypoxic Atmosphere	1	0.7
Total	135	100.0

4.1.11. Cause of death

The pathophysiological cause of death was generally recorded in either the coroners finding or the pathology report. Head injuries (43.7%), multiple injuries (23.7%) and drowning (15.6%) were the most common cause of death for workers who died from a work-related fall (Table 8).

Table 8: Cause of death of workers fatally injured as a result of work-related falls – New Zealand 1985-1994

	Number	Percent
Head injuries	59	43.7
Multiple injuries	32	23.7
Drowning	21	15.6
Chest/abdominal/pelvis injuries	9	6.7
Other injuries	13	9.6
Unknown	1	0.7
Total	135	100.0

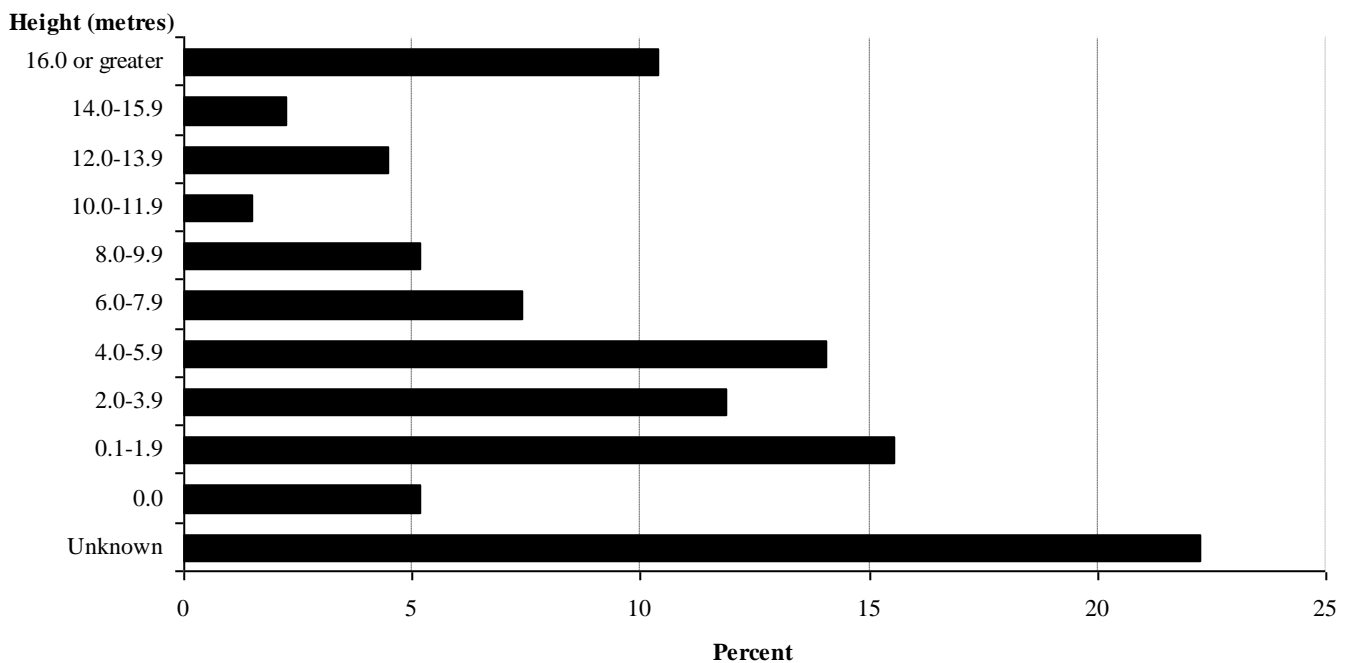
4.1.12 Details of injury event

Height of fall

The height from which the worker fell was explicitly stated in 90 (67%) of the coronial files. In a further 15 files (11%) it was possible to deduce from the object from which they fell that the fall was less than 2 metres (e.g. cow catcher of a train). It was not possible to estimate a fall height for the remaining 22% of files (e.g. *fall from a boat*).

The range of fall heights was from zero metres (*fall at ground level*) to 6400 metres (*fall from an aeroplane*). After the workers whose fall height was not known were excluded, about one quarter of falls (n=28, 27%) occurred from less than two metres. Over half of the falls (n=63, 60%) occurred under a height of six metres. About one quarter of falls occurred at a height over 10 metres (n=25, 24%) (Figure 8).

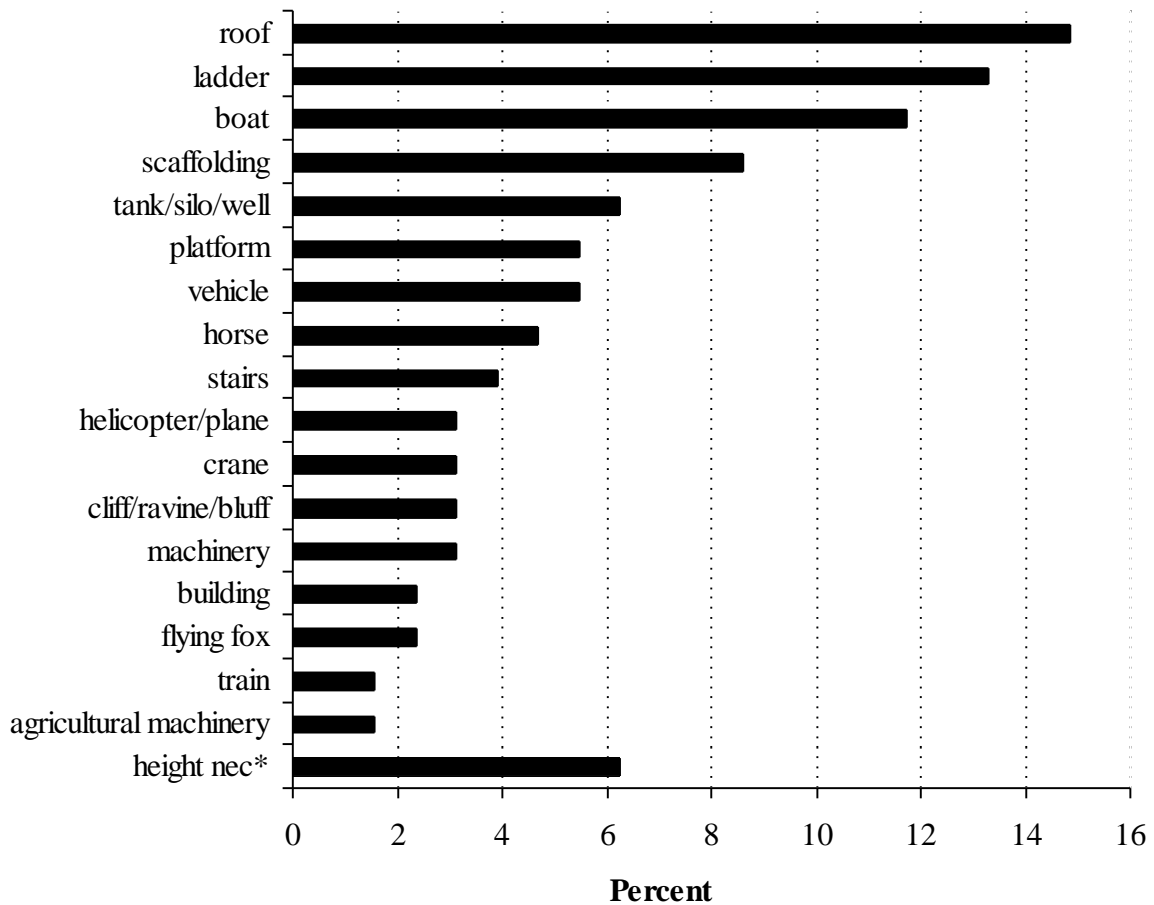
Figure 8: Height of fall for deaths involving fatal work-related falls - New Zealand 1985-1994



Origin of fall

The specific origin of the fall was the precise location where the worker was standing or sitting at the time of the fall. The most common sites were roofs (15%), ladders (13%), boats (12%) and scaffolding (9%) (Figure 9). Six cases of falls at ground level, have not been included in this figure.

Figure 9: Origin of fall for incidents involving fatal work-related slips, trips and falls – New Zealand 1985-1994



**Height not elsewhere classified included a number of different origins that involved only one death.*

Place of incident

Falls most commonly occurred at industrial and construction sites (predominately construction sites and factories), farms, and in open water (Table 9).

Table 9: General place of fatal incident involving workers fatally injured as the result of work-related falls - New Zealand 1985-1994

	Number	Percent
Home	9	6.7
School, other educational area	3	2.2
Sports or recreational area	4	3.0
Road	6	4.4
Trade or service area	6	4.4
Industrial or construction area		
Construction site	23	17.0
Demolition site	3	2.2
Factory/plant	16	11.9
Storage area	5	3.7
General industrial area	2	1.5
Other industrial area	4	3.0
Mine or quarry	3	2.2
Farm (excluding farm house)	21	15.6
Bush & remote or undeveloped	4	3.0
Railway	2	1.5
Open water	21	15.6
Other specified place	2	1.5
Unspecified	1	0.7
Total	135	100.0

A more specific analysis of the place of the fatal incident shows that falls most commonly occurred from roofs (17.8%), in the ocean (11.9%) (Table 10)

Table 10: Specific place of fatal incident involving workers fatally injured as a result of work-related falls - New Zealand 1985-1994.

	Number	Percent
Room	7	5.2
Structure		
Workshop	1	0.7
Specialised Structures (e.g. silo, tank, pylon)	12	8.9
in or around a structure being erected demolished renovated	15	11.1
Part of a building/structure		
escalator elevator	1	0.7
stairs/ladders	4	3.0
roof	24	17.8
part of building structure (unspecified)	1	0.7
Road/footpath	5	3.7
Bridge	3	2.2
Part of grounds		
paddock field	12	8.9
race track/race course	1	0.7
factory yard	3	2.2
production area	1	0.7
railway track and surrounds	3	2.2
Water		
dam	1	0.7
river creek lake reservoir	5	3.7
sea surf bay ocean	16	11.9
wharf jetty	5	3.7
body of water unspecified	1	0.7
Cliff face or ravine	7	5.2
Other place	4	3.0
Platform, crane or hoist	3	2.2
Total	135	100.0

4.1.13 Employment

Employment arrangements

The employment status was one of the least well-recorded details in the coronial files, with the information not available for about 10% of cases. The highest proportion of falls occurred to workers in paid employment (Table 11).

Table 11: Employment status of workers of work-related fatal falls - 1985-1994

	Number	Percent
Self Employed	30	22.2
Paid Employee	85	63.0
Apprentice	0	0.0
Official Volunteer	2	1.5
Unpaid	7	5.2
Missing	11	8.1
Total	135	100.0

The majority of coronial reports did not give information about the workers working hours (69% missing), casual working arrangements (71% missing), or usual working schedule (79% missing). The length of time the worker had been in the job was missing for 42% of cases.

Occupation – numbers and rates

The occupational groups ‘Agriculture and Fishing’, ‘Trade workers’, ‘Plant and Machine Operators and assemblers’ account for a substantial portion of the deaths (Table 12).

Reference to the total burden compared with work-related injury for these occupational groups reveals that falls account for 57% of those in “*Plant and machinery operators*” and 40% of all injury deaths of “*Trades workers*”.

The highest rate of work-related falls was in the ‘*Building and related workers*’ group, with a rate nearly eleven times (10.6 per 100,000 workers per year) the overall rate. Other notably high rates were observed in the ‘*Agricultural and fishery workers*’ (2.5 per 100,000 workers per year) and ‘*Building trades workers*’ (3.1 per 100,000 workers per year) groups.

**Table 12: Occupation of workers fatally injured as a result of work-related falls –
New Zealand 1984-1994**

	Number	Percent	Rate	95% CI
Professionals	3	2.2	0.19	0.06-0.55
Physical mathematical and engineering science professionals	2	1.5	0.90	0.25-3.29
Other professionals	1	0.7	0.24	0.04-1.37
Technicians and Associate Professionals	4	3.0	0.24	0.09-0.62
Physical science and engineering associate professionals	2	1.5	0.42	0.12-1.53
Other associate professionals	2	1.5	0.19	0.05-0.71
Clerks	1	0.7	0.05	0.01-0.28
Office clerks	1	0.7	0.07	0.01-0.37
Service and sales workers	9	6.7	0.48	0.25-0.91
Personal and protective service workers	7	5.2	0.66	0.32-1.36
Salespersons demonstrators and models	2	1.5	0.24	0.07-0.89
Agriculture and fishery workers	36	26.7	2.50	1.80-3.45
Market orientated agricultural and fishery workers	36	26.7	2.50	1.80-3.45
Trades workers	32	23.7	2.03	1.44-2.87
Building Trades Workers	21	15.6	3.11	2.04-4.76
Metal and Machinery Trades Workers	11	8.1	1.94	1.09-3.48
Plant and Machine Operators and Assemblers	31	23.0	1.85	1.31-2.63
Industrial Plant Operators	2	1.5	1.08	0.30-3.95
Stationary Machine Operators and Assemblers	5	3.7	0.54	0.23-1.27
Drivers and Mobile Machinery Operators	12	8.9	2.66	1.52-4.65
Building and Related Workers	12	8.9	10.59	6.06-18.50
Elementary Occupations	17	12.6	1.72	1.07-2.76
Labourers and Related Elementary Service Workers	17	12.6	1.72	1.07-2.76
Unknown	2	1.5		
Total	135	100.0	0.92	0.77-1.08

Industry – numbers and rates

The highest number of fatal injuries occurred in the ‘*Construction*’ and the ‘*Agriculture, Forestry and Fishing*’ industries (Table 13), each contributing to about a third of the total burden of work-related falls. Within the ‘*Construction*’ group about a third of all deaths were the result of a fall. The rate of work-related falls in Construction was 4.6 per 100,000 workers, over four times that of the overall rate of work-related falls.

Table 13: Industries in which workers fatally injured as a result of work-related falls – New Zealand 1984-1994

	Number	Percent	Rate	95% CI
Agriculture Forestry and Fishing	38	28.1	2.53	1.84 - 3.47
Mining	5	3.7	9.87	4.22 - 23.10
Manufacturing	11	8.1	0.41	0.23 - 0.73
Electricity, Gas and Water Supply	3	2.2	2.18	0.74 - 6.42
Construction	43	31.9	4.57	3.39 - 6.15
Wholesale trade	1	0.7	0.12	0.02 - 0.68
Retail Trade	3	2.2	0.17	0.06 - 0.51
Transport and Storage	11	8.1	1.57	0.88 - 2.81
Communication Services	1	0.7	0.59	0.10 - 3.33
Finance and Insurance	1	0.7	0.19	0.03 - 1.08
Property and Business Services	3	2.2	0.25	0.09 - 0.74
Government Administration and Defence	3	2.2	0.49	0.17 - 1.44
Cultural and Recreational Services	5	3.7	1.73	0.74 - 4.05
Personal and Other Services	4	3.0	0.62	0.24 - 1.60
Unknown	3	2.2	-	-
Total	135	100.0	1.09	0.92 - 1.29

4.1.14 Safety equipment

Examples of the types of safety equipment that might be useful in preventing falls or decreasing the severity of the injury include guardrails, safety harnesses, fall arrest devices, safety nets, flotation devices and hard hats. Information about the use and availability of safety equipment such as safety helmets and fall arrest devices was not consistently reported in the coronial files. In 61 incidents (45%) of incidents, there was no information in the file to indicate whether appropriate safety equipment had been used by the deceased. Safety equipment was probably not appropriate in 34 (25%) of the fatalities. *e.g. deceased slipped when walking up stairs.* In 29 cases (21%), information in the coronial file explicitly stated that appropriate safety equipment had not been used. In five of those incidents, the document (usually from the accident inspector) stated that the safety equipment had been provided by the employer, but was not used by the employee. There were 4 cases where safety equipment was partially used or used incorrectly *e.g. case where deceased was wearing a helmet but it was not done up*, and a further 2 cases where the deceased was in the process of attaching a safety harness when they fell. In 5 cases safety equipment was worn but the circumstances of the fall meant that the deceased was not protected from injury.

4.1.15 Common characteristics of work-related falls

Below is a summary of some characteristics and contributing factors of falls from the same origin. For the later if the police, OSH or the coroner identified unsafe work practices, these were coded in preference to a description of the specific contributing factor.

Roof

Eighteen workers were killed when they fell from roofs. The workers were predominantly employed in the ‘*Construction industry*’ (16 incidents). One incident involved a worker in the ‘*Agriculture, forestry and fishing*’ industry and for one incident the industry was not known. The most common occupation in these falls were builder’s labourer (four incidents), carpenter/and or joiner (four incidents), roofer (three incidents), plumber (two incidents) and building exterior cleaner (two incidents). There was one fatality each for plasterers, radio and television repairers, steel erectors in construction and nursery growers.

Characteristics of the incidents were:

- rotten structure on which the worker was standing (five incidents);
- unsupported structure on which the worker was standing (two incidents);
- the worker lost balance and slipped from roof (seven incidents);
- wind blew the worker off roof (one worker);
- the worker fell through an unguarded skylight or holes in roof (two incidents).

Known contributing factors to the incidents were:

- rotten beam or purlin (five incidents);
- slippery conditions (four incidents);
- avoiding another hazard, distracted (two incidents);

- environmental conditions (two incidents);
- overreached (one incident) and
- unsafe work practice (two incidents).

The lack of a safety harness was commented on by accident inspectors in ten of the files, in at least two of these cases a safety harness was provided by the employer. In one case the worker was in the process of attaching his safety harness when he fell.

Ladders

Seventeen fatalities resulted from falls from ladders. The industries in which the fatally injured workers were employed were ‘*Construction*’ (eight incidents), ‘*Manufacturing*’ (three incidents), ‘*Transport and storage*’ (two incidents) and one each in ‘*Electricity, gas and water supply*’, ‘*Retail trade*’ and ‘*Communication services*’. The industry was unknown for one worker. The occupations of the worker were painter/decorator (two incidents), fitter and turner (two incidents), linesperson, sales assistant, plumber, electronic and telecommunications engineer, roofer, builders labourer, quality inspector, heating and ventilation mechanic, plumber, electrical fitter, pipe fitter and builder (one incident each).

Characteristics of the incidents were:

- slipped or overbalanced when ascending or descending ladder (five incidents);
- part of ladder was rotten and broke or aluminum sheered off (three incidents);
- outside agency caused worker to lose balance on ladder (three incidents) and
- ladder slid (four incidents).

Known contributing factors to the incidents were:

- poor equipment maintenance (three incidents);
- outside agency (one incident);
- ladder not secured (four incidents);
- ladder upside down (one incident) and
- worker overreached from ladder (two incidents).

Two of the workers were wearing appropriate safety equipment at the time of the injury. A further two cases were not using safety equipment. No mention was made of safety equipment for the other cases.

Boats

There were 15 deaths that were the result of the decedent falling from a boat. Almost all of the fatalities resulted from drowning (14 incidents) with a further one being the result of being hit by a moving object. Incidents most commonly occurred in open water (13 incidents), with the other two occurring on a river and while the boat was moored near shore. Industries represented in this category were ‘*Agricultural, farming and fishing*’ (11 incidents), ‘*Transport and storage*’ (three incidents) and ‘*Cultural and recreational services*’ (one incident). In terms of the decedents occupation, 10 were fishermen, and one each were ; cook, deck rating, travel attendant, sports official, and unknown.

The boats involved in the fatalities were fishing trawlers (11 incidents), ships (two incidents), aluminium dinghy (one incident), and unspecified (one incident). There were no witnesses for five of the incidents.

Known contributing factors to the incidents were:

- slippery surface (one incident);
- consumption of alcohol or drugs (five incidents);
- unsafe work practice (three incidents) and
- loss of balance with unexpected event e.g. change of boat speed (two incidents).

None of the coronial files reported that the worker was wearing personal protective equipment at the time of the incident.

Vehicles (including trains)

There were 11 fatalities that resulted from a fall from a vehicle. The type of vehicles were trucks (three incidents), trains (three incidents), tractor (two incidents), fork lift (one incident), digger (one incident), mobile crane (one incident) and 4-wheel bike (one incident). Industries involved were '*Transport and storage*' (four incidents), '*Agriculture, forestry and fishing*' (three incidents), '*Wholesale trade*', '*Construction*', '*Retail trade*' and '*Personal and other services*' (one incident each). There were three farmers and one fatality from each of the following occupations - labourer, earthmoving machine operator, railway shunter, locomotive driver, loader and checker, refuse collector, milk vendor and heavy truck driver.

Characteristics of the incidents were:

- being knocked off the vehicle by a falling rock (one incident);
- hitching a ride on the side of a vehicle (two incidents);
- feeding out from the back of a tractor (two incidents);
- trying to stop a runaway vehicle (one incident);
- jumped from a vehicle about to crash (one incident);
- using the cowcatcher of train (two incidents) and
- standing on the tray of a vehicle at, low speed (two incidents).

Known contributing factors to the incidents were:

- unsafe work practice (six incidents) and
- equipment failure (one incident);

The use of protective equipment was not mentioned in the coronial file for any of the fatalities.

Scaffolding

There were 10 workers who died as the result of falls from scaffolding. The workers involved were either in the construction industry (n=8) or the manufacturing industry

(n=2). Two of the workers were builders, two were riggers, one a scaffolder, one a plumber, one a carpenter, one a boat builder and one a plasterer.

Characteristics of the incidents were:

- the worker slipped or lost their balance and fell from the scaffolding (five incidents);
- part of the scaffolding collapsed resulting in the worker falling (two incidents);
- falling from or through scaffolding that was poorly designed or installed (two incidents); and
- unexpected force shifted scaffolding resulting in the worker falling (two incidents).

Known contributing factors to the incidents were:

- inappropriate work practices (two incidents);
- inappropriate construction of scaffolding including planking (six incidents);
- safety equipment not used (seven incidents) and
- unexpected force shifted scaffolding (two incidents).

Silos, wells, tanks, drains

There were eight fatalities that resulted from a fall into, a silo (one incident), tank (three incidents) or well (two incidents), open drain (one incident) or freezer hatch (one incident). The industries in which the workers were employed were *'Agriculture, forestry and fishing'* (three incidents), *'Manufacturing'* (two incidents), *'Mining'* (one incident), *'Personal and other services'* (one incident), and *'Transport and storage'* (one incident). Occupations of the workers included farmer (three incidents), general labourer (one incident), boiler attendant (one incident), milk and other dairy products maker (one incident), electrical fitter (one incident) and heavy truck driver (one incident).

Known contributing factors to the incidents were:

- Slippery surface (five incidents);
- Alcohol use by the worker (one incident) and
- The worker being distracted by another event (one incident).

In the only case where there was evidence of the use of personal protective equipment, the worker was wearing a hard helmet, but it did not protect him from the head injury which he received.

Platforms

Seven fatalities resulted from falls from platforms. The industries of the involved workers were *'Construction'* (three incidents), *'Property and business services'* (one incident), *'Electricity, gas and water supply'* (one incident), *'Manufacturing'* (one incident), and *'Transport and storage'* (one incident). The occupations covered were builders labourers (two incidents), electrician, fitter and welder, linesperson, slaughterer and a fork lift operator (one incident each).

Characteristics of the incidents were:

- Supporting structure failed (three incidents);
- Worker lost balance when platform unexpectedly lowered (one incident) and
- Worker slipped (two incidents).

Known contributing factors to the incidents were:

- poor equipment design (one incident);
- fatigue of supporting material (two incidents);
- poor communication between workers (one incident);
- unsafe work practice (one incident) and
- lack of guard rail (one incident).

In one case, safety equipment provided was not used, and in one case there was no safety equipment. In the remaining cases safety equipment was not mentioned.

Horses

Six fatalities resulted from a fall from a horse. Four were of workers employed in the '*Agricultural forestry and fishing*' industry and two in '*Cultural and recreational services*'. Three were employed in the horse racing industry (two were horse trainers/grooms and one was a jockey) and three were farmers.

For the farmers, in all three cases the fall was not witnessed, so contributing factors were difficult to determine. There was no mention in any of the coronial files of helmet use.

Two of the three incidents occurred while the horse was being exercised. One was on the road where the horse was spooked by a motor cyclist, rearing up and throwing the rider. In the second case the horse galloped from a paddock over a cliff. The third incident occurred just after a race - the horse broke its leg, catapulting the worker out of the saddle.

Stairs

Five fatalities involved workers falling down stairs. One fatality occurred in each of the following - '*Manufacturing*', '*Transport and storage*', '*Government administration and defence*', '*Agriculture, forestry and fishing*' and '*Personal and other services*' industries. The workers' occupations were cleaner, ships deck officer, armed forces, cook and gardener.

Characteristics of the incidents were:

- stumbled/slipped and fell down stairs (four incidents) and
- large wave caused boat to pitch, causing the worker to fall down stairs (one incident).

Known contributing factors to the incidents were:

- consumption of alcohol (two incidents) and
- environmental conditions (one incident).

The use of protective equipment was not mentioned in the coronial file for any of the fatalities.

Helicopter/plane

Four fatalities resulted from three incidents in falls from helicopters or planes. The industries involved were petroleum mining (one incident, two fatalities), defence (one incident) and the police force (one incident). In terms of occupation of the workers, one was a detective, one was in the armed forces, one was an electrical technician and the occupation of one was unknown.

All the incidents involved a failure of equipment. In the incident that involved two fatalities, the workers were in a training operation, playing survivor in a dry-winch rescue exercise with a helicopter. A piece of equipment failed, sending the workers plummeting to the ship below. In the other helicopter incident, a policeman was involved in a cannabis recover operation. He was chained under the helicopter and, a piece of the equipment failed, causing the worker to fall to the ground below. The final incident involved a parachute instructor in the armed forces. His parachute failed to open.

Cliff

Four incidents involved a fall over a cliff or bluff (this does not include the incident of the horse running over a cliff described above). The industries in which these incidents occurred were '*Agriculture forestry and fishing*' (three incidents) and '*Government administration*' (Department of Conservation, one incident). The occupations of the worker were 'Hunter and trapper' (three fatalities) and Sheep farmer (one fatality). There was no witness for any of these incidents. In all cases, the contributory factor appeared to be that the worker slipped. In one case, icy conditions were noted in the file.

Cranes

There were four fatalities involving cranes - three involved falls from height and one was a slip while operating a crane at ground level. Industries in which the workers were employed were '*Property and business services*' (two incidents), '*Construction*' (one incident) and '*Agriculture, forestry and fishing*' (one incident). The workers' occupations were crane operator (two incidents), fisherman (one incident) and a machinery mechanic (one incident).

Characteristics of the incidents were:

- crane overbalanced, worker jumped from crane (one incident);
- fall while climbing up the crane (one incident);
- slipped when exiting crane cabin (one incident) and

- lost footing while operating crane controls in one hand and holding the guide ropes in another (one incident).

Known contributing factors to the incidents were:

- poor work practice (two incidents) and
- slippery surface (two incidents).

For two of the fatalities, hard hats were worn. One of these fatalities was the result of a head injury.

Falls related to machinery

There were four fatalities related to machinery that is not classified elsewhere. In one instance, the worker fell into a foam hopper and in another the worker fell into a brick press. One worker lost balance and fell from a seed harrow, and another was hit by a flywheel, causing him to lose balance and fall. The industries in which the fatalities occurred were '*Agriculture, forestry and fishing*' (two incidents) and '*Manufacturing*' (two incidents). Occupations in which the fatalities occurred were general labourer, furnace operator, farmer and fire fighter (one fatality each).

Known contributing factors to the incidents were:

- unsafe work practice (three incidents).

The seed harrow from which one of the workers fell had no guard railing or barriers to prevent falling from the platform. There was no information in the coronial files about safety equipment in the other incidents.

Flying fox

Two events involving flying foxes resulted in three fall fatalities. The industries involved were '*Agriculture forestry and fishing*' (two incidents) and '*Cultural and recreational services*' (one incident). Occupations of the workers were '*Crop and livestock farmer*' (two fatalities) and '*Forest worker*' (one fatality). The incident that resulted in the double fatality involved the workers riding on a load being transported across ravine using a flying fox. A failure in equipment resulted in the fox and the workers falling to the river below. In the other case a track cutter was skiving from his job and fell from a flying fox, there were no witnesses to the incident. All of the deaths were the result of drowning.

Building

Three fatalities resulted from falls from buildings. The industries of the workers were '*Construction*' (two incidents) and '*Finance and insurance*' (one incident). The workers' occupations were a builders labourer, accountant and painter/decorator.

In the first incident, a plasterer had secured a plastic clad bicycle chain to a pulley loop so that plaster could be moved between floors on the exterior of the building. The worker was absailing between scaffolding using this system and a rope. It was not designed to hold his weight. The chain broke and the worker fell 16 stories. The worker was not using the appropriate safety equipment. In the second case, a painter on

a second storey ledge was coming down off a ladder when, the ladder fell over. The painter caught it, went to step backwards and missed the ledge. The worker was not using the safety harness provided by the employer. In the final incident, an office worker was sitting on a window and, the window rail fell out of the socket holder (which had occurred a number of times previously). The glass was unable to withstand the contact and the worker fell six storeys through the window. The use of personal protective equipment was not relevant in this case.

Other falls

Eight fatalities resulted from other falls. The fatally injured workers were employed in the ‘*Construction*’ (four incidents), ‘*Agriculture, forestry and fishing*’, ‘*Mining*’, and ‘*Electricity gas and water supply*’ industries (one incident each). The industry was unknown for one worker. Occupations of the workers were one each from ‘Steel erector construction’, ‘Excavating machine operator’, ‘Light truck or van driver’, ‘Logger’, ‘Linesperson’, ‘Radio and television repairer’, ‘Builder's labourer’ and ‘Structural engineer’.

Characteristics of the incidents were:

- Termite infested power pole snapped at ground level (one incident);
- Unbraced steel column collapsed (one incident);
- An excavator holding up structure collapsed (one incident);
- The worker fell through a gap between a lift opening and a floor landing (one incident);
- Slipped from a ledge (one incident);
- Lost balance climbing a tree (one incident);
- Prefabricated walkway collapsed (one incident) and
- Breakage of piece of equipment knocked worker into a river (one incident).

Known contributing factors to the incidents were:

- Unsafe work practice (five incidents);
- Workers medication was likely to be a contributing factor (one incident) and
- Maintenance of equipment poor (two incidents).

In one incident a safety harness was used but because the fall resulted from a broken pole it did not protect the worker, for one fatality the safety harness was unclipped at the time of the fall and in two instances no safety equipment was not used. In the other cases no safety equipment was mentioned.

4.1.16 Recommendations of coroner and others

In nine of the cases, coroners made specific recommendations. In 27 cases, the investigating officer made recommendations to relevant agencies, the employer and employees. In eight cases, the employer was prosecuted, most frequently under the Construction Act. In seven cases, the employer was required to take some corrective action but was not prosecuted.

4.2. Feasibility of Identifying Non-Fatal falls

Using both NZHIS and ACC linked datasets 1107 non-fatal fall injuries were identified. After manual review of these cases, 91 cases were excluded because they did not fulfill either the fall or work-related definition. This left 1016 cases, giving a rate of 62.0 per 100,000 workers.

Table 14 shows the distribution of cases across the ACC work indicator and NZHIS activity code. Using the NZHIS database, 717 (70.6%) work-related fall cases were identified. There was concordance with the ACC work indicator for 558 of these cases. The ACC indicator, identified an additional 298 work-related fall cases.

Table 14: Use of NZHIS and ACC databases for the identification of non-fatal work-related falls

NZHIS Activity code	ACC		No match with ACC file	Total
	Work	Non work		
Working for an income	558 (54.9%)	83 (8.2%)	76 (7.5%)	717 (70.6%)
Not specified	183 (18.0%)	0	0	183 (18.0%)
Other categories (e.g. while engaged in leisure activity)	116 (11.4%)	0	0	116 (11.4%)
Total	857 (84.3%)	83 (8.3%)	76 (7.5%)	1016 (100.0%)

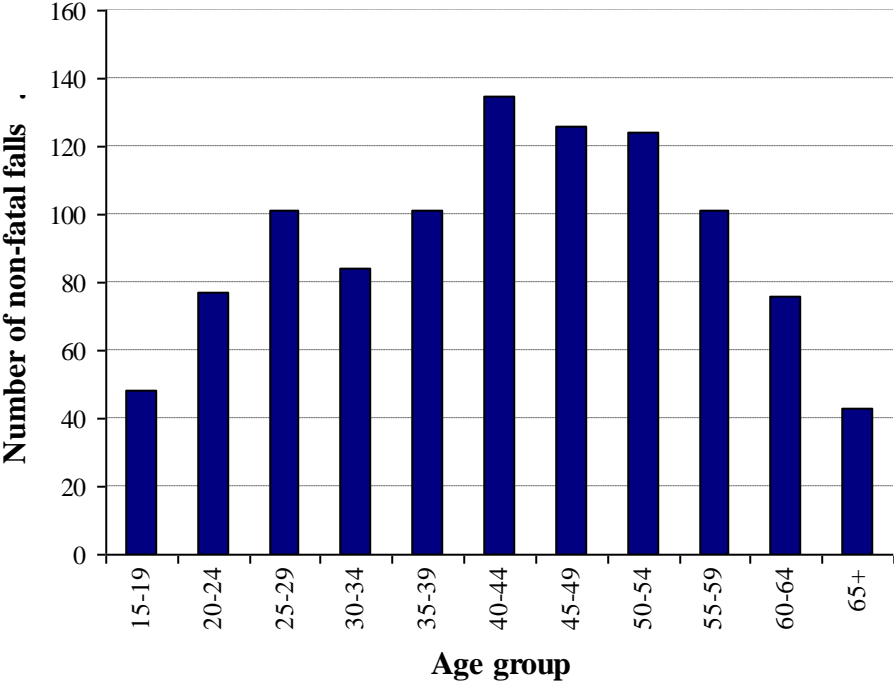
For the purposes of illustrating the value of the matching we have produced below some descriptive statistics of these falls. These incidents are described using variables in NZHIS and ACC data. The source of the information is identified at the foot of each table or figure.

4.3. Selected Demographic Statistics

4.3.1. Age group

The highest number of injuries occurred in the age groups 40-44, 45-49 and 50-54 (Figure 10, Table 15), and these injuries comprised about 40% of all work related falls. The lowest frequency and proportion of fall were in workers under 20 and workers over 65 years of age. There was a gradual increase in the rate for ages 30-34 and upwards. The highest rate was observed in the 65+ year age group (Figure 11, Table 15). The median age was 43 years.

Figure 10: Age of workers of work-related non-fatal slip trip and fall injuries (age 15-84): 2001



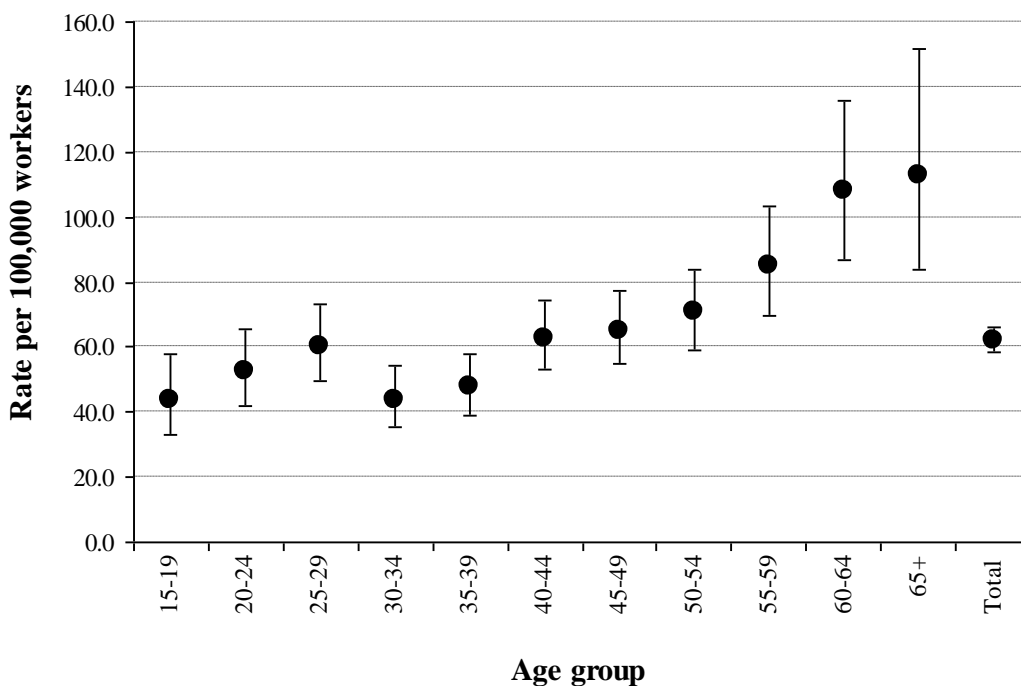
primary source: ACC, secondary source: NZHIS

Table 15: Age of workers non-fatally injured as the result of a work-related fall. Number, percent and rate – New Zealand 2001

	Number	Percent	Rate (per 100,000 workers)	95% CI
15-19	48	4.7	43.8	33.0 - 58.1
20-24	77	7.6	52.5	42.0 - 65.6
25-29	101	9.9	60.1	49.5 - 73.1
30-34	84	8.3	43.8	35.4 - 54.2
35-39	101	9.9	47.5	39.1 - 57.8
40-44	135	13.3	62.8	53.1 - 74.4
45-49	126	12.4	65.2	54.8 - 77.6
50-54	124	12.2	70.6	59.2 - 84.1
55-59	101	9.9	84.9	69.9 - 103.2
60-64	76	7.5	108.3	86.6 - 135.6
65+	43	4.2	112.5	83.6 - 151.5
Total	1016	100.0	62.0	58.3 - 65.9

primary source: ACC, secondary source: NZHIS

Figure 11: Age of workers non-fatally injured as the result of a work-related fall. Rate and 95% confidence interval – New Zealand 2001



primary source: ACC, secondary source: NZHIS

4.3.2. Gender

Approximately three quarters of workers injured in falls were male (76%) (Table 16). The rate for males was 88.0 per 100,000 workers nearly three times the rate for females, which was 31.7 per 100,000 workers.

Table 16: Gender of workers non-fatally injured as the result of work-related falls. Number, percent and rate – New Zealand 2001

	Number	Percent	Rate	
			(per 100,000 working persons)	95% CI
Male	775	76.3	88.0	82.0 - 94.4
Female	241	23.7	31.7	28.0 - 36.0
Total	1016	752.6	62.0	58.3 - 65.9

source: ACC primary source, NZHIS secondary source

4.3.3. Ethnic origin

The majority of work-related fall injuries were to Europeans (70.1%) with Maori (12.8%) having the next highest proportion (Table 17).

Table 17: Ethnicity of workers non-fatally injured as the result of work-related falls. Number, percent – New Zealand 2001

	Number	Percent
European	712	70.1
Maori	130	12.8
Pacific Islander	45	4.4
Asian	34	3.3
Other	60	5.9
Unknown	35	3.4
Total	1016	100.0

source: NZHIS

4.3.4. Regional area

The rate of non-falls varied markedly between regions. The highest rate was observed in Gisborne (113.2 per 100,000 workers) and the lowest in Wellington (31.2 per 100,000 workers) (Table 18).

Table 18: Regional Council in which non-fatal work-related fall incidents occurred - New Zealand 2001

	Rate			
	Number	Percent	(per 100,000 workers)	95% CI
Gisborne	17	1.7	113.2	70.7 - 181.3
Hawkes Bay	49	4.8	88.2	66.7 - 116.6
Northland	41	4.0	87.0	64.2 - 118.0
Auckland	403	39.7	86.2	78.2 - 95.0
Nelson/Tasman	26	2.6	76.6	52.3 - 112.3
Bay of Plenty	62	6.1	73.7	57.5 - 94.5
West Coast	9	0.9	73.5	38.7 - 139.7
Marlborough	11	1.1	65.6	36.6 - 117.5
Manawatu/Wanganui	55	5.4	64.8	49.8 - 84.3
Waikato	84	8.3	62.5	50.5 - 77.4
Otago	43	4.2	55.9	41.5 - 75.3
Southland	22	2.2	54.5	36.0 - 82.4
Taranaki	22	2.2	53.5	35.4 - 81.0
Canterbury	93	9.2	45.8	37.4 - 56.1
Wellington	59	5.8	31.2	24.2 - 40.3
Unknown	19	1.9	-	- -
Chatham Islands	1	0.1	-	- -
Total	1016	100	67.7*	63.6 - 71.9

* The rate here differs from that reported elsewhere because of the source used for the population was different

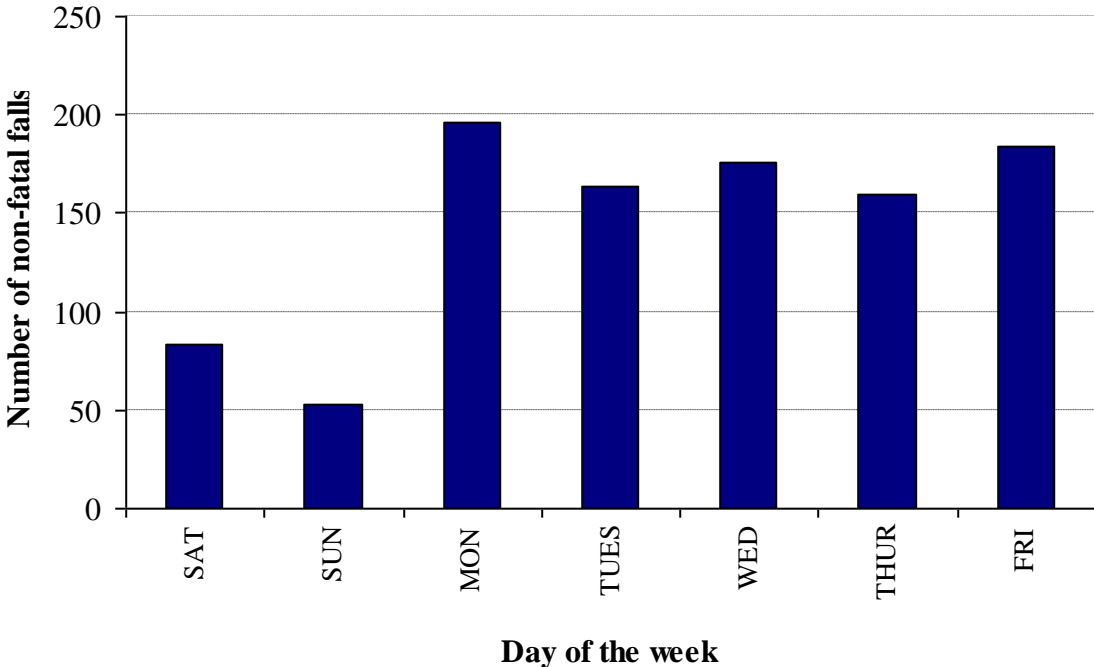
source: ACC

4.3.5. Temporal patterns

Day of week

Most incidents occurred on weekdays (87%) (Figure 12). Five percent of incidents occurred on a Sunday, a day that has not traditionally been a workday in New Zealand.

Figure 12: Day of the week that workers were non-fatally injured as the result of a work-related fall. Number – New Zealand 2001

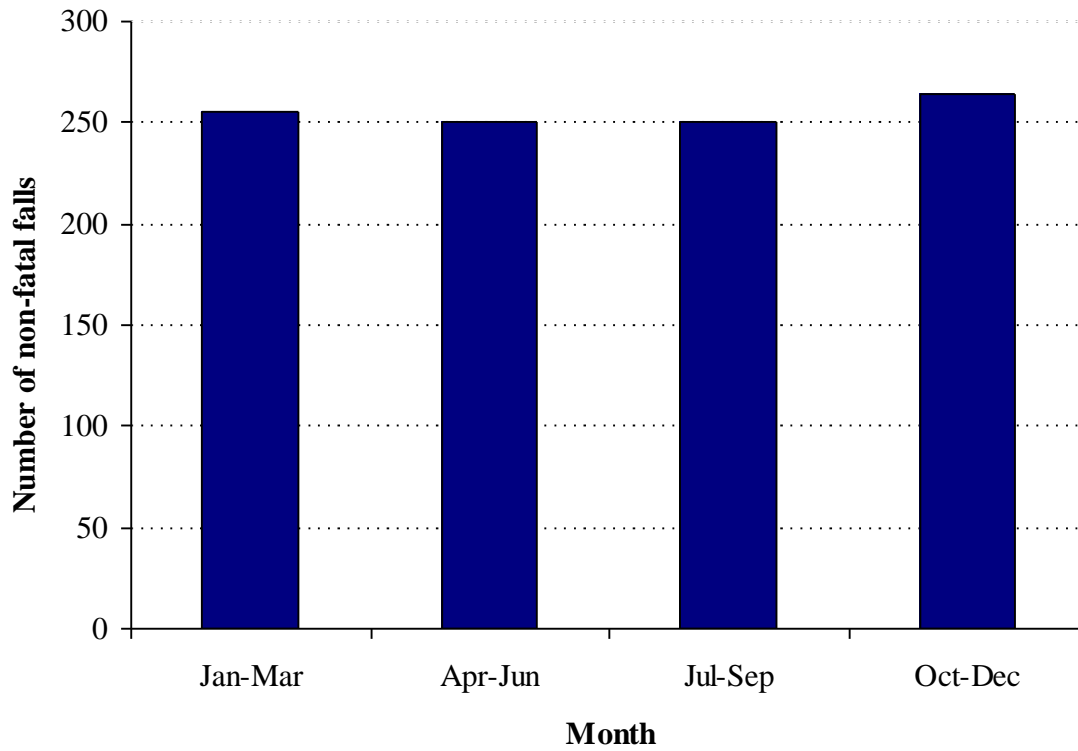


source: ACC

Month of the year

The number of non-fatal falls did not vary significantly during the year (Figure 13).

Figure 13: Month of the year that workers were non-fatally injured as the result of a work-related fall. Number – New Zealand 2001



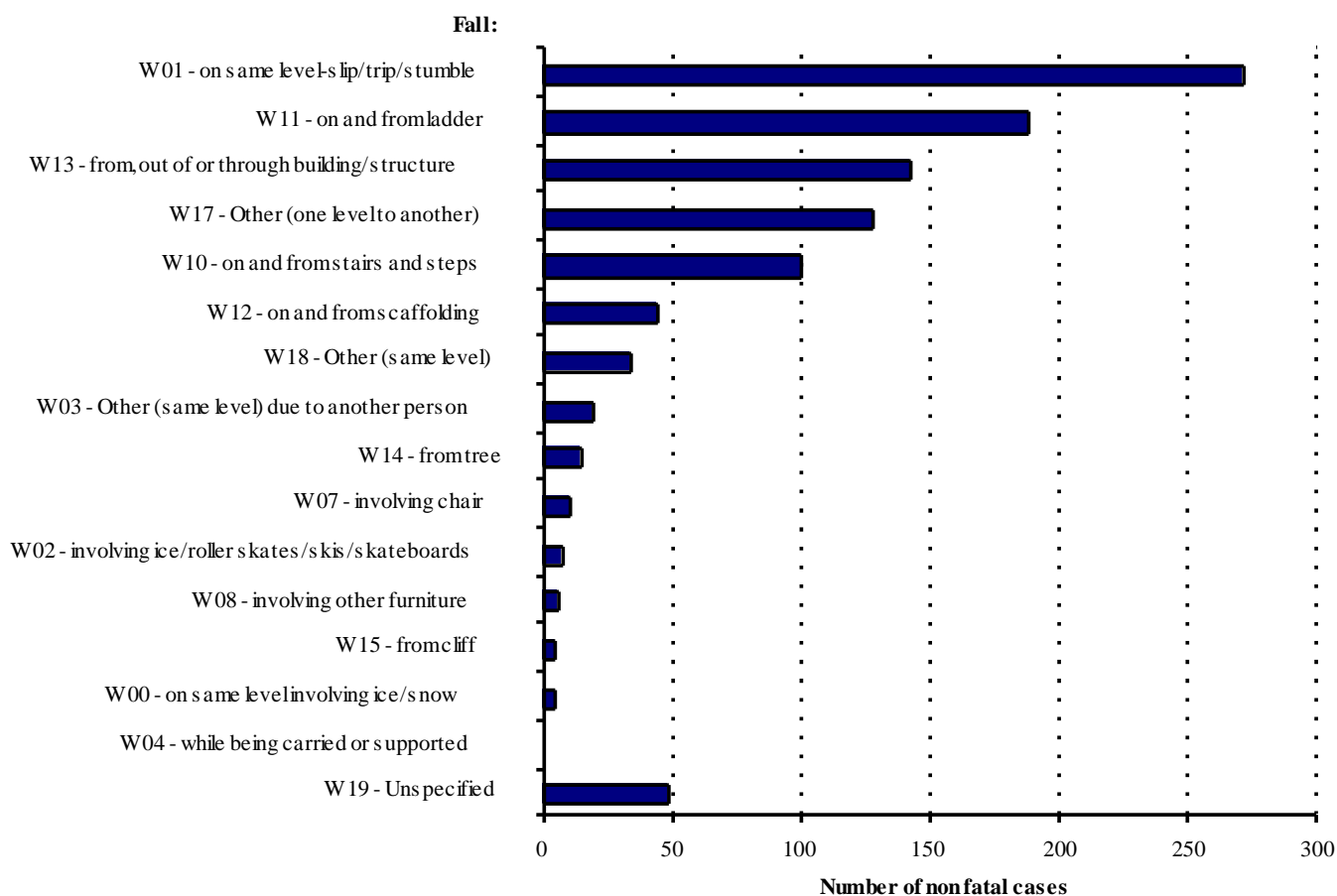
source: ACC

4.3.6. Circumstances of the fall

Mechanism of fall

The mechanism of the incident is the physical event that best describes the circumstances of the non-fatal incident. This has been described for the current data set using the External Cause code of injury commonly known as E-codes. The E-codes most commonly recorded were ‘fall on the same level as the result of a slip trip or stumble’ (27%), a ‘fall on and from a ladder’ (19%) and a ‘fall from out of or through a building or structure’ (14%) (Figure 14).

Figure 14: Mechanism of incidents involving non-fatal work-related slips, trips and falls - New Zealand 2001



source: NZHIS

Loss of balance (36%) and tripping, stumbling or slipping (32%) accounted for the majority of the “causes” (Table 19).

Table 19: “Cause (what went wrong)” – for work-related falls - New Zealand 2001

	Number	Percent
Loss of balance	363	35.7
Tripping/stumbling/slipping	322	31.7
Work property or characteristics	66	6.5
Misjudgement of support	50	4.9
Something gave way/broke underfoot	32	3.1
Loss of hold	20	2.0
Unclear cause	19	1.9
Lifting/carrying strain	14	1.4
Object coming loose or goods shifting	14	1.4
Collision/being knocked over by an object	13	1.3
Struck/pushed by a person/animal/object	9	0.9
Inadvertent machine movement	6	0.6
Collapse of goods	4	0.4
Loss of consciousness/giddy	4	0.4
Fire or explosion	3	0.3
Electric shock	1	0.1
No ACC record	76	7.5
Total	1016	100.0

source: ACC

Information on what the worker was doing before they fell was not very useful because a general category (Employment tasks NEC) was used for about half the cases. Of the remaining cases, the most common activities were walking/running and ascending/descending (Table 20).

Table 20: “AP (activity prior to injury) – for work-related falls - New Zealand 2001

	Number	Percent
Employment Tasks NEC	531	52.3
Walking, Running	118	11.6
Ascending / Descending	79	7.8
Getting On Or Off, In Or Out Of	19	1.9
Lifting Lowering Loading Unloading	11	1.1
Operating Machine	10	1.0
Recreation Or Sporting Activity	6	0.6
Carrying	4	0.4
Other	50	4.9
Undefined	112	11.0
No ACC record	76	7.5
Total	1016	100.0

source:ACC

The injured worker most commonly hit the ground or floor (58%) or an object (22%) (Table 21).

Table 21: “Contact (What the injured person hit when they fell)” – for work-related falls - New Zealand 2001

	Number	Percent
Impact/contact with ground/floor	590	58.1
Impact/contact with object	225	22.1
Other Or Unclear Contact	57	5.6
Strenuous Movement Without Lifting	24	2.4
Falling Objects Not Being Handled	10	1.0
Strenuous Movement With Lifting	10	1.0
Other	24	2.4
No ACC record	76	7.5
Total	1016	100.0

source:ACC

Other objects commonly involved in slip, trip and fall incident were the ground (20%), other external agencies (14%) and ladders (13%) (Table 22).

Table 22: “EA (external agency other than road)” – for work-related falls - New Zealand 2001

	Number	Percent
Ground/path	201	19.8
External agency NEC	142	14.0
Ladder, Stepladder	135	13.3
Floor	70	6.9
Stairs, Steps (fixed)	67	6.6
Self	34	3.3
Wind, snow, ice	32	3.1
Other person	30	3.0
Glass	23	2.3
Machinery	21	2.1
Fence, Railing, Wall	19	1.9
Plant, Bush, Tree	19	1.9
Environmental Factors N.e.c.	18	1.8
Furniture	17	1.7
Hole, Well, Tunnel, Ditch	13	1.3
Tools	8	0.8
Vehicle	7	0.7
Box, carton, crate	6	0.6
Sharp Object (not Knife)	6	0.6
Animal	5	0.5
Not Obtainable	44	4.3
No External Agency Involved	4	0.4
Other	19	1.9
No ACC record	76	7.5
Total	1016	100.0

source:ACC

4.3.7. Details of injury

Diagnosis of injury

The body sites most commonly injured were the ‘knee and lower leg’ (23%), followed by the head (16%) and the elbow and forearm (13%) (Table 23).

Table 23: Injury site for workers injured as a result of non-fatal work-related slips, trips and falls - New Zealand 2001

Body site injured	Number	Percent
Knee and lower leg	235	23.1
Head	165	16.2
Elbow and forearm	132	13.0
Abdomen/lower back/lumbar spine/pelvis	107	10.5
Wrist and hand	85	8.4
Thorax	71	7.0
Shoulder and upper arm	68	6.7
Ankle and foot	62	6.1
Hip and thigh	56	5.5
Neck	27	2.7
Multiple regions	5	0.5
Other injuries	3	0.3
Total	1016	100.0

source: ACC

Length of hospital stay

About a third of cases spent less than one day in hospital, with a further half being in hospital for four days or less (Table 24).

Table 24: Number of days hospital stay for non-fatal work-related slips, trips and falls - New Zealand 2001

	Number	Percent
0	344	33.9
1-4	478	47.0
5-10	137	13.5
11-14	25	2.5
15-19	17	1.7
20+	15	1.5
Total	1016	100.0

source: NZHIS

4.3.8. Details of injury event

Place of incident

Nearly half (48%) of all identified non-fatal falls occurred at industrial and construction sites (48%)(Table 25). A further 17% of non-fatal falls occurred in trade or service areas.

Table 25: “Scene (type of location where accident occurred) - work-related falls - New Zealand 2001

	Number	Percent
Home	54	5.3
School, other educational area	20	2.0
Sports or recreational area	21	2.1
Road/street	26	2.6
Trade or service area	168	16.5
Industrial or construction area	485	47.7
Farm	38	3.7
Place of medical treatment	13	1.3
Other specified place	95	9.4
Unspecified	20	2.0
No ACC record	76	7.5
Total	1016	100.1

source:ACC

4.3.9. Employment

Employment arrangements

The only information available on employment arrangements comes from the ACC workers' compensation database. This records the account from which the claim was made. The majority of fall injuries were found in the employers/other insurers account (61%) and the self-employed account (23%) (Table 26).

Table 26: Funding account of work-related non-fatal fall injuries - New Zealand 2001

	Number	Percent
Earners	78	7.7
Employers/Other Insurer	624	61.4
Non-earners	5	0.5
Self-employed work	233	22.9
No ACC record	76	7.5
Total	1016	100.0

source: ACC

Occupation – numbers and rates

The highest number of identified non-fatal fall injuries occurred to workers in the occupation groups '*Plant and machinery operators and assemblers*', '*Elementary occupations*' and '*Agricultural and fishery workers*' and (Table 27).

'*Plant and machinery operators*' had the highest rate of work-related falls, with a rate that was over double (149 per 100,000 workers per year) the overall rate. Other notably high rates were observed in '*Agricultural and fishery workers*' (112 per 100,000 workers per year) and '*Elementary workers*' (142 per 100,000 workers per year) (Table 27).

**Table 27: Occupation of workers injured as a result of non-fatal work-related falls –
New Zealand 1984-1994**

Occupation	Rate (per 100,000 workers)			
	Number	Percent		95% CI
Legislators, administrators and managers	3	0.3	1.4	0.5 - 4.2
Legislators and administrators	3			
Corporate managers	43			
Professionals	82	8.1	34.5	27.8 - 42.8
Physical, mathematical and engineering science	16			
Life science and health professionals	20			
Teaching professionals	22			
Other professionals	24			
Technicians and Association Professionals	50	4.9	26.6	20.1 - 35.0
Physical science and engineering associate professionals	13			
Life science and health associate professionals	8			
Other associate professionals	29			
Clerks	23	2.3	10.9	7.2 - 16.3
Office clerks	20			
Customer services clerks	3			
Service and Sales Workers	68	6.7	28.6	22.6 - 36.2
Personal and protective service workers	46			
Salespersons demonstrators and models	22			
Agriculture and fishery workers	137	13.5	111.5	94.3 - 131.8
Market orientated agricultural and fishery workers	137			
Trades workers	82	8.1	57.2	46.1 - 71.0
Building Trades Workers	51			
Metal and Machinery Trades Workers	15			
Other craft and related trades workers	16			
Plant and Machine Operators and Assemblers	211	20.8	148.8	130.0 - 170.3
Industrial Plant Operators	59			
Stationary Machine Operators and Assemblers	23			
Drivers and Mobile Machinery Operators	35			
Building and Related Workers	94			
Elementary Occupations	139	13.7	142.3	120.5 - 168.0
Labourers and Related Elementary Service Workers	139			
Unknown	149	14.7	-	-
Total	1016	100.0	62.0	58.3 - 65.9

primary source: ACC, secondary source: NZHIS

5. DISCUSSION

5.1. *Fatal falls*

During the decade of the study we identified 135 deaths that resulted from a work-related slip, trip or fall. This is a rate of 0.9 per 100,000 workers and represents approximately 15% of all work-related fatal injuries that occurred during that period. This is likely to be an underestimate given the difficulty of initially identifying work-related cases in coronial files. This study is descriptive and so no causal inferences can be made although the potential importance of some factors have been highlighted. Of particular interest is the number of fatal falls that occurred from heights less than 2 metres, where workers may not have considered the risk of falling was high. Falls occurred most commonly in the construction and fishing industries where workers are commonly working either at heights or on unsteady work surfaces. Well accepted safety precautions, such as use of a harness on a roof, were often found not to have been used. Factors such as inconvenience of use may have been a factor in this.

5.2. *Non-fatal falls*

The secondary aim of the project was to determine the feasibility of deriving a reliable estimate of the incidence of work-related slips, trips and falls which result in public hospital inpatient treatment. It was estimated that in a one-year period there were 1016 work-related falls required admission to hospital. This is likely to be an underestimate, because not all “falls” are coded as such under ICD. For example, falls from moving motor vehicles on public roads are coded under transportation codes. In this context it should be noted that the process for identification of fatal cases was different to that for fatal falls.

The method of case selection used variables in either the ACC or NZHIS file to identify work-relatedness. Table 14 shows that in only 55% of cases was there direct concordance between the two datasets. This however is not as poor a mismatch as it might at first seem since in 18% of cases the NZHIS file had the cases coded as “unspecified”. What this does demonstrate, however, is the value of matching.

There were 199 cases (19.5%) where the ACC file indicate the incident was work-related whereas the NZHIS file indicated contrary, or vice versa. As mentioned in the method section all these cases were accepted as work-related since we had no information on the reliability of the coding for either organization. In addition there were 76 (7.5%) cases where NZHIS files indicated were work-related but there was no ACC claim. These were also accepted as it is quite feasible for someone to be injured at work and no claim to be made (e.g. they were off work for less than a week)

Although it was not within our brief we elected to describe the epidemiology of these non-fatal events. The results of that process further illustrate the value of matching. The NZHIS uses the ICD to code the circumstances of injury. This coding frame is limited in terms of describing the circumstances of injury, and this is particularly the case for falls. Agencies

such as ACC tend to use a range of codes to describe the circumstances of injury. A range of codes has, in theory, the potential to provide greater insight in the circumstances surrounding the events. The irony in this particular case is that ACC has no code which identifies a fall.

This study provides ACC and others, for the first time with an insight into the circumstances of a significant cause of non-fatal work-related injury. It is of course limited to the more serious cases, those resulting in hospitalization. It should also be noted that our description of the events was illustrative rather than comprehensive as it was beyond our brief and resources to describe these incidents. Given their importance, consideration should be given to a more in depth analysis of these cases.

Those most at risk were male, aged between 40 and 54 years, employed as “plant and machinery operators and assemblers, or “agriculture, farming and fishing” workers. Typically the falls involved a loss of balance or a fall, either on the same level or from a ladder, or from, out or through a building.

While we have estimated the significance of fatal falls relative to all fatal injury we have not provided the complementary estimate for serious non-fatal falls. This is because there has not been to date any estimate of incidence of serious non-fatal work-related injury in New Zealand. Nevertheless, at approximately 1000 cases per year work-related serious non-fatal falls is in absolute terms a significant issue.

Our inability to routinely and reliably identify work-related fatal and serious non-fatal falls, continue to be a major shortcoming of national information systems. This coupled with shortcomings in ICD code for defining a “Fall” and the absence of any indicators for “Falls” in the ACC database are major barriers to producing timely inexpensive estimates on incidence of work-related falls and describing the epidemiology of these events so as to guide prevention efforts.

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6. REFERENCES

1. Buckley SM, Chalmers, D.J., Langley, J.D. Falls from buildings and other fixed structures in New Zealand. *Safety Science* 1996; 21:247-254.
2. National Safety Council. *Accidents Facts*. 1993 Edition. Itasca, Illinois, 1993.
3. Courtney TK, Sorock GS, Manning DP, Collins JW, Holbein-Jenny MA. Occupational slip, trip, and FALL-related injuries--can the contribution of slipperiness be isolated? *Ergonomics*. 2001; 44:1118-37.
4. Fingerhut LA, Cox, C.S., Warner, M. *International Comparative Analysis of Injury Mortality: Findings from the ICE on Injury Statistics*. Hyattsville, MD: National Center for Health Statistics, 1998.
5. National Occupational Health and Safety Commission. *Work-related fatalities involving falls in Australia, 1989 to 1992*. Australia: National Occupational Health and Safety Commission, 2000.
6. Leamon TB, Murphy, P.L. Occupational slips and falls: more than a trivial problem. *Ergonomics* 1995; 38:487-498.
7. Hyos CG, Zimolong, B. Occupational safety and accident prevention. *Advances in Human Factors/Ergonomics* 1988; 11:167-178.
8. Buck PCC, V.P. Slipping, tripping, and falling accidents at work: a national picture. *Ergonomics* 1985; 2:949-958.
9. Bentley TAH, R.A. Identification of risk factors and countermeasures for slip, trip and FALL accidents during the delivery of mail. *Applied Ergonomics* 2001; 32:127-134.
10. Health and Safety Executive. *Slips and Trips, Guidance for Employers on Identifying Hazards and Controlling Risks*. London: HMSO, 1996.
11. Lund J. Accidental falls at work, in the home and during leisure activities. *Journal of Occupational Accidents* 1984; 6:181-193.
12. Axelsson P-O, Carter, N. Measures to prevent portable ladder accidents in the construction industry. *Ergonomics* 1995; 38:250-259.
13. Jones D, Switzer-McIntyre S. Falls from trucks: a descriptive study based on a workers compensation database. *Work*. 2003; 20:179-84.
14. Nagata H. Occupational accidents while waking on stairways. *Safety Science* 1991; 14:199-211.
15. Cohen HH, Templer, J., Archea, J. An analysis of occupational stair accident patterns. *Journal of Safety Research*. 1985; 16:171-181.
16. Buskin SE, Paulozzi, L.J. Fatal injuries in the construction industry in Washington State. *American Journal of Industrial Medicine* 1987; 11:453-460.
17. Cattledge GH, Hendricks S, Stanevich R. Fatal occupational falls in the U.S. construction industry, 1980-1989. *Accident Analysis & Prevention*. 1996; 28:647-54.
18. Lipscomb HJ, Li L, Dement JM. Falls among union carpenters. *American Journal of Industrial Medicine*. 2003; 44:148-56.
19. Sprince NL, Zwerling C, Lynch CF, et al. Risk factors for falls among Iowa farmers: A case-control study nested in the Agricultural Health Study. *American Journal of Industrial Medicine* 2003; 44:265-272.
20. Bentley TA, Haslam RA. Slip, trip and FALL accidents occurring during the delivery of mail. *Ergonomics*. 1998; 41:1859-72.

21. Jensen OC. Non-fatal occupational FALL and slip injuries among commercial fishermen analyzed by use of the NOMESCO injury registration system. *American Journal of Industrial Medicine*. 2000; 37:637-44.
22. Senior LBNYMAP. Hospitalizations for FALL-related injuries among active-duty Army soldiers, 1980-1998. *Work* 2002; 18:161-170.
23. Laflamme L. Falls among Swedish nurses and nursing auxiliaries: types of injuries and their relation to age over time. *Work* 1998; 10:147-155.
24. Feyer A-M, Langley, J. Howard, M. Horsburgh, S. Wright, C. Alsop, J. Cryer, C. The Work-Related Fatal Injury Study: numbers, rates and trends of work-related fatal injuries in New Zealand 1985-1994. *The New Zealand Medical Journal* 2001; 114:6-10.
25. New Zealand Environmental and Occupational Health Research Centre IPRU. Work-related fatal traffic injuries in New Zealand: 1985-1998. Dunedin: University of Otago, 2003.
26. Statistics New Zealand. www.statsnz.govt.nz, 2004.

Appendix 1

Other external causes of accidental injury (W00–X59)

Falls (W00–W19)

[See pages 1013–1017 for fourth-character subdivisions]

Excludes: assault (Y01–Y02)
fall (in)(from):

- animal (V80.–)
- burning building (X00.–)
- into fire (X00–X04, X08–X09)
- into water (with drowning or submersion) (W65–W74)
- machinery (in operation) (W28–W31)
- transport vehicle (V01–V99)
- intentional self-harm (X80–X81)

W00 Fall on same level involving ice and snow

Excludes: fall with mention of:

- ice-skates and skis (W02.–)
- stairs and steps (W10.–)

W01 Fall on same level from slipping, tripping and stumbling

Excludes: fall involving ice or snow (W00.–)

W02 Fall involving ice-skates, skis, roller-skates or skateboards

W03 Other fall on same level due to collision with, or pushing by, another person

Includes: fall due to collision of pedestrian (conveyance) with another pedestrian (conveyance)

Excludes: crushed or pushed by crowd or human stampede (W52.–)
fall involving ice or snow (W00.–)

W04 Fall while being carried or supported by other persons

Includes: accidentally dropped while being carried

W05 Fall involving wheelchair

W06 Fall involving bed

W07 Fall involving chair

W08 Fall involving other furniture

W09 Fall involving playground equipment

Excludes: fall involving recreational machinery (W31.–)

W10 Fall on and from stairs and steps

Includes: fall (on)(from):

- escalator
- incline
- involving ice or snow on stairs and steps
- ramp

W11 Fall on and from ladder

W12 Fall on and from scaffolding

W13 Fall from, out of or through building or structure*Includes:* fall from, out of or through:

- balcony
- bridge
- building
- flag-pole
- floor
- railing
- roof
- tower
- turret
- viaduct
- wall
- window

Excludes: collapse of a building or structure (W20.–)
fall or jump from burning building (X00.–)**W14** Fall from tree**W15** Fall from cliff**W16** Diving or jumping into water causing injury other than drowning or submersion*Includes:* striking or hitting:

- against bottom when jumping or diving into shallow water
- wall or diving board of swimming-pool
- water surface

Excludes: accidental drowning and submersion (W65–W74)
diving with insufficient air supply (W81.–)
effects of air pressure from diving (W94.–)**W17** Other fall from one level to another*Includes:* fall from or into:

- cavity
- dock
- haystack
- hole
- pit
- quarry
- shaft
- tank
- well

W18 Other fall on same level*Includes:* fall:

- from bumping against object
- from or off toilet
- on same level NOS

W19 Unspecified fall*Includes:* accidental fall NOS