The Epidemiology of Serious Non-Fatal Work-Related Traumatic Injury – a Demonstration Project

Injury Prevention Research Unit

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The Epidemiology of Serious Non-Fatal Work-Related Traumatic Injury - A Demonstration Project

A report for Official Statistics Research, Statistics New Zealand

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Abbreviations

ACC	Accident Compensation Corporation
ANZSIC	Australian and New Zealand Standard Industrial Classification
ICD-9	International Classification of Diseases, 9th Revision
ICD-10	International Classification of Diseases, 10th Revision
ICD-10-AM	International Classification of Diseases, 10th Revision, Australian Modification
ICE	International Collaborative Effort on Injury Statistics
ICISS	ICD10-based Injury Severity Score
IIM	Injury Information Manager
IPRU	Injury Prevention Research Unit
LEED	Linked Employer Employee Data
LFS	Labour Force Survey
MVTC	Motor vehicle traffic crash
NMDS	NZHIS National Minimum Data Set of hospital discharges
NZHIS	New Zealand Health Information Service
NZIPS	New Zealand Injury Prevention Strategy
NZSCO	New Zealand Standard Classification of Occupations
PHI	Public Health Intelligence
PHO	Primary Health Organisation
SNZ	Statistics New Zealand
SRR	Survival Risk Ratio
wcdays	Weekly (earning-related) compensation in days.
WHO	World Health Organisation
WRFIS	Work-Related Fatal Injury Study
WRNFI	Work-Related Non-Fatal Injury

Foreword

Colin Cryer was the Principal Investigator on this project. He was involved in all aspects of the project including project co-ordination, planning and taking the lead in writing the final report. Gabrielle Davie, biostatistician, was responsible for the analysis. Ari Samaranayaka carried out the analysis. Professor John Langley and Gabrielle Davie were involved in planning, advising on methodology, consideration of findings and writing the final report. Daniel Russell, data manager/programmer, was responsible for preparing the data and for data linkage.

Executive Summary

Background and aims

Many government agencies are interested in reliable statistics to describe the size and nature of, and trends in, the work-related traumatic injury problem. There have been problems identifying and describing work-related traumatic injury in New Zealand on an ongoing basis. There are two national administrative data sets, ACC data and NZHIS NMDS of hospitalisations, that are potential source of work-related traumatic injury statistics. However, each data source on their own has potential limitations.

This project used linked administrative data sources to provide a description of the epidemiology of serious threat-to-life work-related traumatic injury. We also considered whether it was possible to use ACC data on their own to provide a valid description of serious work-related injury. In this regard, whether that can be realised depends on the completeness and accuracy of these ACC data, and the effect of extraneous factors on the likelihood of making an earnings-related claim. This project investigated ACC data for its accuracy through direct comparison with NMDS data.

Aim: To present an accurate picture of the epidemiology of serious (threat-to-life) work-related injuries using a linked data set

This work also permitted an investigation of the accuracy of some key ACC data:

(a) to judge whether it can be used for official statistical purposes, including for describing the epidemiology of serious disabling work-related injuries and

(b) for the development of national indicators of work-related traumatic injury incidence based on ACC data alone – as possible NZIPS indicators.

Methods

1. For the ACC-NMDS linked data set, a cross-sectional analysis was carried out. Numbers, and where possible rates, of traumatic injury were presented overall and for the following dimensions: age, gender, ethnicity, industry, occupation, employment status, diagnosis, and by external cause of injury.
2. This descriptive picture was compared with the picture obtained for the analysis of ACC data on their own. Various severity thresholds, based on length of time off work, were investigated: over 7 days, over 14 days, over 21 days, etc.
3. Additionally, concordances between NMDS and ACC data, for common fields among those listed above, were investigated.

Results

There were 763,539 work-related injury ACC claims and 297,859 injury cases identified from NMDS data (all activities) during the period 2002 to 2004 (ACC data) and 2000 to 2005 (NMDS)[a]. Of these, 16,098 records were linked.

[a] All discharges considered in this work were first admissions. All claims were new claims. However, multiple admissions and multiple claims were possible for a person for separate traumatic injury events.

Epidemiology of serious threat-to-life work-related traumatic injury

There were 1,143 cases identified over the 3 years considered, ie. 381 per year. The results show:

- rates increase after age 54, particularly in the eldest age group (65-84)
- very high rates for men compared with women
- higher rates for the self-employed compared with employees
- higher rates for Māori than European or Pacific peoples
- highest rates within mining,
- also very high rates for the industry groups:
    - Agriculture, forestry, fishing
    - Electricity, gas, water
    - Construction
    - Transport, storage
- Very high rates for the occupational groups:
    - Agriculture and fishery workers
    - Plant and machinery operators, assemblers.
    - Elementary occupations (includes occupations such as cleaners, caretakers, couriers, hotel porters, refuse collectors, street cleaners, packers, railway shunters, labourers)

The most frequently occurring nature and body site of injury combinations include traumatic brain injury (with or without fracture), spinal injury and vertebral column fracture, injury to the thorax (fracture and / or internal injury), fracture to the upper extremity (arm and shoulder), and hip fracture. The most frequently occurring external causes (in order of magnitude) were: falls, land transport related, struck by / against, machinery-related, due to fire or hot object or substance, and natural / environmental causes. These accounted for 84% of cases.

Epidemiology of serious disabling work-related traumatic injury - ACC earnings-related compensation for over 175 days

There were 7,230 cases identified over the 3 years considered, ie. 2,410 per year. The results show:

- increasing rates across age groups to 55-64, and then a decline in the rate for age 65-84, which had a rate similar to that for 35-44 year olds;
- higher rates for men compared with women;
- similar rates for the self-employed compared with employees
- higher rates for Māori than for all other ethnic groups
- high rates for the industry groups:
    - Agriculture, forestry, fishing
    - Mining
    - Manufacturing
    - Electricity, gas, water
    - Construction
    - Transport, storage

- high rates for the occupational groups:
    - Agriculture and fishery workers
    - Trade workers
    - Plant and machinery operators, assemblers
    - Elementary occupations.

The most frequently occurring nature and body site of injury combinations (excluding the "unspecifieds") were: upper and lower extremity fracture (excluding hip fracture), upper extremity dislocation, open wounds and contusions, lower extremity contusions, and vertebral column fractures.

Concordance of ACC and NMDS data

Of the 1140 persons in the linked dataset of cases, age was equivalent for 97% of people. Information on gender was concordant for 1138 of the 1140 persons. The two data sets showed the same ethnic group classification in 78% of cases. The Kappa statistics for the concordance was 0.55 – ie. "moderate" concordance.

Less than 40% of these linked cases were classified to the same diagnostic groups by NMDS and ACC (Kappa = 0.34 - "poor" concordance). Some of the discrepancy was due to similar body sites being concordant, but different natures of injury.

Discussion

Principal findings

The outcomes include:

1. the first accurate epidemiological description of **serious threat-to-life work-related traumatic injury** in New Zealand, as produced from the linked dataset;

2. a description of the agreement between some key fields in the ACC and NMDS data sets;

3. an assessment of the suitability of ACC data on its own for presenting the epidemiology of serious non-fatal work-related traumatic injury;

4. a presentation of the epidemiology of **serious disabling work-related traumatic injury** based on ACC data alone.

What new knowledge this study brings.

The epidemiological description of serious threat-to-life traumatic injury provides government and non-government agencies, for the first time, with a picture of the burden of these serious injuries. This information can be used as a starting point for further work to inform priority setting, planning, policy making, surveillance and monitoring.

This work has indicated that ACC data on their own are a suitable source from which an acceptable epidemiological picture of serious disabling non-fatal work-related traumatic injury can be derived, provided the identification of traumatic injury cases is not compromised by deficiencies in the ACC diagnostic data recorded on the ACC data base. The ACC algorithm used to identify traumatic injury, and its performance, should be investigated further and if found to be acceptable, then it will give the opportunity for routine monitoring of the national burden of serious disabling work-related traumatic injury using this source.

If the ACC injury diagnosis data is found not to compromise the identification of traumatic injury cases, this will open the way for the development of serious disabling traumatic injury indicators to support, at the very least, the Workplace Health and Safety Strategy. It could also be the basis for the development of more general threat-of-disability national traumatic injury indicators.

Recommendations

Recommendation 1

Since the epidemiological picture of serious threat-to-life work-related traumatic injury only provides part of the picture, and this is complemented by the picture of serious disabling work-related traumatic injury, the goal should be to present both pictures alongside each other when describing serious non-fatal work-related traumatic injury. It appears that an epidemiological picture can be produced for serious threat-to-life work-related traumatic injury at this time – a picture for which we have identified no threats to validity. It is less certain for serious disabling work-related traumatic injury and so further work to investigate the validity of using ACC data for this purpose should be carried out firstly (see below).

Recommendation 2

The algorithm used to determine cases of traumatic injury, for the serious disabling traumatic injury epidemiological analysis, is based on ACC diagnosis data. This and other work suggest that there are problems with ACC diagnosis coding, which seems to be due to the ACC capturing preliminary diagnosis rather than a confirmed diagnosis. It is unclear to what extent this will affect the algorithm used to differentiate traumatic injury from gradual process / occupational disease cases. We recommend that this be investigated.

Recommendation 3

We recommend that further work be carried out to explain the results obtained for serious threat-to-life injuries as follows:

a) Identify specific occupational groups that are at particular risk
b) Describe the circumstances of injury in those occupational groups as well as the nature of injury that results.

Recommendation 4

Given that we have identified unexplained high rates of traumatic injury for Māori, we recommend that a project be commissioned to describe the epidemiology of serious work-related traumatic injury for this population. It seems appropriate that such a project should be lead by Māori investigator(s) to ensure appropriate ownership of the results, and ownership of the implications and recommendations coming from such work.

Recommendation 5

It is recommended that the discrepancies found between NMDS and ACC data should be discussed with ACC in the context of the work on the accuracy of NMDS data (IPRU paper in preparation). ACC will be encouraged to consider the potential problems with their data, and the implications these have for informing injury prevention activities - both internal and external to the ACC.

Recommendation 6

We are ignorant of the accuracy of the industry and occupation codes captured on the ACC database, as well as the data from which we derived work-related status. As far as we are aware, no audits of the quality of these data have been carried out. It is important that the accuracy of these fields be assessed, since they are key fields for producing the epidemiological picture for serious threat-to-life and disabling work-related injury. We recommend that this work be funded, and the results disseminated widely in New Zealand.

Recommendation 7

This work has been limited to the investigation of non-MVTC serious non-fatal work-related injury. MVTCs have been found to be a significant cause of the burden of work-related fatal injury, and this is likely to be the case for serious non-fatal work-related traumatic injury also. It is recommended, therefore, that work be commissioned to investigate methods to extend this work to investigate serious non-fatal work-related MVTC traumatic injury.

1. Background and aims

1.1. Background

1.1.1. Introduction

Many Government agencies are interested in reliable statistics to describe the size and nature of, and trends in, the work-related traumatic injury problem. There have been problems identifying and describing work-related traumatic injury in New Zealand on an ongoing basis. (Langley, Feyer et al. 2000) Valid estimates of work-related fatal injury cannot readily be determined without special one-off expensive studies. We are not aware of any epidemiological description of work-related non-fatal injury (WRNFI) incidence for New Zealand that has previously been published in peer reviewed journals or reports The validity of descriptions in in-house reports of WRNFI have not been investigated.

There are two national administrative data sets, ACC data and NZHIS NMDS of hospitalisations, that are potential source of information on work-related traumatic injury. However, on their own, each data source has potential limitations (Table 1).

Table 1: Likely accuracy of selected ACC and NMDS data for describing the epidemiology of non-fatal work-related traumatic injury

	ACC	NMDS	Explanation
Accuracy of work-relatedness information	**Probably very good**	**Less good**	**There are powerful financial drivers (levy rates) to maximize the accuracy of these ACC data, particularly for earnings-related claims. No such system exists with NMDS. The activity codes which identify work activity in NMDS have only recently been introduced, utilisation is generally poor and accuracy is unknown.**
Accuracy of external cause coded data	**Probably poor**	**OK**	**There are no ACC coding guidelines and there is no audit data to gauge accuracy. This contrasts with NMDS.**
Accuracy of diagnosis code	**Probably less good**	**Good**	**As above. In addition, historically, ACC diagnostic data has typically related to when the injured person was first seen, as opposed to NMDS where a confirmed diagnosis is used, ie. after all tests etc have been performed.**
Effects of extraneous factors other than the incidence of traumatic injury	**Probably high**[b]	**Probably high but can be controlled**	**Both data sets have threats to validity which cannot be ignored. The presence of accurate and detailed diagnosis data in the NMDS provides a mechanism to control these (see the next section).**

[b] Raymont A, Slack A, Gallagher L, Cumming J. Factors influencing claims to the ACC. Wellington, New Zealand: Health Services Research Centre, August 2003.

When we were asked to develop serious non-fatal injury indicators for the New Zealand Injury Prevention Strategy (NZIPS), we could only propose provisional serious non-fatal work-related injury indicators for the reasons given in Table 1. (Cryer, Langley et al. 2004)

1.2. Scope of the current work

ACC and NMDS data are the only national data sources available that, on their own, have the potential to be used to describe the national burden of serious[c] non-fatal work-related traumatic injury

In regard to ACC data, whether that potential can be realised depends on the completeness and accuracy of these ACC data, and the effect of extraneous factors on the likelihood of making a (earnings-related) claim. This project investigated ACC data for its accuracy through direct comparison with the NMDS. Should ACC data be suitable, then this will provide the opportunity for regular presentations of the national burden of these injuries – in which we can have confidence that they are a valid representation of the incidence of such events in the community.

There is a problem with the use of the NMDS on their own for describing the burden of serious non-fatal work-related traumatic injury. For these data, the identification of work-related cases is via the ICD activity code, and currently there are a significant proportion of records (39%) whose activity is coded to "unspecified". (Langley, Davie et al. 2007) Consequently, unless this is a differential problem and is not a problem for injury hospitalisations resulting from paid work, this currently excludes the use of NMDS, on their own, for this purpose

This project used linked administrative data sources to provide a description of the epidemiology of serious threat-to-life work-related traumatic injury. The linked data used the best administrative data source to identify work-related traumatic injury cases (namely ACC data), and used the NZHIS NMDS of hospital discharges to identify serious disabling traumatic injury cases. The use of only serious traumatic injury cases, defined as an ICISS severity score $\leq$0.941, was chosen so that the likely biases of extraneous factors on case ascertainment were minimised (see section 2.2.4). (Stephenson, Langley et al. 2002) (Stephenson, Henley et al. 2004) This is the first time that such an analysis has been carried out in New Zealand for non-MVTC work-related injury and so as a result we have, for the first time, been able to gain insights into the characteristics of the people being seriously injured at work, as well as the role that both NMDS and ACC data can play (see section 1.3).

Aim:

To present an accurate picture of the epidemiology of serious (threat-to-life) work-related injuries using a linked data set.

This work will also permit an investigation of the accuracy of key ACC data:

(a) to judge whether ACC data can be used for official statistical purposes, including for describing the epidemiology of serious (disabling) work-related injuries and
(b) for the development of national indicators of work-related traumatic injury incidence based on ACC data – as possible NZIPS indicators.

[c] Our interest is in important traumatic injury; important because they are associated with significant threat-to-life, threat of disability, or cost.

Ethics /Privacy

This project made use of the following sensitive data to complete the data integration: all recorded name fields (e.g. first name, surname), last known residential address, and National Health Index number. IPRU have research ethical approval for the integration and analysis of these data and have security measures in place to ensure confidentiality. Fields containing names were only used within the data linkage process and the subsequent linked data set and non-linked data sources used for the analysis did not contain any sensitive data fields.

1.3. Project outcomes

The outcomes include:

1. the first accurate epidemiological description of serious non-fatal traumatic injury in New Zealand, as produced from the linked dataset;

2. a description of the accuracy of some key fields in the ACC data set;

3. an epidemiological description based on ACC data alone;

4. an assessment of the suitability of ACC data on their own for presenting the epidemiology of serious threat-to-life work-related traumatic injury.

The valid description of the epidemiology of serious non-fatal work-related traumatic injury is important to meet specific traumatic injury priority setting, policy, prevention and control needs of government and non-government agencies. This report focuses on two dimensions of serious injury: threat-to-life and (threat-of-) disability.

1.4. Relevance to the Official Statistics System

Part 8 of the Injury Prevention, Rehabilitation and Compensation Act, 2001 states that injury-related statistics are official statistics classified under section 4 of the Statistics Act 1975. The Statistics NZ Injury Information Manager (IIM) is required by this Act to facilitate the development and maintenance of a coherent set of statistics and indicators, and a research database on injury-related information and to enable the analysis of such information, to enhance policy development in both the government and private sectors. The Act also states that another purpose of the IIM is to enable the effectiveness of government agencies to be monitored in relation to the Government's overall injury management (including injury prevention) objectives.

In 2003 the NZ Government signed off the New Zealand Injury Prevention Strategy (NZIPS), which included six priority areas. This current work describes the problem of work-related injury in New Zealand, one of the NZIPS priority areas. IPRU recently developed serious injury outcome indicators for NZIPS. (Cryer, Langley et al. 2004) (Cryer and Langley 2006) To minimise threats to validity for the non-fatal injury indicators, injuries were regarded as serious if their estimated survival probability (ICISS) was 94.1% or worse, where ICISS was derived for each NMDS diagnosis code. Serious injury defined in this way minimises the likely effect of extraneous factors (eg. factors that affect health service use or claims to the ACC, that are independent of severity of injury) on case ascertainment. Consequently, a linked data set in which work-relatedness is defined using ACC data, and serious injury defined using ICISS derived from NMDS diagnosis data, created the opportunity to produce the most accurate epidemiological picture of serious non-fatal work-related injury available to us today. This is the basis of the current project.

This epidemiological description provides stakeholders (Department of Labour, the ACC, Ministry of Health, Council of Trade Unions, Business NZ, and other relevant agencies) with, for the first time, an accurate picture of the burden of these serious injuries, where serious is defined in terms of threat-to-life. Such a picture is needed for many functions including priority setting, planning, policy making, surveillance and monitoring. It also provides an exemplar for the IIM of the utility of an integrated injury database similar to the one the IIM may develop. Additionally, this work provides an assessment of whether ACC data, on their own, are a suitable source from which an acceptable epidemiological picture of serious non-fatal work-related injury can be derived.

If as a result of this or follow-up projects, ACC data is found to be sufficiently accurate, this would also open the way to produce additional valid national indicators of injury incidence aimed at monitoring the impact of NZIPS on serious disabling traumatic injury incidence. The New Zealand Injury Prevention Strategy secretariat recognise that it is a priority to produce serious injury indicators that are complementary to the current NZIPS threat-to-life serious injury indicators - complementary indicators where “serious” is defined in terms of threat-of-disability, rather than threat-to-life. The development of these complementary indicators is important since there are many injuries that are very disabling (eg. amputation of fingers, penetrating eye injuries) but which have a low threat-to-life. Within the New Zealand context, should ACC data be found to be sufficiently accurate, then these data are crucial for the development of such indicators.

2. Methods

2.1. Methodological approach

1. For the ACC-NMDS linked data set, a cross-sectional analysis was carried out. Numbers, and where possible rates, of traumatic injury were presented overall and for the following dimensions: age, gender, ethnicity, industry, occupation, employment status, diagnosis, and by external cause of injury.
2. This descriptive picture was compared with the picture obtained for the analysis of ACC data on their own. Various severity thresholds, based on length of time off work, were investigated: over 7 days, over 14 days, over 21 days, etc.
3. Additionally, concordances between NMDS and ACC data, for common fields among those identified above, were investigated.

2.2. Methods description

2.2.1. Population

People living in New Zealand aged 15 to 84 working for income.

2.2.2. Theoretical definition of work-related traumatic injury

Our theoretical definition of a work-related traumatic injury was as follows: any traumatic injury arising out of, or in the course of, paid employment and occurring at the workplace, but not whilst driving or being transported on public highways. (Although we are interested in work-related MVTC injury - see Recommendation 7, page 53 - these injuries are much more difficult to identify than non-MVTC injury cases. Consequently our theoretical and case definitions have been chosen to reflect this.) Paid employment includes people who are working for pay, profit, or payment-in-kind. The workplace is any place where the worker (self-employed or employee, full-time or part-time) is present in the exercise of his or her duty. The definition excludes self-harm, motor vehicle traffic crash (MVTC)-related, commuting, bystander injury, voluntary and apprentice workers, and traumatic injury resulting from unpaid home duties. It also excludes occupational disease or harm caused by non-discrete events ("gradual process").

2.2.3. Case definition of work-related traumatic injury

Work-related traumatic injury is operationally defined in this study as one in which the injured person is compensated by the ACC from the Employer, Self-Employed, or Residual Accounts, for which the 'Work' field is set to 'Yes'. This definition excludes bystander, commuter and MVTC-related injury. We believe the ACC data provides the most valid means for the ascertainment of work-related cases than other national databases, including the NMDS.

2.2.4. Case definition of serious threat-to-life traumatic injury

For this part of the study, a traumatic injury was defined as one having a principal diagnosis of traumatic injury on the NMDS hospital discharge record (relating to the first admission following injury) from within the ICD-10 code range S00 to T78. This excludes: complications of trauma, surgical and medical care, and sequelae of injuries (previously called "late effects").

This work defines cases of serious threat-to-life non-fatal traumatic injury as cases that are hospitalised with an ICISS of less than or equal to 0.941. This is equivalent to selecting patients whose injuries give the patient an estimated survival probability of 94.1% or worse at first admission. This represents around 15% of all publicly-funded traumatic injury discharges from hospital. The threshold is consistent with the definition of "serious non-fatal injury" used in the NZIPS indicators of injury incidence and was chosen at this level to include those traumatic injury diagnoses admitted to hospital in almost all instances.

Determining which injuries are "serious" by the ICISS method involves calculating a Survival Risk Ratio (SRR) for each individual traumatic injury diagnosis code. For a given traumatic injury diagnosis, an SRR is the proportion of first admission cases with that traumatic injury diagnosis who do not die - or in other words a given SRR represents the likelihood that a patient will survive a particular traumatic injury. Each patient's ICISS (estimated survival probability) is the product of the probabilities of surviving each of their injuries individually

$$\mathbf{ICISS = SRR_{Diagnosis\ A} \times SRR_{Diagnosis\ B} \times SRR_{Diagnosis\ C} \times \ldots}$$

Previous IPRU research has demonstrated that ICISS, based on hospitalised traumatic injury fatalities, were as good as, or better than, a range of other severity measures based on the ICD-9 coding frame (Stephenson, Langley et al. 2002), as well as a reasonable way to estimate severity for administrative databases using ICD-10 or ICD-10-AM (Stephenson, Henley et al. 2004).

2.2.5. Case definition of serious disabling traumatic injury

Participation restriction is one dimension of disability as described in the WHO's International Classification of Functioning, Disability and Health (ICF). (World Health Organization 2001) Time off work, or reduced work, because of traumatic injury, is a direct measure of participation restriction due to traumatic injury. This is the basis of the serious disabling traumatic injury case definition for this project.

Within ACC data, the variable that captures earnings-related compensation for either (a) time off work, or (b) reduced or changed work activities, is "wcdays". For example, wcdays>0 identifies any claims that attract any earning-related compensation. Within ACC, there is a stand-down period of 7 days before earnings-related compensation is paid. So wcdays>0 represents cases where earning-related compensation has been paid for the period beyond the first 7 days after the traumatic injury occurred.

We investigated a number of case definitions relating to wcdays: >0, >7, >14, >21, >49, >84, and >175. This approximates to time off work / reduced or changed duties for the following periods: over 1 week, over 2 weeks, over 3 weeks, over 4 weeks, over 2 months, over 3 months, and over 6 months, respectively.

2.2.6. Source Data

Numerator data

(1) Serious threat-to-life work-related traumatic injury

ACC claims for work-related traumatic injury that occurred in the period 2002 to 2004 were linked to the NZHIS NMDS of hospital discharges that occurred in the period 2002 to 2005. The ACC data was used to determine work-relatedness (see case definition above), whilst the NMDS was used to identify cases of serious traumatic injury (see definition of serious threat-to-life traumatic injury above). IPRU holds a subset of NMDS, where discharge events contain at least one external cause code. ACC data was requested for this project (see Appendix A). IPRU carried out data integration (see section 2.2.7, page 8).

(2) Serious disabling work-related traumatic injury

To describe the epidemiology of serious disabling work-related traumatic injury, ACC Entitlement Claims data on their own were used as the numerators, for events that occurred during the period 1 January 2002 to 31 December 2004 using various case definitions based on the length of time off work: ie. over 7 days, over 14 days, over 21 days, etc

The request for ACC data is reproduced in Appendix A, page 56.

Denominator data

Worker-years information is available in a variety of Statistics New Zealand (SNZ) sources such as Census data, Household Labour Force Survey (LFS), Quarterly Employment Survey, Household Economic Survey, Business Demography Survey, and Linked Employer Employee Data (LEED). Information from the different SNZ surveys do not agree due to different methodologies used in surveys (personal communication, Ronald Mair, SNZ, 19 February 2007). Also, the results reported in different quarterly reports of the same survey can differ due to updating of previous survey results when new information is available (source: Quarterly Household Labour Force Survey reports of SNZ). This provides one explanation for the slight discrepancies in worker-years in the results.

The denominators for age, gender, employment status, ethnic group and occupation were obtained from the LFS; and those for Industry were from the LEED. The pros and cons of each data source are listed in Appendix B, page 58.

Age groups: Worker-years data for each age group was obtained for each year from the quarterly household LFS[d]. All working people were included irrespective of employment status (employee, self-employed, part-time, full-time). People younger than 15 years were excluded. People older than 84 years could not be identified from the LFS data, hence were not excluded. Working people in this age group, however, were assumed to be few relative to other age groups.

[d] http://www2.stats.govt.nz/domino/external/PASFull/pasfull.nsf/hotpalpha?OpenView&Start=500

Gender: Number of employed people by gender was obtained from the LFS[e].

Employment status: Person-years information was obtained for each year from the LFS[f].

Ethnic groups: Person-years information for the European, Māori, Pacific, and Other specified ethnic groups were obtained from the LFS[g]. Note that person-years for Asians were included in 'other specified ethnicities' group.

Industry: Person-years for various industries (categorised to ANZSIC level 1) were obtained for each year from LEED[h].

Occupation: Person-years information for various occupations (categorized to NZSCO level 1) was sourced from the LFS.

2.2.7. Linking the data

The description of the method used and the results of the data linkage procedure are presented in Appendix C, page 59. A synopsis is presented below.

There were 763,539 ACC claims records, and 297,859 hospital discharge records used in the linkage. Note that readmissions to hospital for the same event were excluded. The purpose of the record linkage was to link ACC work-related claims to a hospital discharge record that related to the person and the same event. The software used was AUTOMATCH. There were 8 "passes" to identify linked person-events, although most of the linked cases were identified by the 5th pass. The following was the aim of these first 5 passes:

- Pass 1: find all of the obvious links, where all fields match almost exactly;
- Pass 2: link if they have the same ACC (M45) claim number;
- Pass 3: link if they match on NHI number and injury date;
- Pass 4: link where we are confident that it is the same person and there is less than 4 days difference in injury date;
- Pass 5: link where we are confident that it is the same person and there is less than 4 days difference in injury date and there has been character transposition in the date of birth.

After each pass, the records were sorted according to the closeness of the match and a manual scan was conducted to decide on an appropriate cut-off threshold for deciding on what is a positive link. The strategy for setting the threshold was to minimise false positive links.

.

A thorough clerical review of the final pass (pass 8) was used to establish whether any more cases existed that could still be matched without the inclusion of false-positive results.

[e] http://www2.stats.govt.nz/domino/external/PASFull/pasfull.nsf/hotpalpha?OpenView&Start=500

[f] labour market statistics 2005, table 2.10, page 34 (Document is saved as D:\Datasets\StatNZ\labour market stats 2005 web.pdf file)

[g] source: http://www2.stats.govt.nz/domino/external/PASFull/pasfull.nsf/hotpalpha?OpenView&Start=500

[h] source: http://www.stats.govt.nz/products-and-services/table-builder/default.htm - then go to 'LEED statistics' then to 'LEED annual tables' then to 'main earnings source by industry')

2.2.8. Checking, understanding, and initial processing of the data

Linked ACC-NMDS data

The data were checked for consistency with the study definitions – see Appendix E, page 71.

Frequency distributions were calculated for age, gender, ethnic group, employment status, diagnosis, and external cause.

- Level 1 prioritised ethnic group was used (therefore counts within groups are additive, i.e., one person does not belong to more than one ethnic group). (Ministry of Health 2004) Ethnic group was allocated, by Public Health Intelligence, Ministry of Health (PHI), as follows. Māori ethnicity was allocated to a person according to whether or not any previous NZHIS record (as identified by their unique NHI identifiers) had been recorded as Māori, either sole or total, in any NMDS discharge record (1982-2006), cancer registry record (1948-2006), PHO data (2006), or on the Mortality Collections (1988-2003). For each person in the remaining records, the person was allocated to Pacific ethnicity if amongst the same data sets in any of their records they were recorded as Pacific ethnicity. The process was continued for each person captured on NZHIS data and through each ethnic group in priority ethnic group order.
- For diagnosis, the frequency table was based on the Barell diagnosis matrix[i]. (Barell, Aharonson-Daniel, et al. 2002) The full Barell matrix was constructed for linked data, based on NMDS principal diagnosis of the first admission record. From that, we identified 15 cells with the most frequent diagnoses, and all other diagnoses were grouped into a single group.
- For the tabulation of external cause, we used the first occurrence of the e-code on the NMDS first admission record, and used ICD-10 external cause of injury groupings based on the International Collaborative Effort on Injury Statistics (ICE) matrix[j].

ACC data alone

The data were checked for consistency with the study definitions and a summary of the number of cases selected for each part of the descriptive epidemiology of serious disabling work-related injury was produced – see Appendix E, page 799.

2.2.9. Statistical analysis

Analysis of linked data

In the main descriptive epidemiological analysis, we sought to emulate the analyses provided in the two Work-Related Fatal Injuries Studies (WRFIS) (Cryer and Fleming 1987) (Feyer, Langley et al. 2001) but with cases defined as serious threat-to-life non-fatal work-related traumatic injury rather than fatal work-related traumatic injury. For the analyses in these WRFIS studies, numbers and rates of traumatic injury were presented overall and

[i] http://www.cdc.gov/nchs/about/otheract/ice/barellmatrix.htm
[j] http://www.cdc.gov/nchs/about/otheract/ice/matrix10.htm

by age, gender, ethnicity, occupation and industry. Some of this information was presented by employment status – self-employed (with or without staff working for them) and employees.

A cross-sectional analysis was carried out using the linked NMDS-ACC serious threat-to-life work-related traumatic injury data, and this emulated the WRFIS studies analyses, as described above. Additionally, the numbers of cases were presented by diagnosis of injury, and by external cause of injury.

The following variables were included in this analysis: gender, diagnosis and external cause from NZHIS NMDS, and age, industry, occupation, and employment status from ACC data. (These latter data are captured from the part of the ACC45 (M45) form completed by the claimant.) The choice was based on our perception of which source of data had the most accurate data. For industry, occupation and employment status, this was captured only on the ACC data. Prioritised ethnicity was captured from NZHIS data based on the method described by Curtis and colleagues. (Curtis, Wright, et al. 2005) These data were provided by Public Health Intelligence (PHI, Ministry of Health)

- Ages were grouped to 10-year groups from 15 to 64, and everyone aged 65 and above were placed in a single group.

- Employment status was classified as employees and self-employed.

- Ethnic groups were based on level 1 of the ethnic standard classification, (Ministry of Health 2004) ie. European, Māori, Pacific Islands, Asian, Other specified, and Unspecified. (Note: for the presentation of rates, denominators were not available for “Asians” from the LFS, and so this group was collapsed into “Other ethnic groups”.)

- Industry groups and occupation groups were based on ANZSIC level 1 and NZSCO level 1 categories, respectively.

For diagnosis, groupings were based on the most frequent cells of the Barell matrix. Since there are no sensible denominators, it was impossible to calculate rates for diagnosis groups. External cause was presented using the ICE matrix.

Rates

Rates of traumatic injury claims were calculated for each level of the risk factor variables. For the calculations of these rates, the numerator was the number of work-related serious threat-to-life injuries present in the linked dataset for the particular level of the risk factor, and the denominator was the number of worker-years in that group. For the rates, each individual (whether full-time or part-time staff) was counted in the denominator equally. This approach to the analysis had previously been checked against rates calculated using hours worked. Although the absolute rates changed according to which denominator was used, the use of this more exact method made little difference to the relative rates – eg. the rate for males relative to that for females. (Cryer and Fleming 1987)

Comparison with the analysis of ACC data alone

Cross-sectional analyses of the relative frequencies expressed as percentages (rather than rates) of injuries were carried out using the ACC Entitlement Claims for serious non-fatal work-related traumatic injury, which again emulated the WRFIS analyses, as described above. (If relative frequencies are equivalent, then so are the rates.) The descriptive picture for serious threat-to-life work-related injury, using the linked data, was compared with the frequency distributions produced using ACC data on their own – for the various definitions of a case (ie. using a variety of time-off work thresholds to define serious disabling traumatic injury). This gives insight into, for example, how priorities might change when considering serious traumatic injury along the dimension of threat-to-life, compared with threat-of-disability.

Comparisons were made for each of the variables of interest – ie. by age group, gender, ethnicity (prioritised, level 1), occupation and industry group, and diagnosis. Diagnoses were grouped into the same 16 diagnoses groups identified in linked data analysis. For ACC data, because Read codes rather than ICD10 codes were recorded for most claims records, Read codes were mapped to ICD-10 codes. The diagnosis flagged in the ACC data with principal injury indicator or, in the absence of such an indicator, the first diagnosis recorded (i.e., injury sequence number 1) was used.

Although descriptive statistics across external cause codes (using ICE matrix) were presented for the linked data, it could not be done for this comparison with ACC data alone because of the major differences in the coding frames for external cause used by ACC and NMDS.

No inferential statistical methods were employed for this analysis due to the complex dependency that existed between the linked data and the ACC data.

Epidemiological description using ACC data alone

A cross-sectional analysis was carried out using the ACC earnings-related compensation data alone. This was presented for three earnings-related compensation thresholds: (a) wcdays>0, (b) wcdays>21, and (c) wcdays>175 days. This corresponds, approximately, to the following time off work thresholds: (a) over 1 week, (b) over 4 weeks, and (c) over six months. Fewer earnings-related compensation thresholds were chosen for this part of the analysis since it was observed that the epidemiological picture produced changes little for each small change in the threshold (eg. wcdays>7days compared with wcdays>14 days). The picture for short, medium and long earnings-related compensation thresholds could be presented without much loss of information.

The presentation also sought to emulate the WRFIS studies analyses, as described above. Additionally, the number of cases was presented by injury diagnosis. In the absence of an elegant method of presenting circumstances of injury using ACC's in-house Activity, Cause, Contact, and Agency codes (Jenny Mason, ACC, personal correspondence, 11 July 2007), a summary of the circumstances of injury was not presented as part of this epidemiological description.

Concordance of data in key fields

The concordance of data between NZHIS hospitalisations and ACC data, for common fields, were considered as follows. (Fields common to both the NMDS and ACC claims data include age, gender, ethnicity, diagnosis, external cause of injury, and activity.)

AGE: The value derived from ACC data (date of birth and accident date) was subtracted from that derived from the NMDS (date of birth and date of injury) and the resultant residuals described using descriptive statistics.

GENDER: The degree of concordance was shown as a 2x2 table and measured using the kappa statistic. (Altman, 1991) Values were interpreted using the method of Landis and Koch (1977). (Landis and Koch, 1977)

ETHNICITY: The degree of concordance between ACC ethnicity and prioritised ethnicity derived from NZHIS data was considered (Māori, Pacific peoples, other groups except NZ European, NZ European). Similar to gender, concordance was shown using a 5x5 table (ie. the above categories and "unknown") and measured using the kappa statistic.

DIAGNOSIS: ACC data on diagnosis was requested from ACC in the form it was initially recorded, as well as with Read and ICD-9 codes translated to ICD-10. The correspondence between the ICD-10 codes for primary diagnosis for the first admission record from NMDS and the derived ICD-10 principal diagnosis from ACC data was considered for the most frequently (top 15 from the serious threat-to-life traumatic injury data analysis) occurring diagnosis / body site combinations from the Barell matrix.

EXTERNAL CAUSE: External cause was recorded for ACC claims using ACC's in-house circumstances of injury codes ("Activity", "Cause" and "Contact"). The distribution of NMDS ICD-10 external cause codes, categorised using the ICE external cause of injury matrix, were cross-tabulated with each of the "Activity", "Cause", and "Contact" categories. Concordances for selected causes from the ICE matrix were described.

ACTIVITY: The ICD-10 activity code captured by the NMDS includes the option: "While working for income". If both ACC data on work-relatedness and the NMDS coding to this work activity rubric are accurate, then all of the NMDS activity codes amongst these ACC-defined work-related cases, would be coded to "While working for income". For the selected cases, NMDS activity codes were tabulated, and some discrepancies investigated.

For all the above, given (a) that previous work on the accuracy of the NMDS[k] (Langley, Stephenson et al. 2006) shows reasonable accuracy for external cause at the group level and for diagnosis at all levels, and (b) there is no published comparable study for ACC data, then we have considered any discrepancies would (in the first instance) suggest that there may be problems with the accuracy of ACC's data.

[k] Work to investigate the accuracy of ICD-10 coded diagnosis data for New Zealand public hospital discharges is ongoing.

3. Results

3.1. Linking the data

3.1.1. Linkage results

Figure 4 (Appendix C, page 62) displays the number of matched record-pairs after each pass of the record linkage process. 78% of the matched record-pairs were matched on the first pass; 99.6% on the fifth pass. There were 16,098 matched record-pairs which relates to 5.4% of the NZHIS hospital discharges and 2.1% of ACC work-related claim records.

For the subset of NMDS discharges identified as serious threat-to-life traumatic injury (ICISS<0.941) with the Activity field coded to "While working for income", the linkage rate to the ACC data was 70%. If this is broken down by external cause, a high proportion of falls cases linked (85%), and a low proportion of MVTC cases (13%). Under the IPRC Act, MVTC cases should be compensated from the Motor Vehicle account and so should not have been captured in the ACC data set used in this study. Without the MVTC cases, the linkage rate was 78% amongst those classified by NMDS as working for income.

3.2. Checking, understanding, and initial processing of the data

3.2.1. Linked ACC-NMDS data

(1) Checking for inclusion/exclusion criteria

There were 763,539 work-related injury ACC claims and 297,859 injury discharges from the NMDS during the periods that were considered[I]. Of these, 16,098 records were linked. The following information relates to these linked records.

Appendix E (page 71) gives a discussion of the data relative to the selection criteria for a case. Table 2 gives a summary of case selection for the epidemiological analysis using the linked data.

Table 2: Summary of case selection for linked data analysis

ACC work-related claims	763,539
NMDS discharges	297,859
Linked records	16,098
Linked records excluded due to diagnoses beyond the range (S00-T78)	218
Linked records excluded due to non-serious (ICISS>0.941)	14705
Linked records excluded due to fatality	32
Cases remaining in linked dataset for further analyses	1,143
People remaining in the linked dataset	1,140

[I] All discharges were first admissions. All claims were new claims. However, multiple admissions and multiple claims were possible for a person for separate traumatic injury events.

(2) Descriptive statistics of linked data

The following descriptive analysis includes the above mentioned 1143 claims from 1140 persons that were retained in the data set. The distribution of cases by age is shown in Figure 1, by ethnic group in Figure 2, and by external cause in Figure 3. A summary of the other distributions by gender and employment status is as follows:

- Gender: male 89%; female 11%.
- Employment Status: employees 75%; self-employed 25%.

Figure 1: Age distribution of cases in the linked dataset.

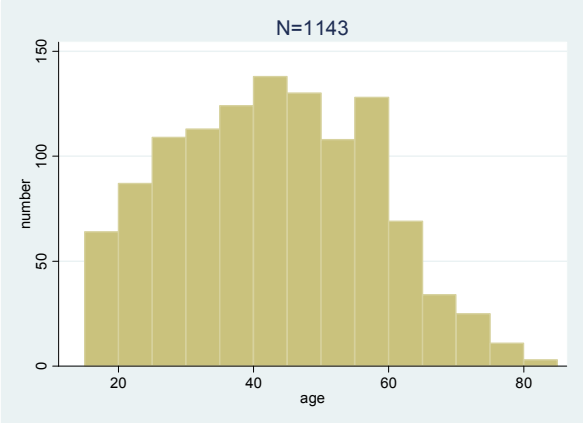
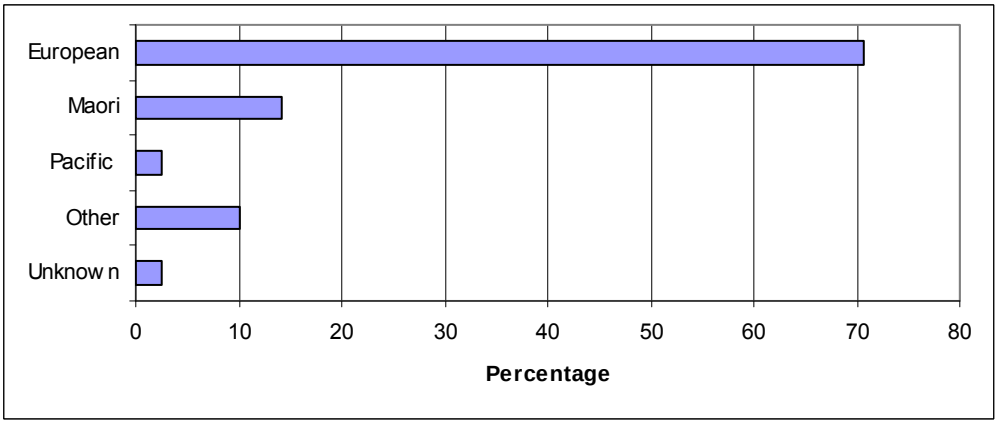


Figure 2: Distribution of cases in the linked dataset by ethnic group

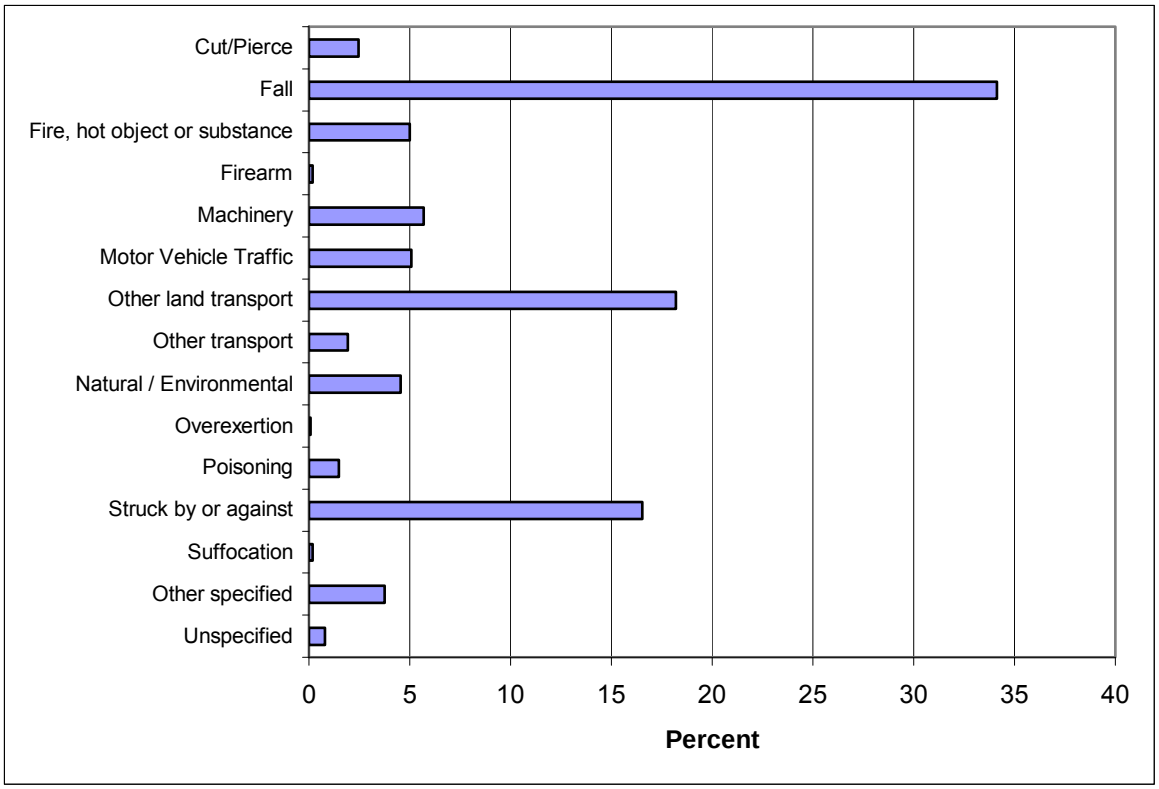


The distribution of serious threat-to-life work-related injury cases by diagnosis group, classified from the NMDS primary diagnosis from the first admission record, is shown in Table 3.

Table 3: The distribution of cases in the linked dataset by diagnosis group.

Diagnosis	Freq.	Percent
Traumatic brain injury/Fracture	105	9.19
Other head/Fracture	56	4.90
Vertebral column/Fracture	82	7.17
Thorax/Fracture	95	8.31
Pelvis and lower back/Fracture	59	5.16
Upper extremity/fracture	72	6.30
Hip/fracture	83	7.26
Other lower extremity/fracture	60	5.25
Traumatic brain injury/Internal Organ	137	11.99
Spinal cord/Internal organ	36	3.15
Thorax/Internal organ	75	6.56
Abdomen/Internal organ	49	4.29
Traumatic brain injury/Open wound	30	2.62
Head and neck, other/Burn	28	2.45
Upper extremity/Burn	31	2.71
other	145	12.69
Total	1,143	100.00

Figure 3: The distribution of cases in the linked dataset by mechanism / cause



The presence of MVTC injury cases is discussed in Appendix E, page 77.

3.2.2. ACC data alone

There were 763,539 ACC claims data records from 537,580 people supplied by ACC according to the specification in Appendix A. The summary of the exclusions and inclusions of cases for the analysis is presented in Table 4: Details of these exclusions are given in Appendix E, page 79.

Table 4: Summary of case selection for the analysis of ACC data

Summary of exclusions:

All claims provided		763,539
Excluded due to under age 15	33	
Excluded due to gradual process / disease	49,802	
Excluded due to fatal injuries	195	
Claims remaining		713,509

Excluded from different severity thresholds

Severity threshold	Claims excluded	Claims remaining
Claims remaining		713,509
Wcdays > 0	640,909	72,590
Wcdays > 7	11,318	61,272
Wcdays > 14	8,566	52,706
Wcdays > 21	5,937	46,769
Wcdays > 49	22,283	24,486
Wcdays > 84	9,420	15,066
Wcdays > 175	7,836	7,230

3.3. Epidemiology of serious threat-to-life work-related traumatic injury

Table 5 shows the numbers and rates of serious non-fatal work-related traumatic injury, where serious is defined in terms of threat-to-life (ICISS≤0.941). This includes the variables: age, gender, employment status, ethnic group, industry and occupation. Numbers and rates are shown by year, but also aggregated across the three years 2002-2004. The results show:

- That rates increase after age 54, particularly in the eldest age group (65-84)
- substantially higher rates for men compared with women
- higher rates for the self-employed compared with employees
- higher rates for Māori than European or Pacific peoples[m]
- highest rates within mining,
- also very high rates for the industry groups:
    - Agriculture, forestry, fishing
    - Electricity, gas, water
    - Construction
    - Transport, storage
- Very high rates for the occupational groups:
    - Agriculture and fishery workers
    - Plant and machinery operators, assemblers.
    - Elementary occupations (includes occupations such as cleaners, caretakers, couriers, hotel porters, refuse collectors, street cleaners, packers, railway shunters, labourers)

Table 6 shows the numbers of serious traumatic injury events within diagnosis category – shown in the form of the Barell matrix. The body sites where serious injuries occurred most frequently were: brain, thorax and upper extremity. The most frequently occurring types of serious traumatic injury were fractures, internal organ injuries and burns.

Table 7 shows the most frequently occurring diagnostic groups for the primary diagnosis, ie. the most frequently occurring nature and body site of injury combinations. These include traumatic brain injury (with or without fracture), spinal injury and vertebral column fracture, injury to the thorax (fracture and / or internal injury), fracture to the upper extremity (arm and shoulder), and hip fracture. Table 8 shows the ICE matrix groupings of external causes of injury for serious threat-to-life injuries.

[m] Note that in this and other tables in sections 3.3 to 3.5, the “Asian” ethnic has been amalgamated into the “Other ethnic groups” category. We used the LFS as the source of denominators for the ethnic group rates in the tables shown, and the ethnic group tabulations within these survey data presentations do not provide separate workforce numbers for “Asians”.

Table 5: Numbers and rates of serious non-fatal traumatic injury, where serious is defined in terms of threat-to-life (ICISS≤0.941)

		2002				2003				2004				All Years			
		injuries	worker-years in 100,000	Rate & CI		injuries	worker-years in 100,000	Rate & CI		injuries	worker-years in 100,000	Rate & CI		injuries	worker-years in 100,000	Rate & CI	
Age groups																	
	15-24	42	3.13	13.43	9.7 - 18.2	46	3.23	14.24	10.4 - 19.0	63	3.31	19.05	14.6 - 24.4	151	9.66	15.63	13.2 - 18.3
	25-34	78	3.96	19.71	15.6 - 24.6	74	3.98	18.59	14.6 - 23.3	70	4.14	16.91	13.2 - 21.4	222	12.08	18.38	16.0 - 21.0
	35-44	89	4.81	18.51	14.9 - 22.8	88	4.86	18.12	14.6 - 22.3	85	5.04	16.86	13.5 - 20.9	262	14.71	17.81	15.7 - 20.1
	45-54	80	4.19	19.09	15.1 - 23.8	77	4.29	17.94	14.1 - 22.4	81	4.49	18.03	14.3 - 22.4	238	12.98	18.34	16.1 - 20.8
	55-64	54	2.27	23.75	17.8 - 31.0	75	2.42	30.98	24.4 - 38.8	68	2.68	25.33	19.7 - 32.1	197	7.38	26.70	23.1 - 30.7
	65 - 84	25	0.41	61.12	39.6 - 90.2	24	0.43	55.75	35.7 - 82.9	24	0.51	47.36	30.4 - 70.5	73	1.35	54.22	42.5 - 68.2
	Total	368	18.77	19.61	17.7 - 21.7	384	19.21	19.99	18.0 - 22.1	391	20.17	19.38	17.5 - 21.4	1143	58.15	19.66	18.5 - 20.8
Gender																	
	Female	37	8.52	4.34	3.1 - 6.0	39	8.95	4.36	3.1 - 6.0	46	9.22	4.99	3.6 - 6.6	122	26.69	4.57	3.8 - 5.5
	Male	331	10.25	32.28	28.9 - 36.0	345	10.57	32.65	29.3 - 36.3	345	10.95	31.51	28.3 - 35.0	1021	31.77	32.14	30.2 - 34.2
	total	368	18.77	19.61	17.7 - 21.7	384	19.51	19.68	17.8 - 21.8	391	20.17	19.39	17.5 - 21.4	1143	58.45	19.56	18.4 - 20.7
Employment status																	
	employees	267	15.00	17.80	15.7 - 20.1	288	15.43	18.67	16.6 - 20.1	301	15.87	18.97	16.9 - 21.2	856	46.30	18.49	17.3 - 19.8
	self-employed	101	3.70	27.28	22.2 - 33.2	96	3.72	25.82	20.9 - 31.5	90	3.79	23.77	19.1 - 29.2	287	11.21	25.61	22.7 - 28.8
	total	368	18.70	19.67	17.7 - 21.8	384	19.15	20.06	18.1 - 22.2	391	19.66	19.89	18.0 - 22.0	1143	57.51	19.88	18.7 - 21.1
Ethnic group																	
	European	259	14.81	17.48	15.4 - 19.8	269	15.32	17.56	15.5 - 19.8	280	15.87	17.64	15.6 - 19.8	808	46.01	17.56	16.4 - 18.8
	Maori	51	1.80	28.35	21.1 - 37.3	62	1.87	33.20	25.5 - 42.5	49	1.80	27.18	20.1 - 35.9	162	5.47	29.62	25.2 - 34.6
	Pacific Islands	9	0.87	10.36	4.7 - 19.7	4	0.87	4.62	1.3 - 11.8	16	0.89	17.94	10.3 - 29.1	29	2.63	11.04	7.4 - 15.9
	Other specified	36	1.27	28.29	19.8 - 39.2	44	1.43	30.71	22.3 - 41.2	36	1.58	22.77	16.0 - 31.5	116	4.29	27.06	22.4 - 32.5
	unspecified	13	0.01	945.45	504.4 - 1611.3	5	0.02	202.02	65.6 - 470.8	10	0.02	459.77	220.7 - 843.9	28	0.06	464.73	309.0 - 671.0
	total	368	18.77	19.61	17.6 - 21.7	384	19.51	19.68	17.8 - 21.8	391	20.17	19.38	17.5 - 21.4	1143	58.45	19.55	18.4 - 20.7
Industry																	
A01 - A04	Agriculture,Forestry, Fishing	103	1.78	57.91	47.3 - 70.2	99	1.76	56.27	45.7 - 68.5	97	1.74	55.60	45.1 - 67.8	299	5.28	56.60	50.4 - 63.4
B11 - B15	Mining	2	0.04	52.58	6.4 - 189.8	4	0.04	95.31	26.0 - 243.8	6	0.04	139.57	51.2 - 303.5	12	0.12	97.56	50.4 - 170.4
C21 - C29	Manufacturing	45	2.76	16.29	11.9 - 21.8	58	2.81	20.66	15.7 - 26.7	54	2.84	19.03	14.3 - 24.8	157	8.41	18.67	15.9 - 21.8
D36 - D37	Electricity,Gas,Water	2	0.06	31.82	3.9 - 114.9	6	0.06	101.99	37.4 - 221.9	3	0.06	50.38	10.4 - 147.2	11	0.18	60.70	30.3 - 108.6
E41 - E42	Construction	61	1.24	49.05	37.5 - 63.0	60	1.33	45.10	34.4 - 58.1	64	1.45	44.13	34.0 - 56.4	185	4.02	45.97	39.6 - 53.1
F45 - F47	Wholesale	12	1.16	10.36	5.3 - 18.1	9	1.19	7.53	3.4 - 14.3	11	1.23	8.95	4.5 - 16.0	32	3.58	8.93	6.1 - 12.6
G51 - G53	Retail, Services	19	2.32	8.20	4.9 - 12.8	25	2.41	10.38	6.7 - 15.3	19	2.51	7.58	4.6 - 11.8	63	7.23	8.71	6.7 - 11.1
H57	Accommodation, Cafe, Restaurants	7	1.00	7.01	2.8 - 14.4	7	1.06	6.60	2.6 - 13.6	8	1.11	7.19	3.1 - 14.2	22	3.17	6.94	4.4 - 10.5
I61 - I67	Transport, Storage	30	0.75	39.97	27.0 - 57.0	28	0.78	36.02	23.9 - 52.0	35	0.81	43.30	30.2 - 60.2	93	2.34	39.81	32.1 - 48.8
J71	Communication Service	5	0.27	18.43	6.0 - 43.0	1	0.26	3.82	0.0 - 21.3	0	0.26	0.00	-	6	0.79	7.58	2.8 - 16.5
K73 - K75	Finance,Insurance	1	0.47	2.13	0.0 - 11.8	1	0.49	2.03	0.0 - 11.3	2	0.51	3.94	0.0 - 14.2	4	1.47	2.72	0.0 - 7.0
L77 - L78	Property, Business service	17	2.71	6.28	3.6 - 10.1	13	2.83	4.59	2.4 - 7.8	23	2.99	7.70	4.9 - 11.6	53	8.53	6.22	4.7 - 8.1
M81 - M82	Govt administration,Defence	3	0.60	5.00	1.0 - 14.6	3	0.61	4.93	1.0 - 14.4	4	0.63	6.38	1.7 - 16.3	10	1.84	5.45	2.6 - 10.0
N84	Education	3	1.43	2.10	0.0 - 6.1	7	1.52	4.61	1.8 - 9.5	3	1.59	1.89	0.0 - 5.5	13	4.54	2.86	1.5 - 4.9
O86 - O87	Health, Community service	7	1.55	4.52	1.8 - 9.3	2	1.61	1.24	0.0 - 4.5	6	1.66	3.62	1.3 - 7.9	15	4.82	3.12	1.7 - 5.1
P91 - P93	Cultural,Recreational	15	0.48	31.32	17.5 - 51.6	12	0.51	23.40	12.1 - 40.9	15	0.54	27.96	15.6 - 46.1	42	1.53	27.49	19.8 - 37.1
Q95 - Q97	Personal & Other services	5	0.63	7.91	2.6 - 18.5	12	0.66	18.27	9.4 - 31.9	10	0.69	14.48	6.9 - 26.6	27	1.98	13.64	9.0 - 19.8
R98	Not elsewhere classified	0				0				0				0			
	Missing	31	0.21	148.00	100.6 - 210.0	37	0.21	174.72	123.0 - 240.7	31	0.22	143.24	97.3 - 203.3	99	0.64	155.26	126.2 - 190.0
	Total	368	19.46	18.91	17.0 - 20.9	384	20.14	19.06	17.2 - 21.1	391	20.86	18.74	16.9 - 20.7	1143	60.46	18.90	17.8 - 20.0
Occupation																	
1000 - 1229	Legislators, Administrators, Managers	21	2.50	8.42	5.2 - 12.9	16	2.40	6.66	3.8 - 10.8	18	2.47	7.30	4.3 - 11.5	55	7.37	7.47	5.6 - 9.7
2000 - 2451	Professionals	18	2.58	6.97	4.1 - 11.0	23	2.81	8.17	43.4 - 66.1	18	2.89	6.23	3.7 - 9.8	59	8.29	7.12	5.4 - 9.2
3000 - 3381	Technicians & Associate professionals	19	2.35	8.10	4.9 - 12.6	13	2.10	6.19	3.3 - 10.6	23	2.17	10.61	6.7 - 15.9	55	6.61	8.32	6.3 - 10.7
4000 - 4222	Clerks	7	2.17	3.23	1.3 - 6.7	6	2.47	2.43	0.0 - 5.3	9	2.49	3.62	1.7 - 6.9	22	7.12	3.09	1.9 - 4.7
5000 - 5231	Service & Sales workers	18	2.85	6.32	3.8 - 10.0	20	2.96	6.75	4.1 - 10.4	10	3.18	3.15	1.5 - 5.8	48	8.99	5.34	3.9 - 7.1
6000 - 6144	Agriculture & Fishery workers	95	1.65	57.68	46.7 - 70.5	98	1.62	60.57	49.2 - 73.8	107	1.59	67.34	55.2 - 81.4	300	4.85	61.80	55.0 - 69.2
7000 - 7441	Trade workers	35	1.75	20.03	14.0 - 27.9	40	1.82	21.98	15.7 - 29.9	43	1.86	23.11	16.7 - 31.1	118	5.43	21.74	18.0 - 26.0
8000 - 8412	Plant & Machine operators, Assemblers	68	1.65	41.21	32.0 - 52.2	92	1.71	53.86	43.4 - 66.0	78	1.67	46.59	36.8 - 58.2	238	5.03	47.30	41.5 - 5.4
9000 - 9151	Elementary occupation	56	1.18	47.38	35.8 - 61.5	49	1.23	39.81	29.4 - 52.6	54	1.33	40.75	30.6 - 53.2	159	3.74	42.54	36.2 - 49.7
9700 - 9999	Unknown	31	0.04	738.10	502.0 - 1046.0	27	0.03	1000.00	660 - 1451.6	31	0.02	1347.83	917.6 - 1907.7	89	0.09	967.39	777.6 - 1189.3
	Total	368	18.71	19.67	17.7 - 21.9	384	19.15	20.05	18.1 - 22.2	391	19.66	19.89	18.0 - 22.0	1143	57.52	19.87	18.7 - 21.1
Number of people		368				382				390				1140			

Table 6: The numbers of serious threat-to-life injury events within primary diagnosis category – shown in the form of a Barrell matrix

Body region	Nature of injury																
	Fracture	Dislocation	Internal organ injuries	Open wound	Amputation	Blood vessel	Superficial & contusions	Crushing	Burn	Effects of foreign bodies entering orifice	Other effects of external causess	Poisoning	Toxic effects	Multiple injuries	Other specified	Unspecified	Total
Traumatic brain injury	105	0	137	30	0	0	0	0	0	0	0	0	0	0	0	3	275
Other head	56	0	0	2	1	0	10	0	11	0	0	0	0	0	1	1	82
Neck	0	0	0	4	0	0	4	0	0	0	0	0	0	0	0	1	9
Head and neck, other	0	0	0	0	0	0	0	0	28	0	0	0	0	0	0	0	28
Spinal cord	0	0	36	0	0	0	0	0	0	0	0	0	0	0	0	2	38
Vertebral column	82	5	0	0	0	0	0	0	0	0	0	0	0	0	1	0	88
Thorax	95	0	75	1	0	0	2	0	0	0	0	0	0	0	2	0	175
Abdomen	0	0	49	1	0	1	2	0	0	0	0	0	0	0	0	0	53
Pelvis and lower back	59	1	5	1	0	0	4	0	0	0	0	0	0	0	0	0	70
Abdomen, lower back & pelvis	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	2
Other trunk	0	0	0	0	0	0	1	0	11	0	0	0	0	0	1	0	13
Upper extremity	72	2	0	7	2	1	11	0	31	0	0	0	0	0	4	3	133
Hip	83	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	84
Other lower extremity	60	1	0	4	0	2	3	1	13	0	0	0	0	0	1	1	86
multiple body regions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
System wide	0	0	0	0	0	0	0	0	0	0	5	1	1	0	0	0	7
unspecified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	612	10	302	50	3	4	37	2	94	0	5	1	1	0	10	12	1,143

Table 7: The most frequently occurring diagnostic groups (Nature of, and body site of injury combinations) of the primary diagnosis

Diagnosis group	Freq.	Percent
Traumatic brain injury/Fracture	105	9.2
Other head/Fracture	56	4.9
Vertebral column/Fracture	82	7.2
Thorax/Fracture	95	8.3
Pelvis and lower back/Fracture	59	5.2
Upper extremity/Fracture	72	6.3
Hip/Fracture	83	7.3
Other lower extremity/Fracture	60	5.3
Traumatic brain injury/Internal Organ	137	12.0
Spinal cord/Internal organ	36	3.2
Thorax/Internal organ	75	6.6
Abdomen/Internal organ	49	4.3
Traumatic brain injury/Open wound	30	2.6
Head and neck, other/Burn	28	2.5
Upper extremity/Burn	31	2.7
Other	145	12.7
Total	1,143	100.0

Table 8: ICE matrix of external cause of injury for serious threat-to-life injuries.

	Manner/intent			
Mechanism/Cause	Assault	Other	Unintentional	Total
Cut/Pierce	6	0	22	28
Fall	0	0	390	390
Fire/Hot object or Substance	0	0	57	57
Firearm	2	0	0	2
Machinery	0	0	65	65
Motor Vehicle Traffic	0	0	39	39
Natural/Environmental	0	0	52	52
Other Land Transport	0	0	208	208
Other Specified	2	1	40	43
Other Transport	0	0	22	22
Overexertion	0	0	1	1
Pedal Cyclist, other	0	0	1	1
Pedestrian, other	0	0	18	18
Poisoning	0	0	17	17
Struck by or against	31	0	158	189
Suffocation	1	0	1	2
Unspecified	3	0	6	9
Total	45	1	1,097	1,143

3.4. ACC data alone compared to linked ACC-NMDS data

Table 9 shows the comparison of the distributions of traumatic injury events (percents) based on a case definition of duration of earnings-related compensation (ACC data) against a case definition of threat-to-life serious traumatic injury (linked NMDS-ACC data). It shows the distributions for age, gender, employment status, ethnic group, industry, occupation and diagnosis.

Age: The most frequently occurring categories for all distributions were the age groups of 35-44 and 45-54, although a lesser proportion of cases fell into these groups for threat-to-life serious traumatic injury than for the ACC data alone. A smaller proportion of cases aged 65+ experienced serious disabling traumatic injury compared with serious threat-to-life work-related traumatic injury.

Gender: In all cases, the frequency for men was much higher than for women; it was around 75% for ACC data, and around 90% for serious threat-to-life traumatic injury.

Employment status: The vast majority of incidents involved employees rather than self-employed persons; the proportion of employees being lower, however, for serious threat-to-life traumatic injury.

Ethnic Group: The distributions for each different case definition (columns in Table 9) were similar, although the proportion classified to ”Other specified” was less in the ACC data than for serious threat-to-life traumatic injury.

Industry: There were similarities in the distributions. Differences included:

- A higher proportion of “agriculture, forestry, fishing”-related for serious threat-to-life traumatic injury
- A lower proportion of “Manufacturing”-related for serious threat-to-life traumatic injury

Occupation: There were again similarities in the distributions. Differences included:

- a much higher proportion of serious threat-to-life injuries for “Agriculture and fishery workers”;
- a lower proportion for “Trade workers”
- a lower proportion for “Plant and Machinery operators, Assemblers”

Diagnosis: There were major differences in the types of diagnoses captured as serious threat-to-life traumatic injury, and serious disabling traumatic injury. This was true for all the diagnostic groups listed, with the exception of upper and lower extremity fracture (arm and leg), excluding hip fracture. (Note: this part of the table is based on the most frequently occurring diagnosis and body site of injury combinations for cases of serious threat-to-life work-related traumatic injury. See tables 12, 14 and 16 for the most frequently occurring diagnosis / body site combinations for serious disabling work-related traumatic injury.

Table 10 shows the numbers of all ACC claims, satisfying our definition of work-related traumatic injury (ie. without the application of an earnings-related compensation threshold), within diagnosis category – shown in the form of a Barell matrix. This shows quite different frequently occurring diagnosis groups compared with serious threat-to-life traumatic injury (Table 7). The most frequently occurring types of traumatic injury (other than “Other specified” and “Unspecified” diagnoses) were: open wound, superficial injury and contusions, and effects of foreign bodies entering an orifice. The most frequently occurring body sites (other than “Unspecified”) were: upper extremity, vertebral

column, and lower extremity other than hip. Excluding the unspecified cases, 6 diagnosis groups account for 70% of the claims. These are:

- Other specified vertebral column injury, which are dominated by:
    - dislocation, sprain and strain of joints and ligaments
        - at neck level
        - of thorax
        - of lumbar spine and pelvis
- Open wound to the arm / shoulder
- Other specified arm / shoulder injury, which are dominated by:
    - dislocation, sprain and strain of joints and ligaments
        - of shoulder girdle
        - of elbow
        - at wrist and hand level
    - injury of muscle and tendon at shoulder and upper arm level
- Other specified injury to the leg (excl. hip), which are dominated by:
    - dislocation, sprain and strain of joints and ligaments
        - at ankle and foot level
        - of knee
- Superficial injury / contusion to the arm / shoulder
- Superficial injury / contusion to the leg (excl. hip).

Table 9: Comparisons of the distributions (percentages) based on a case definition of time off work (ACC data) against a case definition of threat-to-life serious traumatic injury (linked NMDS-ACC data)

		ACC data								NMDS-ACC
		All work-related claims	wcdays>0	wcdays>7	wcdays>14	wcdays>21	wcdays>49	wcdays>84	wcdays>175	linked data. ICSIS≤0.941
	No. of cases:	713509	72590	61272	52706	46769	24486	15066	7230	1143
Age groups										
	15-24	18.7	16.3	15.4	14.6	14.0	11.2	9.5	7.5	13.2
	25-34	21.9	21.5	21.1	20.6	20.5	18.8	17.8	16.8	19.4
	35-44	24.8	26.2	26.4	26.5	26.7	27.0	27.3	28.2	22.9
	45-54	20.5	21.5	22.1	22.5	22.8	24.5	25.8	26.8	20.8
	55-64	11.5	12.6	13.2	13.7	14.0	16.2	17.2	18.1	17.2
	65-84	2.7	1.7	1.9	2.0	2.0	2.4	2.4	2.5	6.4
Gender										
	Female	24.5	22.8	23.0	23.3	23.7	23.7	24.0	24.1	10.7
	Male	75.5	77.2	77.0	76.7	76.3	76.3	76.0	75.9	89.3
Employment status										
	employees	81.7	85.9	85.1	84.6	84.8	82.0	81.2	79.8	74.9
	self-employed	18.3	14.1	14.9	15.4	15.2	18.0	18.8	20.2	25.1
Ethnic group										
	European	71.4	68.0	68.6	68.7	68.6	70.0	70.7	71.6	70.7
	Maori	12.5	15.8	15.4	15.3	15.2	14.8	14.6	14.2	14.2
	Pacific Islands	4.9	4.8	4.6	4.4	4.4	3.9	3.6	3.3	2.5
	Other Specified	6.3	5.8	5.6	5.5	5.4	5.6	5.6	5.5	10.1
	unspecified	4.9	5.6	5.8	6.1	6.3	5.7	5.5	5.4	2.4
Industry										
A01 - A04	Agriculture,Forestry, Fishing	11.5	15.7	16.4	16.8	16.6	19.1	19.6	19.7	26.2
B11 - B15	Mining	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.6	1.0
C21 - C29	Manufacturing	20.8	25.2	25.4	25.9	26.5	23.9	22.4	21.3	13.7
D36 - D37	Electricity,Gas,Water	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	1.0
E41 - E42	Construction	10.2	13.2	13.2	13.1	12.7	14.7	15.9	17.2	16.2
F45 - F47	Wholesale	3.4	3.5	3.4	3.3	3.2	3.5	3.4	3.7	2.8
G51 - G53	Retail, Services	8.1	7.6	7.6	7.5	7.5	7.3	7.6	7.9	5.5
H57	Accommodation, Cafe, Restaurants	2.7	2.8	2.6	2.5	2.4	2.6	2.6	2.8	1.9
I61 - I67	Transport, Storage	4.0	6.4	6.4	6.3	6.2	6.8	7.1	7.0	8.1
J71	Communication Service	0.9	1.2	1.3	1.5	1.6	1.2	1.1	1.0	0.5
K73 - K75	Finance,Insurance	0.4	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3
L77 - L78	Property, Business service	4.6	5.5	5.6	5.8	5.9	5.6	5.2	4.9	4.6
M81 - M82	Govt administration,Defence	1.9	0.8	0.9	0.9	0.9	0.7	0.7	0.6	0.9
N84	Education	3.1	1.6	1.5	1.5	1.4	1.6	1.6	1.6	1.1
O86 - O87	Health, Community service	4.5	5.9	6.0	6.1	6.2	6.3	6.4	6.2	1.3
P91 - P93	Cultural,Recreational	2.5	2.4	2.5	2.6	2.7	2.8	2.7	2.4	3.7
Q95 - Q97	Personal & Other services	2.8	3.1	3.4	3.6	3.8	2.6	2.4	2.3	2.4
	Missing	17.7	4.0	2.5	1.4	1.0	0.4	0.1	0.1	8.7
Occupation										
1000 - 1229	Legislators, Administrators, Managers	6.1	3.0	3.1	3.1	3.2	3.5	3.7	4.1	4.8
2000 - 2451	Professionals	7.7	4.9	4.8	4.7	4.7	4.8	4.9	4.5	5.2
3000 - 3381	Technicians & Associate professionals	6.1	4.5	4.7	4.9	5.1	4.8	4.8	4.4	4.8
4000 - 4222	Clerks	3.3	3.4	3.4	3.6	3.7	3.4	3.1	2.9	1.9
5000 - 5231	Service & Sales workers	10.5	10.1	10.0	10.2	10.3	8.7	8.6	8.7	4.2
6000 - 6144	Agriculture & Fishery workers	14.8	16.3	16.6	16.6	16.3	18.6	19.0	19.4	26.2
7000 - 7441	Trade workers	14.8	14.3	14.1	13.8	13.4	14.2	14.4	14.9	10.3
8000 - 8412	Plant & Machine operators, Assemblers	17.6	23.4	23.5	23.8	24.2	23.5	23.4	23.4	20.8
9000 - 9151	Elementary occupation	13.2	16.4	16.2	16.0	15.9	15.7	15.4	15.2	13.9
9700 - 9999	Unknown	5.9	3.7	3.5	3.4	3.3	2.9	2.6	2.4	7.8
Diagnosis Groups										
	Traumatic brain injury/Fracture	0.1	0.2	0.2	0.2	0.2	0.2	0.3	0.4	9.2
	Other head/Fracture	0.8	0.1	0.1	0.1	0.1	0.0	0.0	0.0	4.9
	Vertebral column/Fracture	0.1	0.6	0.7	0.7	0.8	1.0	1.3	1.6	7.2
	Thorax/Fracture	0.5	1.4	1.4	1.3	1.2	0.9	0.6	0.5	8.3
	Pelvis and lower back/Fracture	0.0	0.1	0.1	0.1	0.2	0.2	0.3	0.3	5.2
	Upper extremity/fracture	1.7	7.6	8.3	8.8	9.0	9.0	7.7	6.6	6.3
	Hip/fracture	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	7.3
	Other lower extremity/fracture	1.0	4.9	5.4	5.8	6.2	7.7	7.8	7.0	5.2
	Traumatic brain injury/Internal Organ	0.5	0.7	0.8	0.8	0.8	1.0	1.2	1.6	12.0
	Spinal cord/Internal organ	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	3.1
	Thorax/Internal organ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.6
	Abdomen/Internal organ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3
	Traumatic brain injury/Open wound	2.1	0.6	0.6	0.5	0.5	0.5	0.5	0.6	2.6
	Head and neck, other/Burn	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.0	2.4
	Upper extremity/Burn	1.1	0.7	0.6	0.4	0.4	0.2	0.1	0.2	2.7
	other	91.8	82.8	81.7	80.8	80.4	78.9	79.9	80.8	12.7

The body of the table includes percentages – with the exception of the row labeled “Number of cases”.

Table from Excel spreadsheet: 6 June 2007

Table 10: Barrell diagnosis matrix for all eligible ACC claims.

	Fracture	Dislocation	Internal organ injuries	Open wound	Amputation	Blood vessel	Superficial & contusions	Crushing	Burn	Effects of foreign bodies entering orifice	Other effects of external causes	Poisoning	Toxic effects	Multiple injuries	Other specified	Unspecified	Not Applicable	Total
Traumatic brain injury	681	0	3,759	15,099	0	0	0	17	0	0	0	0	0	0	7	109	0	19,672
Other head	5,378	26	0	192	0	0	19,076	0	2,873	44,005	0	0	0	0	109	40	0	71,699
Neck	42	37	0	47	0	3	46	0	0	72	0	0	0	0	170	3	0	420
Head and neck, other	0	0	0	0	0	0	0	0	1,543	0	0	0	0	0	0	0	0	1,543
Spinal cord	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	1	0	26
Vertebral column	806	28	30	0	0	0	0	0	0	0	0	0	0	0	163,870	0	0	164,734
Thorax	3,407	16	48	382	0	27	5,919	0	2	1	0	0	0	0	5,471	12	0	15,285
Abdomen	0	0	32	47	0	2	244	0	0	2	0	0	0	0	0	0	0	327
Pelvis and lower back	144	39	21	87	0	0	738	13	0	1	0	0	0	0	0	0	0	1,043
Abdomen, lower back & pelvis	2	0	0	3	0	0	4,243	8	0	0	1	0	0	60	233	93	0	4,643
Other trunk	0	0	0	2	0	0	1,070	16	545	46	0	0	0	1,129	2	1	0	2,811
Upper extremity	12,418	2,543	0	97,321	1,358	25	34,147	7,533	8,123	0	10	0	0	6,317	68,965	58	0	238,818
Hip	36	114	0	377	0	0	59	1	0	0	0	0	0	0	7,955	0	0	8,542
Other lower extremity	7,204	1,009	0	19,733	31	15	30,282	1,604	1,938	0	0	0	0	4,310	51,548	172	0	117,846
Multiple body regions	66	1	0	95	0	0	35	7	13	0	0	0	0	1	1	1	0	220
System wide	0	0	0	0	0	0	0	0	0	0	457	1	679	0	73	0	0	1,210
Unspecified	119	0	0	32	0	0	2,206	0	91	0	4	0	0	128	737	58,982	0	62,299
.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,371	2,371
Total	30,303	3,813	3,915	133,417	1,389	72	98,065	9,199	15,128	44,127	472	1	679	11,945	299,141	59,472	2,371	713,509

Table from Excel spreadsheet: 6 June 2007

3.5. Epidemiology of serious disabling work-related traumatic injury

The traumatic injury rates calculated from ACC data are considerably larger than those calculated from linked data even at the highest disabling severity threshold level. This underlines that "serious" traumatic injury as defined from ACC data (as measured by time-off-work) is not comparable to serious as derived from NMDS data (as measured by threat-to-life).

3.5.1. ACC earnings-related entitlement claims (wcdays>0)

Table 11 shows the numbers and rates of serious non-fatal traumatic injury, where the case definition for serious is the payment of ACC earnings-related compensation (ie. wcdays>0). This represents, approximately, cases who have time off work for traumatic injury of over 1 week. This table includes the variables: age, gender, employment status, ethnic group, industry and occupation. Numbers and rates are shown by year, but also aggregated across the three years 2002-2004. The results show:

- similar rates for all age groups excluding people aged 65-84 - for which group, the rates were lower;
- high rates for men compared with women;
- lower rates for the self-employed compared with employees
- higher rates for Māori than all other ethnic groups
- high rates for the industry groups:
    - Agriculture, forestry, fishing
    - Mining
    - Manufacturing
    - Electricity, gas, water
    - Construction
    - Transport, storage
- high rates for the occupational groups:
    - Agriculture and fishery workers
    - Trade workers
    - Plant and machinery operators, assemblers
    - Elementary occupations.

Table 12 shows the numbers of serious traumatic injury events within diagnosis category using a case definition for serious of wcdays>0 – shown in the form of a Barell matrix.

Table 11: Numbers and rates of serious non-fatal traumatic injury, where the case definition for serious is the payment of ACC earnings-related entitlement claim (wcdays>0).

		2002			2003			2004			All Years		
		injuries	worker-years in 100,000	Rate	injuries	worker-years in 100,000	Rate	injuries	worker-years in 100,000	Rate	injuries	worker-years in 100,000	Rate
Age groups													
	15-24	3,675	3.13	1175.44	4,015	3.23	1242.94	4,172	3.31	1261.66	11,862	9.66	1227.51
	25-34	5,100	3.96	1288.61	5,278	3.98	1325.88	5,235	4.14	1264.80	15,613	12.08	1292.73
	35-44	6,161	4.81	1281.07	6,423	4.86	1322.76	6,464	5.04	1282.09	19,048	14.71	1295.19
	45-54	4,859	4.19	1159.18	5,288	4.29	1231.70	5,481	4.49	1220.03	15,628	12.98	1204.24
	55-64	2,716	2.27	1194.50	3,096	2.42	1278.81	3,358	2.68	1250.88	9,170	7.38	1242.67
	65 -84	358	0.41	875.31	428	0.43	994.19	483	0.51	953.13	1,269	1.35	942.62
	Total	22,869	18.77	1218.51	24,528	19.21	1276.74	25,193	20.17	1248.96	72,590	58.15	1248.31
Gender													
	Female	5,226	8.52	613.56	5,673	8.95	634.21	5,678	9.22	615.67	16,577	26.69	621.21
	Male	17,643	10.25	1720.85	18,855	10.57	1784.67	19,515	10.95	1782.60	56,013	31.77	1763.36
	Total	22,869	18.77	1218.38	24,528	19.51	1257.20	25,193	20.17	1249.03	72,590	58.45	1241.92
Employment status													
	Employees	19581	15.00	1305.23	21042	15.43	1363.88	21727	15.87	1369.15	62350	46.30	1346.68
	Self-employed	3288	3.70	888.17	3486	3.72	937.60	3466	3.79	915.48	10240	11.21	913.80
	Total	22869	18.70	1222.68	24528	19.15	1281.10	25193	19.66	1281.76	72590	57.51	1262.33
Ethnic group													
	European (inc NZ)	15770	14.81	1064.59	16609	15.32	1084.05	16981	15.87	1069.72	49360	46.01	1072.84
	Maori	3606	1.80	2004.17	3942	1.87	2110.56	3889	1.80	2157.56	11437	5.47	2091.05
	Pacific Islands	1004	0.87	1155.35	1189	0.87	1373.77	1295	0.89	1452.20	3488	2.63	1328.13
	Other Specified	1246	1.27	979.17	1379	1.43	962.48	1599	1.58	1011.55	4224	4.29	985.53
	unspecified	1243	0.01	90400.00	1409	0.02	56929.29	1429	0.02	65701.15	4081	0.06	67734.44
	Total	22869	18.77	1218.53	24528	19.51	1257.07	25193	20.17	1248.97	72590	58.45	1241.90
Industry													
A01 - A04	Agriculture,Forestry, Fishing	3,800	1.78	2136.54	3,922	1.76	2229.19	3,710	1.74	2126.65	11432	5.28	2164.13
B11 - B15	Mining	107	0.04	2812.83	97	0.04	2311.17	111	0.04	2582.00	315	0.12	2560.98
C21 - C29	Manufacturing	5,749	2.76	2081.34	6,152	2.81	2191.59	6,370	2.84	2244.32	18271	8.41	2173.17
D36 - D37	Electricity,Gas,Water	128	0.06	2036.60	134	0.06	2277.75	117	0.06	1964.74	379	0.18	2091.27
E41 - E42	Construction	2,884	1.24	2318.98	3,149	1.33	2366.94	3,553	1.45	2449.85	9586	4.02	2382.00
F45 - F47	Wholesale	758	1.16	654.59	871	1.19	728.89	900	1.23	732.42	2529	3.58	706.08
G51 - G53	Retail, Services	1,678	2.32	723.97	1,938	2.41	804.38	1,894	2.51	755.86	5510	7.23	761.81
H57	Accommodation, Cafe, Restaurants	655	1.00	655.56	743	1.06	700.99	650	1.11	584.56	2048	3.17	645.85
I61 - I67	Transport, Storage	1,459	0.75	1943.86	1,594	0.78	2050.45	1,581	0.81	1955.91	4634	2.34	1983.50
J71	Communication Service	276	0.27	1017.14	268	0.26	1023.88	302	0.26	1168.37	846	0.79	1068.75
K73 - K75	Finance,Insurance	37	0.47	78.64	40	0.49	81.30	57	0.51	112.16	134	1.47	91.11
L77 - L78	Property, Business service	1,161	2.71	428.92	1,370	2.83	483.89	1,432	2.99	479.26	3963	8.53	464.82
M81 - M82	Govt administration,Defence	229	0.60	381.57	193	0.61	317.04	177	0.63	282.42	599	1.84	326.32
N84	Education	391	1.43	273.10	411	1.52	270.42	342	1.59	215.53	1144	4.54	252.07
O86 - O87	Health, Community service	1,408	1.55	909.03	1,453	1.61	903.34	1,423	1.66	858.44	4284	4.82	889.71
P91 - P93	Cultural,Recreational	544	0.48	1135.89	592	0.51	1154.60	592	0.54	1103.59	1728	1.53	1130.83
Q95 - Q97	Personal & Other services	774	0.63	1224.26	671	0.66	1021.45	827	0.69	1197.30	2272	1.98	1147.56
	Missing	831	0.21	3967.34	930	0.21	4391.56	1,155	0.22	5336.85	2916	0.64	4573.04
	Total	22869	19.46	1175.13	24528	20.14	1217.71	25193	20.86	1207.73	72590	60.46	1200.56
Occupation													
1000 - 1229	Legislators, Administrators, Managers	834	2.50	334.27	642	2.40	267.17	688	2.47	278.88	2,164	7.37	293.82
2000 - 2451	Professionals	1,200	2.58	464.58	1,240	2.81	440.65	1,087	2.89	376.12	3,527	8.29	425.61
3000 - 3381	Technicians & Associate professionals	979	2.35	417.31	1,152	2.10	548.83	1,161	2.17	535.52	3,292	6.61	497.81
4000 - 4222	Clerks	677	2.17	312.70	824	2.47	333.87	931	2.49	374.20	2,432	7.12	341.53
5000 - 5231	Service & Sales workers	2,339	2.85	821.28	2,511	2.96	847.74	2,467	3.18	777.01	7,317	8.99	814.36
6000 - 6144	Agriculture & Fishery workers	3,741	1.65	2271.40	4,070	1.62	2515.45	4,020	1.59	2529.89	11,831	4.85	2437.37
7000 - 7441	Trade workers	2,951	1.75	1689.18	3,500	1.82	1923.08	3,933	1.86	2113.38	10,384	5.43	1913.04
8000 - 8412	Plant & Machine operators, Assemblers	5,091	1.65	3085.45	5,796	1.71	3393.44	6,121	1.67	3656.51	17,008	5.03	3379.97
9000 - 9151	Elementary occupation	3,899	1.18	3298.65	3,892	1.23	3161.66	4,149	1.33	3131.32	11,940	3.74	3194.22
9700 - 9999	Unknown	1,158	0.04	27571.43	901	0.03	33370.37	636	0.02	27652.17	2,695	0.09	29293.48
	Total	22,869	18.71	1222.61	24,528	19.15	1280.84	25,193	19.66	1281.43	72,590	57.52	1262.11

From Excel spreadsheet: 28 June 2007

Table 12: Barrell diagnosis matrix for the number of eligible ACC earnings-related claims (wcdays>0).

	Fracture	Dislocation	Internal organ injuries	Open wound	Amputation	Blood vessel	Superficial & contusions	Crushing	Burn	Effects of foreign bodies entering orifice	Other effects of external causes	Poisoning	Toxic effects	Multiple injuries	Other specified	Unspecified	Not Applicable	Total
Traumatic brain injury	147	0	535	431	0	0	0	1	0	0	0	0	0	0	1	9	0	1,124
Other head	54	4	0	31	0	0	544	0	54	166	0	0	0	0	2	4	0	859
Neck	34	20	0	6	0	1	1	0	0	0	0	0	0	0	25	0	0	87
Head and neck, other	0	0	0	0	0	0	0	0	112	0	0	0	0	0	0	0	0	112
Spinal cord	0	0	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22
Vertebral column	439	13	3	0	0	0	0	0	0	0	0	0	0	0	13,578	0	0	14,033
Thorax	1,015	1	15	35	0	1	536	0	0	0	0	0	0	0	401	0	0	2,004
Abdomen	0	0	16	5	0	0	23	0	0	1	0	0	0	0	0	0	0	45
Pelvis and lower back	77	16	5	21	0	0	66	0	0	0	0	0	0	0	0	0	0	185
Abdomen, lower back & pelvis	0	0	0	0	0	0	486	1	0	0	1	0	0	6	22	7	0	523
Other trunk	0	0	0	0	0	0	105	2	51	1	0	0	0	127	0	1	0	287
Upper extremity	5,520	889	0	7,294	890	3	1,930	708	510	0	3	0	0	641	9,068	10	0	27,466
Hip	30	36	0	32	0	0	5	0	0	0	0	0	0	0	657	0	0	760
Other lower extremity	3,573	394	0	1,473	18	4	2,102	187	322	0	0	0	0	421	6,635	18	0	15,147
Multiple body regions	18	0	0	4	0	0	2	2	4	0	0	0	0	0	0	0	0	30
System wide	0	0	0	0	0	0	0	0	0	0	29	0	28	0	5	0	0	62
unspecified	22	0	0	5	0	0	75	0	14	0	1	0	0	30	88	9,575	0	9,810
.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34	34
Total	10,929	1,373	596	9,337	908	9	5,875	901	1,067	168	34	0	28	1,225	30,482	9,624	34	72,590

From Excel spreadsheet: 28 June 2007

3.5.2. ACC earnings-related compensation for over 21 days (wcdays>21)

Table 13 shows the numbers and rates of serious non-fatal traumatic injury, where the case definition for serious is the payment of ACC earnings-related compensation for over 21 days (ie. wcdays>21). This represents cases with a time off work and / or changed / reduced duties of over 4 weeks. This table includes the variables: age, gender, employment status, ethnic group, industry and occupation. Numbers and rates are shown by year, but also aggregated across the three years 2002-2004. The results show:

- highest rate for age group 55-64, with the lowest rates rate for age groups 15-24 and 65-84;
- high rates for men compared with women;
- slightly lower rates for the self-employed compared with employees
- higher rates for Māori than for all other ethnic groups
- high rates for the industry groups:
    - Agriculture, forestry, fishing
    - Mining
    - Manufacturing
    - Electricity, gas, water
    - Construction
    - Transport, storage
- high rates for the occupational groups:
    - Agriculture and fishery workers
    - Trade workers
    - Plant and machinery operators, assemblers
    - Elementary occupations.

Table 14 shows the numbers of serious traumatic injury events within diagnosis category using a case definition for serious of wcdays>21 – shown in the form of a Barell matrix.

Table 13: Numbers and rates of serious non-fatal traumatic injury, where the case definition for serious is the payment of ACC earnings-related compensation for over 21 days

		2002			2003			2004			All Years		
		injuries	worker-years in 100,000	Rate	injuries	worker-years in 100,000	Rate	injuries	worker-years in 100,000	Rate	injuries	worker-years in 100,000	Rate
Age groups													
	15-24	2,032	3.13	649.93	2,206	3.23	682.92	2,320	3.31	701.60	6,558	9.66	678.64
	25-34	3,135	3.96	792.12	3,192	3.98	801.86	3,245	4.14	784.01	9,572	12.08	792.55
	35-44	4,014	4.81	834.64	4,208	4.86	866.60	4,276	5.04	848.12	12,498	14.71	849.81
	45-54	3,319	4.19	791.79	3,623	4.29	843.88	3,739	4.49	832.28	10,681	12.98	823.04
	55-64	1,941	2.27	853.66	2,164	2.42	893.85	2,424	2.68	902.96	6,529	7.38	884.78
	65 -84	261	0.41	638.14	310	0.43	720.09	360	0.51	710.41	931	1.35	691.55
	Total	14,702	18.77	783.35	15,703	19.21	817.38	16,364	20.17	811.25	46,769	58.15	804.27
Gender													
	Female	3458	8.52	405.99	3784	8.95	423.03	3846	9.22	417.02	11088	26.69	415.51
	Male	11244	10.25	1096.71	11919	10.57	1128.16	12518	10.95	1143.46	35681	31.77	1123.28
	total	14702	18.77	783.27	15703	19.51	804.87	16364	20.17	811.30	46769	58.45	800.15
Employment status													
	employees	12402	15.00	826.69	13294	15.43	861.68	13972	15.87	880.46	39668	46.30	856.78
	self-employed	2300	3.70	621.29	2409	3.72	647.93	2392	3.79	631.80	7101	11.21	633.68
	total	14702	18.70	786.04	15703	19.15	820.17	16364	19.66	832.56	46769	57.51	813.30
Ethnic group													
	European (inc NZ)	10246	14.81	691.68	10682	15.32	697.20	11150	15.87	702.40	32078	46.01	697.22
	Maori	2187	1.80	1215.51	2500	1.87	1338.51	2432	1.80	1349.24	7119	5.47	1301.58
	Pacific Islands	606	0.87	697.35	686	0.87	792.61	768	0.89	861.23	2060	2.63	784.39
	Other Specified	767	1.27	602.75	805	1.43	561.86	972	1.58	614.90	2544	4.29	593.56
	unspecified	896	0.01		1030	0.02		1042	0.02		2968	0.06	
	total	14702	18.77	783.37	15703	19.51	804.79	16364	20.17	811.26	46769	58.45	800.14
Industry													
A01 - A04	Agriculture,Forestry, Fishing	2,532	1.78	1423.61	2,664	1.76	1514.17	2,549	1.74	1461.14	7745	5.28	1466.16
B11 - B15	Mining	70	0.04	1840.17	69	0.04	1644.03	82	0.04	1907.42	221	0.12	1796.75
C21 - C29	Manufacturing	3,823	2.76	1384.06	4,180	2.81	1489.08	4,406	2.84	1552.35	12409	8.41	1475.94
D36 - D37	Electricity,Gas,Water	81	0.06	1288.78	77	0.06	1308.86	67	0.06	1125.10	225	0.18	1241.52
E41 - E42	Construction	1,807	1.24	1452.98	1,938	1.33	1456.69	2,204	1.45	1519.70	5949	4.02	1478.25
F45 - F47	Wholesale	451	1.16	389.47	510	1.19	426.79	548	1.23	445.96	1509	3.58	421.30
G51 - G53	Retail, Services	1,109	2.32	478.48	1,204	2.41	499.73	1,196	2.51	477.30	3509	7.23	485.15
H57	Accommodation, Cafe, Restaurants	349	1.00	349.30	402	1.06	379.27	365	1.11	328.25	1116	3.17	351.94
I61 - I67	Transport, Storage	923	0.75	1229.73	973	0.78	1251.62	1,020	0.81	1261.88	2916	2.34	1248.14
J71	Communication Service	243	0.27	895.52	236	0.26	901.62	269	0.26	1040.70	748	0.79	944.95
K73 - K75	Finance,Insurance	29	0.47	61.63	30	0.49	60.97	43	0.51	84.61	102	1.47	69.35
L77 - L78	Property, Business service	796	2.71	294.08	955	2.83	337.31	998	2.99	334.01	2749	8.53	322.43
M81 - M82	Govt administration,Defence	172	0.60	286.60	138	0.61	226.69	121	0.63	193.07	431	1.84	234.80
N84	Education	241	1.43	168.33	241	1.52	158.57	191	1.59	120.37	673	4.54	148.29
O86 - O87	Health, Community service	925	1.55	597.20	963	1.61	598.70	1,020	1.66	615.33	2908	4.82	603.94
P91 - P93	Cultural,Recreational	394	0.48	822.68	446	0.51	869.85	438	0.54	816.51	1278	1.53	836.34
Q95 - Q97	Personal & Other services	641	0.63	1013.89	505	0.66	768.75	652	0.69	943.94	1798	1.98	908.15
	Missing	116	0.21		172	0.21		195	0.22		483	0.64	
	Total	14702	19.46	755.47	15703	20.14	779.59	16364	20.86	784.48	46769	60.46	773.51
Occupation													
1000 - 1229	Legislators, Administrators, Managers	548	2.50	219.64	447	2.40	186.02	493	2.47	199.84	1488	7.37	202.04
2000 - 2451	Professionals	729	2.58	282.23	788	2.81	280.03	679	2.89	234.95	2196	8.29	264.99
3000 - 3381	Technicians & Associate professionals	688	2.35	293.27	833	2.10	396.86	843	2.17	388.84	2364	6.61	357.48
4000 - 4222	Clerks	495	2.17	228.64	591	2.47	239.47	665	2.49	267.28	1751	7.12	245.89
5000 - 5231	Service & Sales workers	1,619	2.85	568.47	1,579	2.96	533.09	1,625	3.18	511.81	4823	8.99	536.78
6000 - 6144	Agriculture & Fishery workers	2,417	1.65	1467.52	2,642	1.62	1632.88	2,556	1.59	1608.56	7615	4.85	1568.81
7000 - 7441	Trade workers	1,849	1.75	1058.39	2,055	1.82	1129.12	2,357	1.86	1266.52	6261	5.43	1153.46
8000 - 8412	Plant & Machine operators, Assemblers	3,329	1.65	2017.58	3,837	1.71	2246.49	4,135	1.67	2470.13	11301	5.03	2245.83
9000 - 9151	Elementary occupation	2,451	1.18	2073.60	2,426	1.23	1970.76	2,573	1.33	1941.89	7450	3.74	1993.04
9700 - 9999	Unknown	577	0.04	13738.10	505	0.03	18703.70	438	0.02	19043.48	1520	0.09	16521.74
	Total	14702	18.71	785.99	15703	19.15	820.00	16364	19.66	832.35	46769	57.52	813.16

From Excel spreadsheet: 6 June 2007

Table 14: Barrell diagnosis matrix for the number of eligible ACC earnings-related claims of over 21 days duration (wcdays>21).

	Fracture	Dislocation	Internal organ injuries	Open wound	Amputation	Blood vessel	Superficial & contusions	Crushing	Burn	Effects of foreign bodies entering orifice	Other effects of external causes	Poisoning	Toxic effects	Multiple injuries	Other specified	Unspecified	Not Applicable	Total
Traumatic brain injury	97	0	384	236	0	0	0	0	0	0	0	0	0	0	0	7	0	724
Other head	35	4	0	22	0	0	336	0	30	75	0	0	0	0	2	1	0	505
Neck	26	17	0	0	0	1	1	0	0	0	0	0	0	0	16	0	0	61
Head and neck, other	0	0	0	0	0	0	0	0	56	0	0	0	0	0	0	0	0	56
Spinal cord	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
Vertebral column	368	13	3	0	0	0	0	0	0	0	0	0	0	0	7,711	0	0	8,095
Thorax	574	0	12	16	0	1	263	0	0	0	0	0	0	0	180	0	0	1,046
Abdomen	0	0	12	3	0	0	11	0	0	1	0	0	0	0	0	0	0	27
Pelvis and lower back	73	9	4	13	0	0	27	0	0	0	0	0	0	0	0	0	0	126
Abdomen, lower back & pelvis	0	0	0	0	0	0	262	0	0	0	0	0	0	5	13	5	0	285
Other trunk	0	0	0	0	0	0	61	0	26	1	0	0	0	59	0	1	0	148
Upper extremity	4,198	692	0	3,751	711	1	1,126	376	194	0	3	0	0	453	6,561	9	0	18,075
Hip	29	22	0	13	0	0	2	0	0	0	0	0	0	0	407	0	0	473
Other lower extremity	2,881	315	0	619	15	4	1,150	110	151	0	0	0	0	195	4,033	11	0	9,484
Multiple body regions	5	0	0	2	0	0	0	1	1	0	0	0	0	0	0	0	0	9
System wide	0	0	0	0	0	0	0	0	0	0	19	0	21	0	1	0	0	41
unspecified	17	0	0	3	0	0	35	0	7	0	0	0	0	26	53	7,430	0	7,571
.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	23
Total	8,303	1,072	435	4,678	726	7	3,274	487	465	77	22	0	21	738	18,977	7,464	23	46,769

From Excel spreadsheet: 28 June 2007

3.5.3. ACC earnings-related compensation for over 175 days (wcdays>175).

Table 15 shows the numbers and rates of serious non-fatal traumatic injury, where the case definition for serious is the payment of ACC earnings-related compensation for over 175 days (ie. wcdays>175). This approximates a case definition of serious disabling traumatic injury with a time off work and / or changed / reduced duties of over 6 months. This table includes the variables: age, gender, employment status, ethnic group, industry and occupation. Numbers and rates are shown by year, but also aggregated across the three years 2002-2004. The results show:

- increasing rates across age groups to 55-64, and then a decline in the rate for age 65-84, which had a rate similar to that for 35-44 year olds;
- higher rates for men compared with women;
- similar rates for the self-employed compared with employees
- higher rates for Māori than for all other ethnic groups
- high rates for the industry groups:
    - Agriculture, forestry, fishing
    - Mining
    - Manufacturing
    - Electricity, gas, water
    - Construction
    - Transport, storage
- high rates for the occupational groups:
    - Agriculture and fishery workers
    - Trade workers
    - Plant and machinery operators, assemblers
    - Elementary occupations.

Table 16 shows the numbers of serious traumatic injury events within diagnosis category using a case definition for serious of wcdays>175 – shown in the form of a Barell matrix. Many injuries had unspecified diagnosis and unspecified site. Outside of these, the body sites where serious injuries occurred most frequently were: upper and lower extremities, and the vertebral column. The most frequently occurring types of serious traumatic injury were fractures, contusions, open wounds and dislocations.

The most frequently occurring type and body site of injury combinations (excluding the “unspecifieds”) were: upper and lower extremity fracture (excluding hip fracture), upper extremity dislocation, open wounds and contusions, lower extremity contusions, and vertebral column fractures.

Table 15: Numbers and rates of serious non-fatal traumatic injury, where the case definition for serious is the payment of ACC earnings-related compensation for over 175 days

		2002			2003			2004			All Years		
		injuries	worker-years in 100,000	Rate	injuries	worker-years in 100,000	Rate	injuries	worker-years in 100,000	Rate	injuries	worker-years in 100,000	Rate
Age groups													
	15-24	162	3.13	51.82	179	3.23	55.41	198	3.31	59.88	539	9.66	55.78
	25-34	399	3.96	100.81	428	3.98	107.52	388	4.14	93.74	1,215	12.08	100.60
	35-44	670	4.81	139.31	653	4.86	134.48	719	5.04	142.61	2,042	14.71	138.85
	45-54	624	4.19	148.86	649	4.29	151.17	666	4.49	148.25	1,939	12.98	149.41
	55-64	363	2.27	159.65	459	2.42	189.59	490	2.68	182.53	1,312	7.38	177.80
	65 -84	46	0.41	112.47	63	0.43	146.34	74	0.51	146.03	183	1.35	135.93
	Total	2,264	18.77	120.63	2,431	19.21	126.54	2,535	20.17	125.67	7,230	58.15	124.33
Gender													
	Female	552	8.52	64.81	585	8.95	65.40	609	9.22	66.03	1746	26.69	65.43
	Male	1712	10.25	166.98	1846	10.57	174.73	1926	10.95	175.93	5484	31.77	172.64
	Total	2264	18.77	120.62	2431	19.51	124.60	2535	20.17	125.68	7230	58.45	123.70
Employment status													
	Employees	1773	15.00	118.18	1936	15.43	125.49	2063	15.87	130.00	5772	46.30	124.67
	Self-employed	491	3.70	132.63	495	3.72	133.14	472	3.79	124.67	1458	11.21	130.11
	Total	2264	18.70	121.04	2431	19.15	126.97	2535	19.66	128.97	7230	57.51	125.73
Ethnic group													
	European (inc NZ)	1608	14.81	108.55	1759	15.32	114.81	1809	15.87	113.96	5176	46.01	112.50
	Maori	331	1.80	183.97	347	1.87	185.79	346	1.80	191.96	1024	5.47	187.22
	Pacific Islands	70	0.87	80.55	80	0.87	92.43	91	0.89	102.05	241	2.63	91.77
	Other specified	129	1.27	101.38	117	1.43	81.66	154	1.58	97.42	400	4.29	93.33
	unspecified	126	0.01		128	0.02		135	0.02		389	0.06	
	Total	2264	18.77	120.63	2431	19.51	124.59	2535	20.17	125.68	7230	58.45	123.69
Industry													
A01 - A04	Agriculture,Forestry, Fishing	453	1.78	254.70	516	1.76	293.29	455	1.74	260.82	1424	5.28	269.57
B11 - B15	Mining	11	0.04	289.17	15	0.04	357.40	15	0.04	348.92	41	0.12	333.33
C21 - C29	Manufacturing	486	2.76	175.95	506	2.81	180.26	545	2.84	192.02	1537	8.41	182.81
D36 - D37	Electricity,Gas,Water	12	0.06	190.93	16	0.06	271.97	12	0.06	201.51	40	0.18	220.71
E41 - E42	Construction	366	1.24	294.30	408	1.33	306.67	468	1.45	322.69	1242	4.02	308.62
F45 - F47	Wholesale	92	1.16	79.45	74	1.19	61.93	100	1.23	81.38	266	3.58	74.27
G51 - G53	Retail, Services	187	2.32	80.68	186	2.41	77.20	200	2.51	79.82	573	7.23	79.22
H57	Accommodation, Cafe, Restaurants	64	1.00	64.05	73	1.06	68.87	69	1.11	62.05	206	3.17	64.96
I61 - I67	Transport, Storage	159	0.75	211.84	169	0.78	217.39	180	0.81	222.68	508	2.34	217.44
J71	Communication Service	28	0.27	103.19	18	0.26	68.77	25	0.26	96.72	71	0.79	89.69
K73 - K75	Finance,Insurance	3	0.47	6.38	4	0.49	8.13	6	0.51	11.81	13	1.47	8.84
L77 - L78	Property, Business service	109	2.71	40.27	103	2.83	36.38	142	2.99	47.52	354	8.53	41.52
M81 - M82	Govt administration,Defence	16	0.60	26.66	14	0.61	23.00	16	0.63	25.53	46	1.84	25.06
N84	Education	41	1.43	28.64	50	1.52	32.90	28	1.59	17.65	119	4.54	26.22
O86 - O87	Health, Community service	130	1.55	83.93	150	1.61	93.26	165	1.66	99.54	445	4.82	92.42
P91 - P93	Cultural,Recreational	51	0.48	106.49	65	0.51	126.77	60	0.54	111.85	176	1.53	115.18
Q95 - Q97	Personal & Other services	56	0.63	88.58	63	0.66	95.90	44	0.69	63.70	163	1.98	82.33
	Missing	0	0.21		1	0.21		5	0.22		6	0.64	
	Total	2264	19.46	116.34	2431	20.14	120.69	2535	20.86	121.53	7230	60.46	119.58
Occupation													
1000 - 1229	Legislators, Administrators, Managers	96	2.50	38.48	99	2.40	41.20	101	2.47	40.94	296	7.37	40.19
2000 - 2451	Professionals	102	2.58	39.49	131	2.81	46.55	95	2.89	32.87	328	8.29	39.58
3000 - 3381	Technicians & Associate professionals	92	2.35	39.22	109	2.10	51.93	118	2.17	54.43	319	6.61	48.24
4000 - 4222	Clerks	64	2.17	29.56	60	2.47	24.31	88	2.49	35.37	212	7.12	29.77
5000 - 5231	Service & Sales workers	200	2.85	70.22	218	2.96	73.60	212	3.18	66.77	630	8.99	70.12
6000 - 6144	Agriculture & Fishery workers	441	1.65	267.76	495	1.62	305.93	466	1.59	293.27	1402	4.85	288.83
7000 - 7441	Trade workers	316	1.75	180.88	343	1.82	188.46	421	1.86	226.22	1080	5.43	198.97
8000 - 8412	Plant & Machine operators, Assemblers	517	1.65	313.33	553	1.71	323.77	623	1.67	372.16	1693	5.03	336.45
9000 - 9151	Elementary occupation	365	1.18	308.80	363	1.23	294.88	372	1.33	280.75	1100	3.74	294.28
9700 - 9999	Unknown	71	0.04	1690.48	60	0.03	2222.22	39	0.02	1695.65	170	0.09	1847.83
	Total	2264	18.71	121.04	2431	19.15	126.95	2535	19.66	128.94	7230	57.52	125.71

From Excel spreadsheet: 6 June 2007

Table 16: Barrell diagnosis matrix for the number of eligible ACC earnings-related claims of over 175 days duration (wcdays>175).

	Fracture	Dislocation	Internal organ injuries	Open wound	Amputation	Blood vessel	Superficial & contusions	Crushing	Burn	Effects of foreign bodies entering orifice	Other effects of external causes	Poisoning	Toxic effects	Multiple injuries	Other specified	Unspecified	Not Applicable	Total
Traumatic brain injury	26	0	118	41	0	0	0	0	0	0	0	0	0	0	0	3	0	188
Other head	2	2	0	4	0	0	62	0	2	6	0	0	0	0	0	1	0	79
Neck	11	7	0	0	0	1	1	0	0	0	0	0	0	0	5	0	0	25
Head and neck, other	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	3
Spinal cord	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
Vertebral column	119	4	3	0	0	0	0	0	0	0	0	0	0	0	1,288	0	0	1,414
Thorax	36	0	3	1	0	1	23	0	0	0	0	0	0	0	9	0	0	73
Abdomen	0	0	1	0	0	0	3	0	0	1	0	0	0	0	0	0	0	5
Pelvis and lower back	24	4	0	3	0	0	2	0	0	0	0	0	0	0	0	0	0	33
Abdomen, lower back & pelvis	0	0	0	0	0	0	38	0	0	0	0	0	0	0	0	1	0	39
Other trunk	0	0	0	0	0	0	6	0	3	0	0	0	0	9	0	1	0	19
Upper extremity	474	119	0	130	97	0	145	29	11	0	0	0	0	70	1,277	4	0	2,356
Hip	9	3	0	1	0	0	0	0	0	0	0	0	0	0	58	0	0	71
Other lower extremity	509	59	0	50	6	2	111	12	5	0	0	0	0	11	461	0	0	1,226
Multiple body regions	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
System wide	0	0	0	0	0	0	0	0	0	0	3	0	8	0	0	0	0	11
unspecified	2	0	0	2	0	0	2	0	1	0	0	0	0	5	9	1,649	0	1,670
.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	6
Total	1,212	198	136	232	103	4	393	42	25	7	3	0	8	95	3,107	1,659	6	7,230

From Excel spreadsheet: 28 June 2007

3.6. Concordance of ACC and NMDS data

Concordances of all the demographic variables were evaluated at the person level, rather than the event level.

3.6.1. Age

Table 17 shows, of the 1140 persons in the linked dataset of cases, that age was equivalent for 97% of people, and was within 3 years of one another in all but a small minority of instances[n].

Table 17: Concordance of age captured on the ACC claims and the NMDS datasets.

age_diff1	Freq.	Percent	Cum.
-10	2	0.18	0.18
-4	1	0.09	0.26
-3	1	0.09	0.35
-2	1	0.09	0.44
-1	6	0.53	0.96
0	1,107	97.11	98.07
1	10	0.88	98.95
2	3	0.26	99.21
3	2	0.18	99.39
4	1	0.09	99.47
6	1	0.09	99.56
10	1	0.09	99.65
.	4	0.35	100.00
Total	1,140	100.00	

Age_diff1 is age derived from the NMDS minus age derived from ACC data.

3.6.2. Gender

Table 18 shows, of the 1140 persons in linked dataset, information on gender is concordant for 1138 persons.

Table 18: Concordance of gender on ACC and NMDS data sources

	sex		
GENDER	F	M	Total
F	122	0	122
M	2	1,016	1,018
Total	124	1,016	1,140

The “gender” variable is from NMDS data, the “sex” variable is from ACC data.

[n] The results are very similar when the full set of linked data (n=15,627) is analysed in the same way.

3.6.3. Ethnicity

Table 19 shows the concordance of the ethnicity information from the two sources of data for 1140 people in the linked dataset.

Table 19: Concordance of level 1 ethnicity

nmds_ethnicity	acc_ethnicity: European	Māori	Other eth	Pacific I	Unknown	Total
European	690	16	31	3	68	808
Māori	19	129	3	2	7	160
Other ethnic groups	42	7	41	6	19	115
Pacific Islands	4	3	0	20	2	29
Unknown	15	6	1	0	6	28
Total	770	161	76	31	102	1,140

nmds_ethnicity was provided by PHI and is based on the ethnicity recorded on NZHIS data sets.

The two data sets contained the same ethnic group classification for 78% of people[s]. The Kappa statistics for the concordance was 0.55 (95% confidence interval: 0.50 to 0.60) and this indicates, according to the Landis and Koch grading, that concordance was “moderate”.

The large number of ACC claims with unknown ethnic group contributed significantly to the lack of concordance. The other major mismatch, was the classification of ethnic group as European on one source, and “other ethnic groups” on the other source.

3.6.4. Diagnoses

Using the serious threat-to-life work-related traumatic injury data, 15 diagnosis groups were identified as the most frequent diagnoses (see section 3.3, page 17). Table 23 shows the concordance between ACC principal diagnosis and NMDS primary diagnosis (from the first admission record). The discordance between NMDS primary diagnosis and ACC principal diagnosis can be seen from the off-diagonal entries in this table. Less than 40% of these linked cases were classified to the same diagnostic groups by NMDS and ACC (Kappa = 0.34, 95% confidence interval: 0.30 to 0.37). This indicates, according the Landis and Koch grading, that concordance is “poor”. Some of the discrepancy was due to similar natures of injuries being capture, but slightly different body sites, and some due to the body sites being concordant, but different natures of injury. Furthermore, discordances may arise due to one data source recording a diagnosis as a secondary diagnosis whilst the other recorded it as a primary / principal diagnosis. The “poor” concordance is also a function of the many categories in the concordance matrix. The kappa statistic would take on larger values if some of the categories in the 16x16 matrix were collapsed.

3.6.5. External cause

Falls

Amongst the 1143 cases in the linked data set, there were 390 falls (34%) as classified by NMDS. The "cause" categories to which these cases were classified by ACC are shown in Table 20. 78% of these cases classified to falls using NMDS, are classified to the ACC cause category: "loss of balance or personal control". This is the main ACC cause category in which falls are captured. This includes all of the categories shown in Table 20 up to and including "Other loss of balance and personal control". "Other loss of balance or personal control" accounts for 179 of the cases classified to this main ACC cause category, ie. 59%. These can, theoretically, include non-falls cases of "struck by". Consequently, using ACC data, it would be impossible to identify falls using the ACC "cause" variable since so many cases are coded to this non-specific category.

We considered the distribution of the 349 case that were categorised by ACC as "Other loss of balance or personal control" by NMDS external cause category. This suggests that this non-specific ACC category captures a wide range of external causes of injury. There were 179 (51%) cases classified by NMDS as falls, 76 (22%) as "Other land transport", which are likely to include some falls, 34 (10%) as "Struck by or against", which traditionally have not been classified as falls, and 60 (17%) other specified cases which have been classified outside of the falls categories in the NMDS.

This does not indicate a high lack of concordance in the classification of cases, it simply illustrates that the nature of the ACC codes are such that falls cannot be distinguished from some other external causes (eg. injury resulting from being struck by an object without a fall).

Table 20: The distribution of NMDS falls cases by ACC cause

ACC Cause	Number	Percent	Cumulative percent
Slipping, skidding on foot	53	14	14
Tripping or stumbling	21	5	19
Pushed or pulled	3	1	20
Loss of consciousness/sleep/giddy	5	1	21
Something giving way underfoot	12	3	24
Misjudgment of support	23	6	30
Loss of hold	4	1	31
Struck by hand-held tool/implement	2	1	32
Struck by person/animal	1	0	32
Other loss of balance or personal control	179	46	78
Other	87	22	100
Total	***390***	***100***	

Struck by or against

Amongst the 1143 cases in the linked data set there were 189 cases categorised from NMDS codes to "struck by or against" (17%). The "cause" categories to which these cases were classified by ACC are shown in Table 21.

Table 21: The distribution of "struck by or against" cases, derived from NMDS codes, by ACC cause

ACC Cause	Number	Percent	Cumulative percent
Collapse of stack / goods in bulk	3	2	2
Collision with / knocked over by object	25	13	15
Object coming loose / goods shifting	25	13	28
Pushed or pulled	2	1	29
Struck by hand-held tool/implement	9	5	34
Struck by person/animal	18	10	43
Other loss of balance or personal control	34	18	61
Other and unspecified	73	39	100
Total	***189***	***100***	

26% of these cases classified to "struck by or against" using NMDS, are classified to the ACC cause categories "Collision with / knocked over by an object" or to "Object coming loose / goods shifting"; 10% to "Struck by person/animal" and 5% to "Struck by hand held tool/implement". So, each of these (41% of total) cases have circumstances of injury codes consistent with the NMDS cause code – at this level. "Other loss of balance or personal control" accounts for 34 (18%) of the cases. For these cases, using the ACC Cause classification it is impossible to identify incidences of "struck by or against" from falls.

They were 73 (39%) of the cases coded to "Other and unspecified" categories on ACC data. It is impossible to judge for many of these cases whether the codes used by ACC and NMDS contradict one another. What can be said is that there is a lack of specificity for 34 (18%) yielding the ACC Cause code uninformative in these instances.

Other causes

Analysis of the concordance of other categories run into similar problems due to the lack of equivalence of the circumstances of injury categories used by NMDS and ACC.

3.6.6. Activity codes

Table 22 indicates that 77% of the cases identified by ACC as non-MVTC work-related traumatic injury, and which linked to the NMDS, were classified on NMDS as "While working for income". The other main activity groups to which these cases have been classified were: "Other specified activity" and "Unspecified activity", making up a total of 20%. These mainly comprised falls (78/219; 36%), Other land transport (46/219; 21%); struck by or against (25/219; 11%), MVTC (20/219; 9%); and Natural/Environmental (11/219; 5%).

Table 22 indicates some lack of concordance between the classification of work-related amongst these linked cases, principally due to 14% of NMDS activity codes being either unspecified or missing.

Table 22: NMDS activity codes for cases identified by ACC as non-MVTC work-related traumatic injury.

	n	***%***
While engaged in sports activity	2	0
While engaged in leisure avtivity	0	0
While working for income	881	77
While engaged in other types of work	31	3
While resting, sleeping, eating or engaged in other vital activities	5	0
Other specified activity	64	6
Unspecified activity	155	14
Missing	5	0
Total	***1143***	***100***

Table 23: Concordance of diagnosis groups between NMDS and ACC data.

Diagnosis group from NMDS data	Diagnosis group from acc data																
	Traumatic brain injury/#	Other head/#	Vertebral column/#	Thorax/#	Pelvis and lower back/#	Upper extremity/#	Hip/fracture	Other lower extremity/#	Traumatic brain injury/ Internal Organ	Spinal cord/ Internal organ	Thorax/ Internal organ	Abdomen/ Internal organ	Traumatic brain injury/Open wound	Head and neck, other/Burn	Upper extremity/ Burn	other	Total
Traumatic brain injury/Fracture	31	1	1	0	0	3	0	0	28	0	0	0	21	0	0	20	105
Other head/Fracture	23	3	0	0	0	1	0	0	1	0	0	0	17	0	0	11	56
Vertebral column/Fracture	0	0	30	7	4	1	0	3	2	3	0	0	1	0	0	31	82
Thorax/Fracture	0	0	5	56	1	6	0	0	1	0	0	1	0	0	0	25	95
Pelvis and lower back/Fracture	0	0	2	2	21	3	1	17	0	0	0	0	1	0	0	12	59
Upper extremity/fracture	0	0	0	6	0	42	1	0	1	0	0	0	3	0	0	19	72
Hip/fracture	0	1	0	0	0	3	7	59	0	0	0	0	0	0	0	13	83
Other lower extremity/fracture	0	0	4	0	0	2	1	44	0	0	0	0	1	0	0	8	60
Traumatic brain injury/Internal Organ	9	1	4	5	0	1	0	1	52	0	0	0	14	0	0	50	137
Spinal cord/Internal organ	0	0	10	0	0	1	0	0	3	2	0	1	1	0	0	18	36
Thorax/Internal organ	0	0	3	32	0	3	0	3	3	0	5	0	1	0	0	25	75
Abdomen/Internal organ	0	0	2	11	1	0	0	0	0	0	0	9	1	0	0	25	49
Traumatic brain injury/Open wound	0	2	1	0	0	0	0	0	7	0	0	0	14	0	0	6	30
Head and neck, other/Burn	0	0	0	0	0	0	0	0	0	0	0	0	0	18	5	5	28
Upper extremity/Burn	0	0	0	0	0	1	0	0	0	0	0	0	0	5	14	11	31
other	4	0	4	4	2	3	0	4	7	0	1	0	10	1	3	102	145
total	67	8	66	123	29	70	10	131	105	5	6	11	85	24	22	381	1143

4. Discussion

4.1. Discussion of results

4.1.1. Principal findings

The outcomes include:

1) the first accurate epidemiological description of **serious threat-to-life work-related traumatic injury** in New Zealand, as produced from the linked dataset;

2) a description of the agreements between key fields in the ACC data and NMDS;

3) an assessment of the suitability of ACC data on their own for presenting the epidemiology of serious non-fatal work-related traumatic injury;

4) a presentation of the epidemiology of **serious disabling work-related traumatic injury** based on ACC data alone.

The valid description of the epidemiology of serious non-fatal work-related traumatic injury is important to meet specific priority setting, policy, prevention, and control needs of government and non-government agencies.

These broad findings are elaborated on and discussed below.

Epidemiology of serious threat-to-life work-related traumatic injury

Over the three years, there were 1143 cases of serious threat-to-life non-fatal work-related traumatic injury, which is an average of 381 cases per year. This compares with an average of 74 non-MVTC work-related fatal injuries per year over the last period when we had reliable figures, namely 1985 to 1994. (Feyer, Langley et al. 2001) It also compares with 7,230 (ie. 2,410 per year) of serious disabling work-related traumatic injury cases, where serious was defined as over 175 days of earnings-related compensation payments.

For injures that have a high threat to life, rates across age groups increased beyond age 54, and were almost three times the average rate for people aged 65-84. This pattern is consistent with work in New Zealand and overseas. (Cryer and Fleming 1987) (Feyer, Langley et al. 2001) (National Occupational Health and Safety Commission 1998) (Jenkins, Kisner, et al. 1993) (Harrison, Frommer et al. 1989) (Kisner and Pratt 1997) As expected, rates for men were substantially greater than for women. This again is consistent with many other studies both in New Zealand and elsewhere. (Cryer and Fleming 1987) (Feyer, Langley et al. 2001) (National Occupational Health and Safety Commission 1998) (Jenkins, Kisner, et al. 1993) (Harrison, Frommer et al.

1989) Self-employed workers were at greater risk than employees, also similar to the previous New Zealand work-related fatal injury studies (WRFIS). (Feyer, Langley et al. 2001) (Cryer and Fleming 1987) All of these differences are likely to reflect different working environments. Males, and self-employed persons are more likely to be found in higher risk occupational and industry groups.

Rates for Māori were greater than the rates for Europeans and for Pacific peoples. This was also found in one of the NZ WRFI studies. (Cryer and Fleming 1987) Ethnic group rates were not presented in the other WRFI study (Feyer, Langley et al. 2001). In the Cryer and Fleming WRFI study (Cryer and Fleming 1987), their estimates showed Māori rates to be higher than other groups even within occupational groups. This suggests that it would be worthwhile to carry out work to provide the descriptive epidemiological picture of serious work-related traumatic injury for Māori to help identify those most at risk and to gain insight into causes.

Higher rates were found for the following industry groups:

- Agriculture, forestry, fishing;
- Mining;
- Electricity, gas, water;
- Construction;
- Transport, storage.

Correspondingly, occupational groups who were at high risk were agriculture and fishery workers, plant machinery operators and assemblers, and elementary occupations. These results are again similar to the WRFI studies. (Feyer, Langley et al. 2001) (Cryer and Fleming 1987) These industries and occupations are dominated by work in environments in which traditional occupational health and safety interventions are likely to be less effective in controlling risk.

The major life threatening injuries experienced over the period of study were brain and other head injury, spinal injuries, fractures to the thorax, pelvis, hip and leg, internal organ injury, and burns. Many of these were machinery or vehicle related, falls, or occurred as a result of being struck by an object. To gain better insight, the data on cause and diagnosis would need to be considered relative to other variables – eg. amongst agriculture and fishery workers, to identify who is getting injured, when, where, what (they were doing), how, and with what outcome. Ideally event descriptions, captured on both ACC data and NMDS hospitalisations would be utilised. This more detailed analysis is beyond the scope of this work, but it is strongly recommended as a follow-up.

Threat-to-life compared with disabling injury.

It is important to note that there are far more cases satisfying the various ACC-based serious disabling traumatic injury definitions than the number of cases of serious threat-to-life traumatic injury – in the linked data analysis (Table 24).

Table 24: Number of cases of serious traumatic injury in 2002 to 2004 as defined by threat-to-life compared with disability.

Serious injury dimension		n
Threat-to-life	Linked data	1,143
Disabling	wcdays>175	7,230
Disabling	wcdays>84	15,066
Disabling	wcdays>49	24,485
Disabling	wcdays>21	46,769
Disabling	wcdays>14	52,706
Disabling	wcdays>7	61,272
Disabling	wcdays>0	72,590

This indicates increased numbers of cases that result in temporary or permanent disability (as measured by participation [work] restriction) compared with life-threatening injuries, and serves to emphasise that **these epidemiological descriptions represent two distinct dimensions of the serious non-fatal work-related traumatic injury problem.** It is interesting to note that 20% of the serious threat-to-life non-fatal traumatic injury cases do not result in earnings-related compensation, and that the remaining cases distribute across the wcdays thresholds, with 12% with earnings-related compensation of less than of equal to 21 days, 13% - 22-49 days, 10% - 50-84 days, 17% - 85 to 175 days, and 28% over 175 days.

Notable changes in the epidemiological picture across the various disability thresholds, or between these and the 1,143 serious life-threatening injuries, were as follows.

- There was a greater proportion of women experiencing disabling traumatic injury – right across the severity spectrum - compared with life-threatening traumatic injury.
- The proportion of disabling injuries in the industry group agriculture / forestry / fishing increased as the time off work threshold increased; though with a substantially higher proportion for threat-to-life serious traumatic injury. (This was also reflected in the trend for the occupational group: Agriculture and forestry workers.)
- There was a reduction in the proportion of traumatic injury in Manufacturing from a high of 26% for wcdays>21, to 21% for wcdays>175; these contrast with only 14% of threat-to-life serious traumatic injury in manufacturing industries.
- In the occupational group sales and service workers, the proportion was 9 to 10% for serious disabling traumatic injury, but with a much lower proportion for threat-to-life serious traumatic injury amongst which only 4% occurred in sales and services.
- There was a similar pattern for trade workers. The proportion of disability cases were fairly constant for trade workers - from a definition of disability of wcdays>0 to wcdays>175 (both 15%). However, the proportion of threat-to-life serious traumatic injury amongst trade workers was lower at 10%.

The major contrast, however, is in the types of traumatic injury that represent a threat-to-life compared with those that are associated with disability. There were only two out of 15 diagnosis groups that were associated with disability and were also a threat-to-life: namely fractures to the arms or legs.

It is clear from these patterns that the priorities for research, prevention, policy making, etc. would change according to the severity dimension considered (this is true for all serious disabling injury thresholds including wcdays>175) – and so, ideally in an analysis of the epidemiology of serious non-fatal injury, both dimensions should be considered. It is also clear that, if ACC is interested in serious threat-to-life injury that these results indicate that they need to look beyond their own data source to NMDS to identify such cases; they cannot use their own data alone.

Concordance - Agreement between key fields in the ACC data and NMDS

The NMDS and ACC data were concordant for the variables of age and sex. Twenty three percent of serious threat-to-life traumatic injury cases did not have the same level 1 ethnic group classification on both data sources. Work has been carried out to validate the Māori / non-Māori PHI classification, and this work has found the classification to be reasonably valid. (Cryer, Gulliver, et al. 2007) Incomplete data capture in the ACC claims data appears to be the main reason for these differences.

A large proportion of the serious threat-to-life traumatic injury cases had different diagnoses recorded as principal diagnosis on the ACC data compared with NMDS primary diagnoses. The sorts of differences observed are consistent with our ongoing work investigating ACC claims that attract a lump sum payment for impairment[o]. The ACC diagnoses tend to be the preliminary (rather than confirmatory diagnosis) and so these differences are to be expected. Nevertheless, recent unpublished work investigating the accuracy of NMDS ICD-10 diagnosis data indicates this data source includes quite a large proportion of miscoded cases. This is also likely to contribute to the observed lack of concordance.

In respect of external cause of injury, there is an indication of a lack of concordance between ACC and NMDS coding. For example, 22% of cases coded to “Falls” by NMDS fall outside the main cause category that ACC use for falls. Additionally, there is a lack of specificity in ACC cause coding such that 349 cases are categorised by ACC as “Other loss of balance or personal control”. This category is likely to include cases of falls and struck by / against. As a consequence, when using ACC codes it is not possible to identify the total number of falls resulting in a claim, or that satisfy some earnings-related compensation threshold. Given that falls is one of the NZIPS priority areas, this is a major drawback.

In respect to activity, all of the cases identified by ACC should be non-MVTC work-related injury cases. The claims had been paid from the Employers and the Self-employed accounts. There is some suggestion of a problem with the NMDS Activity classification since for 14% the activity was unspecified, and for 9% of linked serious threat-to-life traumatic injury cases they were coded to activities other than paid work. Furthermore, there were around 400 further traumatic injury incidences that resulted in admission to hospital (but were not included in these 1,143 cases) during the study period, that had an NMDS activity code of: “While working for income”. Currently, we are reticent to use the NMDS activity code to identify work-related cases due to concerns about their completeness and accuracy. On the other hand, there are a handful of injuries, paid from

[o] The development of impairment-related injury indicators – work in progress.

the ACC Employer and Self-employed accounts that, from the free text descriptions of the incidents, appear to be MVTCs. It is our understanding that these should be paid from the Motor Vehicle Account, other than in exceptional circumstances. This affects 1-2% of cases, so perhaps, if this is an error of classification, this level of error can be tolerated.

Epidemiology of serious disabling non-fatal traumatic injury

What do the above results mean for the validity of the results of the epidemiological analysis of serious disabling work-related traumatic injury, where serious is operationally defined using ACC data in terms of earnings-related compensation (time off work)?

The algorithm used to determine cases of traumatic injury is based on ACC diagnosis data. This and other work suggest that there are some potential problems with diagnosis coding. It is unclear to what extent this will affect the algorithm used to differentiate traumatic injury from gradual process / occupational disease cases. This requires investigation.

Provided traumatic injury cases can be identified to an acceptable level of accuracy, the epidemiological picture in terms of age, gender, industry and occupational group is equally valid compared with the epidemiology of serious (threat-to-life) non-fatal work-related traumatic injury. If it is valid, it provides an important additional dimension to the picture of serious non-fatal work-related traumatic injury.

It should be noted that we are ignorant of the accuracy of the industry and occupation coding captured on the ACC database, or far that matter the accuracy of the method used to identify work-related claims. As far as we are aware, no audits of the quality of these data have been carried out. It is important that the accuracy of these fields be assessed, since they are key fields for producing the epidemiological picture for both serious threat-to-life and disabling work-related injury. We strongly recommend that this work be funded, and the results published.

The apparent inaccuracies found with respect to the classification of ethnic group and diagnosis mean that an accurate picture cannot be provided along these dimensions using ACC data alone. The data captured on the circumstances of injury by ACC is potentially very rich, since data are captured along several dimensions: activity, cause, contact, and agent. We asked ACC whether methods had been developed to present these multidimensional data – and were informed “no”. This would, potentially, be a fruitful area to investigate. Additionally, the free text description are likely to contribute useful information in any future analysis of the circumstances of injury – as indicated by an inspection of the free text descriptions from both the NMDS and ACC data for MVTCs and Other Land Transport injury (see Table 8).

Below is a summary of the main results relating to the most serious group of injuries looked at in this study in terms of disability, ie. those that attracted earning-related compensation for over 175 days.

Cases defined as 6 months off work (wcdays>175)

For these injuries, there was a steep gradient in the rates from age 15-24 to age 55-64. As expected, rates for men were substantially greater than for women. These patterns are again likely to reflect the differing

exposures of men and women in the workplace. There were similar rates of these injuries for employed and self-employed workers.

There were high rates of traumatic injury for several industry groups. Agriculture, forestry and fishing, Construction, and Manufacturing demand special attention since each of these have both high rates and numbers of injuries. The former two industries represent less controlled environments than other industry groups - in particular manufacturing. Consistent with this, the occupational groups that had high rates and numbers of these serious disabling injuries were Agriculture and fishery workers, Trades workers, Plant & machinery operators and assemblers, and Elementary occupations.

4.1.2. Strengths and weaknesses of the study

The strengths of this work include the following:

1. We know of no other work, locally or internationally, that presents an epidemiological picture of serious threat-to-life work-related traumatic injury.
2. This work provides confirmation of the need to present the epidemiological picture of serious work-related traumatic injury along more than the threat-to-life dimension of "serious"; but also along the threat-of-disability dimension.
3. The work identifies that some of the ACC data fields capture accurate data (on age, gender), whereas others appear to be problematic (eg. ethnic group, diagnosis). The apparent inaccuracies in the diagnosis codes examined call into question the use of this field for the production of meaningful information. Additionally, in the context of this and like projects, it questions the accuracy of the ACC's algorithm to identify traumatic injury cases – as opposed to gradual process or disease cases.

In respect of (1), the strength of this work is that it monopolises **on the most accurate classification of work-related status from ACC data, as well as the most accurate information on diagnosis, provided by NMDS, to identify cases of serious threat-to-life traumatic injury rather than gradual process or disease**. The work utilises our previous work on the validation of the ICISS threat-to-life severity measure (Stephenson, Henley et al. 2004) and our use of that measure to identify a threshold of serious threat-to-life traumatic injury, to produce the most accurate description of serious threat-to-life work-related traumatic injury using current methods and national data.

This work has identified some of the next steps needed to investigate the utility of ACC data for this particular purpose – described in section 4.2. Such investigations would be useful in order to examine how fit for purpose ACC data is for many other applications where aggregate data is produced and used (eg. informing the ACC board of the external causes and nature of injury claims that attract high financial cost – eg. injury resulting in many weeks off work).

We could argue that the most useful epidemiological information that has been produced by this work is that which describes the epidemiology of serious threat-to-life work-related traumatic injury. For that analysis, the following are potential sources of problems:

a) The identification of work-related cases on ACC data
b) The choice of denominators for the rates

c) The linkage of ACC claims to NMDS hospitalisations
d) The limitations of ICISS for classifying the threat-to-life severity of traumatic injury
e) The accuracy of the data relating to the variables used in this study (ie. age, gender, ethnic group, employment status, industry, occupation, diagnosis and external cause)

a) The identification of work-related cases on ACC data

It seems plausible that the work-related status of earnings–related claims data would be accurate – simply because the amount of payment is linked to earnings. Inaccuracies could arise for other types of claims – where an ACC45 is filled out by a claimant or their representative (eg. at the point of receiving treatment). This is only a theoretical possibility. However, given the importance of ACC data for describing work-related traumatic injury, we believe that this should be investigated. A starting point would be to investigate whether the claims paid from the Employers and the Self-employed accounts are made in all cases for work-related traumatic injury.

b) The choice of denominator for rates

We used the LFS and the LEED survey data as our denominators for the rates. One advantage this has over Census data is that these survey data are collected quarterly, whereas the Census is only collected at one time of year, every 5 years. Consequently, use of these data sources removes the need for interpolation that would be required when using Census data, and also accounts for any seasonal variation in worker numbers. The advantage of the Census is that it is based on a count of the whole population.

We contrasted the denominators generated from LFS and LEED with those from an interpolation from the 2001 and 2006 Census data (Table 25). This table shows that, overall, the denominators increase by between 7% to 11% when using the LFS/LEED compared with Census. The Census "undercount" is greater for the age group 15-24, for employees, for Pacific and for "Other specified" ethnic groups, and for many of the rural and blue collar occupations. This is also reflected in the Industry groups for which there is a Census "undercount". Use of denominators derived from the Census rather than LFS/LEED derived denominators would tend to increase the rates for the industry groups "Agriculture, Forestry and Fishing" and for "Mining" from their current high values, as well as the occupational groups "Agriculture and Fishery workers" and "Plant and Machine Operators, Assemblers".

A Census "overcount" is apparent for people aged 65-84, self-employed, Māori, and those in white collar industries. Use of Census denominators would reduce the rates for these groups compared with the use of LFS/LEED in Table 5 etc. It would

- have a limited effect on the high rates for people aged 65-84,
- reduce the differences between employee and self-employed rates,
- reduce the difference in rates between Māori and other ethnic groups, but would
- exaggerate some of the industry group differences.

It is apparent from the above, that the rates based on the Census data would be numerically different from the rates based on LFS/LEED. Nevertheless, the description of the rates of one group relatively to another would be unchanged if Census-based denominators were used rather than LFS/LEED.

c) The linkage of ACC claims to NMDS hospitalisations

There were 16,098 matched record-pairs which relates to 5.4% of the NZHIS hospital discharges and 2.1% of ACC work-related claim records. However, these figures cannot be used to judge the accuracy/success of the record linkage as the NZHIS dataset contained a large number of records that are unlikely to have an associated ACC claim in the ACC dataset; for example, non-work-related hospitalisations and injuries that occurred in 2005. Also, many of the ACC claims would not be serious enough to warrant admission to hospital.

For the subset of NMDS discharges that had injuries that were a serious threat-to-life (ICISS≤0.941) and with the Activity field coded to "While working for income", the linkage rate to the ACC data was 70%. If this is broken down by external cause, a high proportion of falls cases linked (85%), and a low proportion of MVTC cases (13%). Under the IPRC Act, MVTC cases should be compensated from the Motor Vehicle account and so should not have been captured in the ACC data set used in this study. Without the MVTC cases, the linkage rate was 78% amongst those classified by NMDS as working for income. These linkage rates are consistent with those found for all injury by Statistics New Zealand / Injury Information Manager in the Injury Statistics Pilot Project. To quote:

> *"It was expected that most of the injuries recorded by NZHIS should theoretically have a matching ACC claim. At the end of the linkage exercise, around 70 percent of the NZHIS records had been linked to an ACC record."* [p]

The results we have found suggest that the linkage was successful in the sense that it appears that the numbers of false positive and false negative links is small. It appears that any errors in linkage are unlikely to compromise the validity of the results of other parts of the analysis.

It has been suggested that there are instances of duplicate / multiple records in the ACC database relating to the same injury event (Brian Cosgriff, Statistics New Zealand, personal correspondence, 10 October 2007). Given that linkage was based on one ACC record to one NMDS record, and that best fit links were used, then even in the presence of duplicate ACC records, this should not affect the validity of the linked data source.

d) The limitations of ICISS for classifying threat-to-life severity of injury

Cases of serious threat-to-life injury have been identified by capturing cases that have an ICISS score of ≤0.941. This is consistent with the injury outcome indicators used to monitor the NZIPS. ICISS is an anatomical severity scale in that it is derived from scores (survival probabilities – SRRs) assigned to diagnoses – in this case ICD-10-AM diagnostic codes.

[p] http://www.stats.govt.nz/NR/rdonlyres/23B3D4F9-64A7-442D-966E-3896E63CDDB2/0/PilotTechnicalReport.pdf

Limitations of the ICISS severity score as applied in the derivation of the NZIPS indicators have been discussed in a recent paper by Cryer and colleagues. (Cryer, Langley, et al. 2006) Because of these limitations, further work has been carried out aimed at improving the ICISS severity scoring system. This has resulted in a currently unpublished report (Davie, Cryer, et al. 2007); a journal article is currently under consideration.

This work suggests that the ICISS method, as used for the derivation of the NZIPS indicators, can be improved upon. However, it is unclear whether this is likely to impact on the validity of the NZIPS indicators; and in the context of this report, whether changing to a "better" version of ICISS will impact significantly on the classification of threat-to-life serious traumatic injury cases. We think the impact will be minimal.

The essence of the argument as to why this is, is based around how the ICISS threshold is set; the threshold that is used to define serious threat-to-life traumatic injury. The threshold of 0.941 was set such that cases with injuries with an ICISS score of less than or equal to 0.941 have a high probability of being admitted to hospital. Those with an ICISS score of greater than 0.941 (minor and moderately severe injury) have not only a lower threat-to-life but also a lower probability of being admitted to hospital. With an improved ICISS score, a new threshold would need to be set that defines serious threat-to-life traumatic injury. It is likely to be set at a level to capture pretty much the same set of injury diagnoses as are currently captured as serious threat-to-life injuries using the current ICISS threshold. Hence, improving the ICISS severity scoring is unlikely to have a major practical impact on which injuries are captured as "serious".

e) The accuracy of the data relating to the variables used in this study

The data we used on:

- gender, diagnosis and external cause of injury was captured by NMDS,
- that on age, employment status, industry and occupation from ACC, and
- that for ethnic group from PHI.

Age and gender

The correspondence between age and gender captured on ACC and NMDS data sources gives confidence in the accuracy of these variables on both data sources – and hence for this analysis.

Ethnic group

Level 1 prioritised ethnic group was used (therefore counts within groups are additive, i.e., one person does not belong to more than one ethnic group). (Ministry of Health 2004) Ethnic group was allocated, by Public Health Intelligence, Ministry of Health (PHI), as follows. Māori ethnicity was allocated to a person according to whether or not any previous NZHIS record (as identified by their unique NHI identifiers) had been recorded as Māori, either sole or total, in any NMDS discharge record (1982-2006), cancer registry record (1948-2006), PHO data (2006), or on the Mortality Collections (1988-2003). This has been referred to as the "ever-Maori" method. For each person in the remaining records, the person was allocated to Pacific ethnicity if amongst the same data sets in any of their records they were recorded as Pacific ethnicity. The process was continued for each person captured on NZHIS data and through each ethnic group in priority ethnic group order.

The ethnic group data has been validated in the following context. We have produced a chartbook of indicators of injury incidence for Māori for the New Zealand Injury Prevention Strategy. (Cryer, Gulliver, et al. 2007) For that work, we used the ethnic group classification derived by PHI; the same classification as was used in this analysis of cases of serious threat-to-life injury. As part of the Māori Indicators work, we validated the classification of Māori ethnicity, which used the "ever- Māori" method..

Work to validate this approach to Māori ethnicity classification is described in Appendix D of the Māori injury indicators chartbook report. (Cryer, Gulliver, et al. 2007) The results in Appendix D suggest that the ever-Māori method does well in correcting for Māori undercount and potential numerator-denominator bias[q].

This validation has focused solely on Māori. We have no information on the ethnic group classification for any other ethnic group.

Employment status, industry and occupation

We have no information on the accuracy of data captured by ACC on employment status, industry or occupation. We later recommend that this be rectified.

Diagnosis, external cause, and activity

The accuracy of NMDS diagnosis and circumstances of injury data has been investigated using a simple random sample of 1800 NMDS discharges, selected across the 3 year period July 2001 to June 2004. Records were obtained from the relevant hospitals and recoded by an accredited coder, blind to the codes already recorded for each discharge selected. Around 2% of the discharges, routinely classified by their principal diagnosis as injury cases, were classified by the accredited coder to non-injury diagnoses.

For the remainder, there was apparent misclassification of NMDS primary diagnosis: Diagnosis and external cause had inaccuracies in the ICD-10 at higher levels than equivalent work carried out based on ICD-9 coded data. (Langley, Stephenson et al. 2006) The details of these inaccuracies awaits publication of this work. Activity was inaccurate for 29% of cases overall. This is one reason for the mismatch between cases classified to work-related by ACC compared with the activity as classified by NMDS.

We have no evidence that any of these "opportunities for problems" undermines the validity of the epidemiological results that we have presented, other than for a concern about the level of inaccuracy in regard to diagnosis and external cause coding on NMDS.

[q] When calculating rates for Māori, without some form of correction to ethnicity classification in single sources of numerator data, there are difficulties with the comparability of numerators and denominators, which can lead to numerator-denominator bias.

Table 25: Comparison of worker-years denominators (x100,000) derived from the LFS/LEED surveys compared with those derived from the 2001 and 2006 Censuses.

		Worker-years from LFS/LEED data	Worker years from Census data	Ratio
Age groups				
	15-24	9.66	8.60	1.12
	25-34	12.08	11.26	1.07
	35-44	14.71	13.67	1.08
	45-54	12.98	12.10	1.07
	55-64	7.38	6.94	1.06
	65 -84	1.35	1.73	0.78
	Total	58.15	54.30	1.07
Gender				
	Female	26.69	25.42	1.05
	Male	31.77	28.88	1.10
	Total	58.45	54.30	1.08
Employment status				
	Employees	46.30	41.32	1.12
	Self-employed	11.21	11.53	0.97
	Not elsewhere classified	-	1.45	
	Total	57.51	54.30	1.06
Ethnic group				
	European (inc NZ)	46.01	42.16	1.09
	Maori	5.47	5.91	0.93
	Pacific Islands	2.63	2.25	1.16
	Other Specified	4.29	3.57	1.20
	Unspecified	0.06	0.39	0.15
	Total	58.45	54.30	1.08
Industry				
A01 - A04	Agriculture,Forestry, Fishing	5.28	4.18	1.26
B11 - B15	Mining	0.12	0.10	1.21
C21 - C29	Manufacturing	8.41	6.70	1.26
D36 - D37	Electricity,Gas,Water	0.18	0.17	1.08
E41 - E42	Construction	4.02	3.60	1.12
F45 - F47	Wholesale	3.58	3.05	1.17
G51 - G53	Retail, Services	7.23	6.56	1.10
H57	Accommodation, Cafe, Restaurants	3.17	2.55	1.24
I61 - I67	Transport, Storage	2.34	2.07	1.13
J71	Communication Service	0.79	0.69	1.15
K73 - K75	Finance,Insurance	1.47	1.68	0.88
L77 - L78	Property, Business service	8.53	6.50	1.31
M81 - M82	Govt administration,Defence	1.84	1.86	0.99
N84	Education	4.54	3.92	1.16
O86 - O87	Health, Community service	4.82	4.43	1.09
P91 - P93	Cultural,Recreational	1.53	1.33	1.15
Q95 - Q97	Personal & Other services	1.98	2.03	0.97
	Missing	0.64	2.88	0.22
	Total	60.46	54.30	1.11
Occupation				
1000 - 1229	Legislators, Administrators, Managers	7.37	7.22	1.02
2000 - 2451	Professionals	8.29	7.76	1.07
3000 - 3381	Technicians & Associate professionals	6.61	6.25	1.06
4000 - 4222	Clerks	7.12	6.45	1.10
5000 - 5231	Service & Sales workers	8.99	7.53	1.19
6000 - 6144	Agriculture & Fishery workers	4.85	3.97	1.22
7000 - 7441	Trade workers	5.43	4.58	1.18
8000 - 8412	Plant & Machine operators, Assemblers	5.03	4.33	1.16
9000 - 9151	Elementary occupations	3.74	6.21	0.60
9700 - 9999	Unknown	0.09	-	-
	Total	57.52	54.30	1.06

4.1.3. What new knowledge this study brings

The epidemiological description of serious threat-to-life traumatic injury provides government and non-government agencies, for the first time, with a picture of the burden of these serious injuries. This information can be used as a starting point for further work to inform priority setting, planning, policy making, surveillance and monitoring.

This work has indicated that ACC data on their own are likely to be a suitable source from which an acceptable epidemiological picture of serious disabling non-fatal work-related traumatic injury can be derived, provided the identification of traumatic injury cases is not compromised by deficiencies in the ACC diagnostic data recorded on the ACC data base. The ACC algorithm used to identify traumatic injury, and its performance, should be investigated further and if found to be acceptable, then it will give the opportunity for routine monitoring of the national burden of serious disabling work-related traumatic injury using this source.

If the ACC injury diagnosis data is found not to compromise the identification of traumatic injury cases, this will open the way for the development of threat-of-disability indicators to support, at the very least, the Workplace Health and Safety Strategy. It could also be the basis for the development of more general national threat-of-disability traumatic injury indicators.

4.2. Recommendations

Recommendation 1

Since the epidemiological picture of serious threat-to-life work-related traumatic injury only provides part of the picture, and this is complemented by the picture of serious disabling work-related traumatic injury, the goal should be to present both pictures alongside each other when describing serious non-fatal work-related traumatic injury. It appears that a valid epidemiological picture can be produced for serious threat-to-life work-related traumatic injury at this time. It is less certain for serious disabling work-related traumatic injury and so further work to investigate the validity of using ACC data for this purpose should be carried out firstly (see immediately below).

Recommendation 2

The algorithm used to determine cases of traumatic injury, for the serious disabling epidemiological analysis, is based on ACC diagnosis data. This and other work suggest that there are problems with diagnosis coding, which seems to be due to the ACC capturing preliminary diagnosis rather than a confirmed diagnosis. It is unclear to what extent this will affect the algorithm used to differentiate traumatic injury from gradual process / occupational disease cases. We recommend that this be investigated.

Recommendation 3

The occupational groups presented in various tables throughout the report are broad groups comprising many specific occupations. For example, "Elementary occupations" includes occupations such as cleaners, caretakers, couriers, hotel porters, refuse collectors, street cleaners, packers, railway shunters, builder's labourers, sawmill labourers, and general labourers. Each of these occupations will carry their own varied risks; ie. the major group "Elementary" occupations is heterogeneous in terms of risk.

We recommend that further work be carried out to explain the results obtained for serious threat-to-life injuries as follows:

c) Identify specific occupations that are at particular risk
d) Describe the circumstances of injury in those occupations as well as the nature of injury that results.

Recommendation 4

Given we have identified unexplained high rates of traumatic injury for Māori, we recommend that a project be commissioned to describe the epidemiology of work-related traumatic injury for this population. It seems appropriate that such a project should be lead by Māori investigator(s) to ensure appropriate ownership of the results, and ownership of the implications and recommendations coming from such work.

Recommendation 5

It is recommended that the discrepancies found between NMDS and ACC data should be discussed with ACC in the context of the work on the accuracy of NMDS data (IPRU paper in preparation). ACC will be encouraged to consider the potential problems with their data (and potential solutions), and the implications these have for informing injury prevention activities - both internal and external to the ACC.

Recommendation 6

We are ignorant of the accuracy of the industry and occupation codes captured on the ACC database, as well as the ACC data from which we derived work-related status. As far as we are aware, no audits of the quality of these data have been carried out. It is important that the accuracy of these fields be assessed, since they are key fields for producing the epidemiological picture for serious threat-to-life and disabling work-related injury. We recommend that this work be funded, and the results disseminated widely in New Zealand.

Recommendation 7

This work has been limited to the investigation of non-MVTC serious non-fatal work-related injury. MVTCs have been found to be a significant cause of the burden of work-related fatal injury, and this is likely to be the case for serious non-fatal traumatic injury also. It is recommended, therefore, that work be commissioned to investigate methods to extend this work to investigate serious non-fatal work-related MVTC injury.

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6. Appendix A: Data request

6.1. ACC data

Investigation of the suitability of ACC data for describing the epidemiology of serious non-fatal work-related injury

Names: Colin Cryer; Daniel Russell
Position: Research Associate Professor; Data Manager
Address: Injury Prevention Research Unit (IPRU), Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, P O Box 913, Dunedin.
Date: 29 September 2006

This is a request to the ACC for claims data.

Date data required by: 11 October 2006

Case definition:

Any claim that meets all of the following criteria:

1. Has an injury event date between 1 Jan 2002 and 31 Dec 2004
2. The ACC account is one of {Employer, Self-Employed, Residual}
3. If Residual account, then the at work indicator field is set to "Yes"
4. Age at the time of the injury (that resulted in the claim) is 15 to 84 inclusive.
5. New claims only (as opposed to on-going)

Data required:

We require two SAS (version 9) datasets where the first dataset contains one claim per row and the second contains **all** diagnoses associated with the claim (one to many relationship)

ACC Claims Dataset	**ACC Diagnosis Dataset**
Case ID	Case ID
Person ID	Injury Sequence Number
Claim Date	Primary Injury Indicator
All recorded name fields (e.g. first name, surname, etc)	Read Code (original submitted code)
Last known residential address	ICD-9 Code (original submitted code)
Date of Birth	ICD-10 Code (original submitted code)
Sex	ICD-10 Code (mapped from ICD-9)
Ethnicity	ICD-10 Code (mapped from Read)
NHI Number	ACC Diagnose Code
Resident (R=ordinarily NZ resident; N=NZ citizen, not ordinarily resident in NZ, O=overseas visitor)	Injury Site
ACC 45 Claim Form Number	
Accident Date	
Fatality Indicator	
Activity	

Industry	
Occupation	
ICD External cause code – if available (please provide ICD revision number)	
Cause	
Contact	
Agency type	
Agency1: Road	
Agency1: External agency other than road	
Agency2: Road	
Sport	
SportInv	
Scene	
Location	
Accident Description	
Number of days on which earnings-related compensation is paid[r]	
Time-off work[s]	
Type of Claim (MOE – Medical treatment only, Entitlement, Other)	
At Work Indicator	
Serious Injury Indicator	
Account	
Employment Status	
Gradual Process Claim (Y/N)	
Is an eLodgement Claim (Y/N)	

[r] Could you please derive a variable that approximates this?
[s] Could you please provide the method used to derive this?

7. Appendix B: Pros and cons of selected sources of data for the denominators for rates.

Data sources explored:

(1) SNZ Census data

(2) Household Labour Force Survey (LFS) data

(3) Linked Employer Employee Data (LEED)

(1) SNZ census data:

(a) Available for census years only, hence interpolations/extrapolations have to be done for non-census years.

(b) Censuses are done in certain months of the year. This will affect numbers that are seasonally changing (e.g., some industries are seasonal).

(c) Freely available data tables are usually univariate; thus they cannot be categorised into more than one variable. For example, once the working people are identified from one table they cannot be further grouped into age groups, ethnic groups etc.

(d) Data for census years are available for purchase in required specifications.

(e) Counts from a complete Census are measures with no statistical variation, unlike measures from a sample survey.

(2) Household labour force survey data:

(a) Data comes from sample surveys, thus they are only estimates.

(b) Data are available quarterly. After each survey all previous estimates are updated, therefore all estimates are effectively 'provisional'.

(c) Freely available data tables are for working population, thus the question of excluding non-working population does not arise.

(d) Workers aged less than 15 years can be excluded, but workers aged 85 and older cannot be separated (65+ is a single group).

(e) All tables are univariate. As a consequence, non-eligible age groups cannot be eliminated when categorising into another variable (say when categorising to ethnic groups). However this may not be a big problem because numbers of workers <15 years and >85 years are unlikely to be large.

(f) Most tables include data for each quarter separately; we can get the average of 4 quarters in a year (i.e., people in seasonal employments will be included).

(g) Industry groups are different from ANZSIC groups (some of the groups are combined categories of ANZSIC).

(3) LEED:

(a) Industry groups are coded to ANZSIC groups.

(b) Numbers in LEED differ slightly from LFS numbers

(c) There are slight discrepancies between tables.

8. Appendix C: Record Linkage

Daniel Russell, Data Management, IPRU.

8.1. Preparation of Datasets for Linkage

8.1.1. Data Sources

ACC Work-related Claims

IPRU received two SAS datasets from ACC - a claims data set and a diagnosis data set. The claims data set contained one record per ACC claim for claims that met the following criteria:

1. Has an injury event date between 1 Jan 2002 and 31 Dec 2004
2. The ACC account is one of {Employer, Self-Employed, Residual}
3. If Residual account, then the at work indicator field is set to "Yes"
4. Age at the time of the injury (that resulted in the claim) is between 15 to 84 inclusive.
5. New claims only (as opposed to on-going)

There were 763,539 claim records. The diagnosis data set contains all ACC diagnosis information for the claims that met the criteria given above. There were 926,134 diagnosis records.

NZHIS NMDS Discharges

IPRU maintain a collection of almost 30 years of injury related publicly funded discharges from New Zealand hospitals. These data sets were originally sourced from NZHIS. Discharges between 2002 and 2005, where the ICD-10 principal diagnosis was an 'S' or 'T' code, were selected for linking to the ACC claims dataset. Readmissions for the same event were excluded. There were 297,859 discharge records selected for the record linkage.

8.2. Record Linkage Methodology

8.2.1. Data Cleaning

The purpose of the record linkage was, for each ACC claim, to link an ACC work-related claim to a hospital discharge that related to the same injury event. Therefore, the record linkage needed to match both the same person and the same injury event.

Both datasets were cleaned and new variables were created for the purpose of record linkage. Attributes associated with the person's name were stripped of all non-alphabetic characters, including white space, and converted to uppercase. For example, the surname "O' Conner" was transformed to "OCONNER". The contents of the ACC Claim Form field in the NZHIS dataset is not validated, and therefore can contain invalid ACC M45 claim form numbers. Thus values contained in this field, that could not be parsed into a valid ACC Claim Form Number, were set to missing. All other attributes were checked for unusual values and were set to missing if the values were implausible. The first character of the first given name was extracted as a separate variable to aid with blocking strategies in the record linkage process. Finally, to account for possible mis-spellings, the Soundex phonetic algorithm was used to create codes that would allow for the blocking of

names based on their sound rather than spelling. A list of fields used in the record linkage is shown in Table 26 below.

Table 26 List of attributes used in the record linkage.

NZHIS Hospital Discharge data set	ACC data set
First given name	First given name
Second given name	Second given name
Third given name	First given initial
Initial of first name	Initial of first name
Soundex of surname	Soundex of surname
Soundex of first given name	Soundex of first given name
Sex	Sex
Date of birth	Date of birth
Year of birth	Year of birth
Month of birth	Month of birth
Day of birth	Day of birth
National Health Index (NHI) number	National Health Index (NHI) number
ACC M45 Claim Form Number	ACC M45 Claim Form Number
Injury date	Injury date
Year of injury	Year of injury
Month of injury	Month of injury
Day of injury	Day of injury

8.2.2. Matching Process

The software used for record linkage was AUTOMATCH. The record linkage process involves selecting a matching and blocking strategy at each pass. AUTOMATCH allows up to 8 passes. Blocking variables reduce the number of record pairs that are examined at each pass. For each pass matching variables are compared within each of the datasets and an overall score is computed that describes the similarity of record-pairs. Scores that are above a user defined maximum threshold are classified as matches, scores below the user defined minimum threshold are classified as non-matches and scores in between the two thresholds are classified as undecided cases. Undecided cases are usually subject to clerical/manual review – however, given the large number of records that may be classified as undecided, the minimum and maximum thresholds were always set as equal at each pass to eliminate manual review. After each pass, the record-pairs were sorted in decreasing score order and a manual scan was conducted to decide on an appropriate cut-off threshold.

Table 27 lists the blocking and matching variables selected at each pass.

Table 27 Blocking and matching variables used at each pass

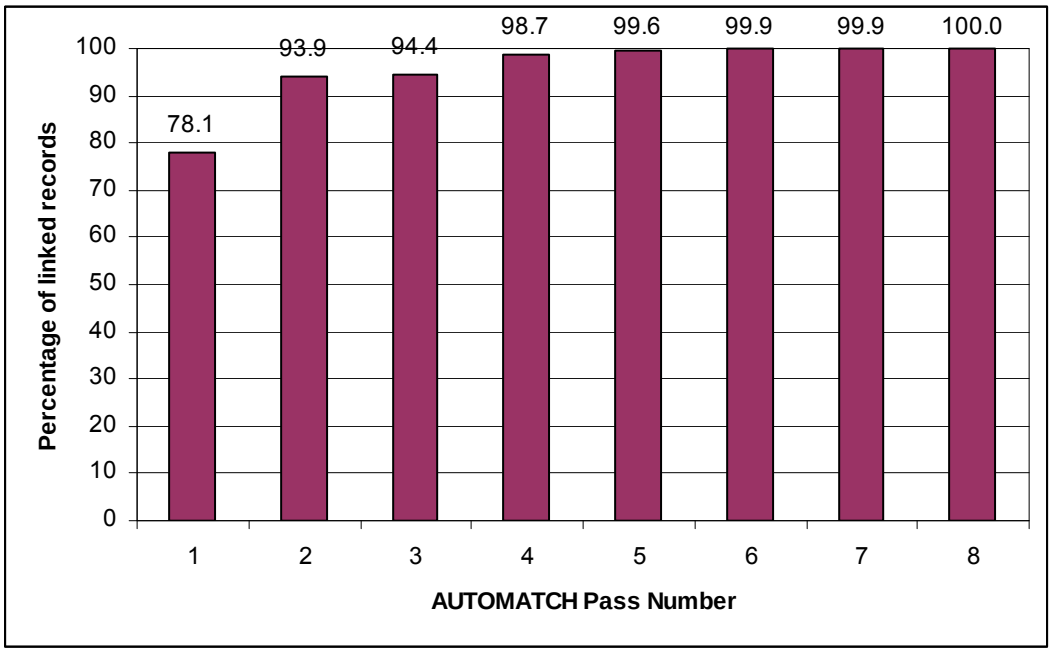
Pass Number	Blocking variables	Matching variables
1	Surname Initial of first name Sex Date of birth Date of injury	First given name Second given name Third given name NHI ACC M45 Claim Number
2	ACC M45 Claim Number Year of injury	Surname First given name Second given name Third given name NHI Date of injury

		Date of birth
3	NHI Date of injury	Surname First given name Second given name Third given name ACC M45 Claim Number Date of birth
4	Soundex of surname Soundex of first given name Sex Date of birth	Date of injury
5	Soundex of surname Soundex of first given name Year of injury	Date of injury Date of birth
6	Date of injury Date of birth Soundex of surname Sex	Date of birth Surname First given name Second given name Third given name
7	Date of injury Year of birth Surname Sex	Date of birth First given name Second given name NHI ACC M45 Claim Number
8	Soundex of surname Soundex of first given name ACC M45 Claim Number	Date of injury

8.3. Linkage Result

Figure 4 displays the number of matched record-pairs after each pass of the record linkage process. 78% of the matched record-pairs were matched on the first. There were 16,098 matched record-pairs which relates to 5.4% of the NZHIS hospital discharges and 2.1% of ACC work-related claim records. However, these percentages cannot be used to judge the accuracy/success of the record linkage as the NZHIS dataset contained a large number of records that are unlikely to have an associated ACC claim in the ACC dataset, for example, non-work-related hospitalisations and injuries that occurred in 2005.

Figure 4: **Bar chart showing cumulative percentage of records linked at each pass.**



Accuracy of the record linkage was not examined in an objective way. However, in all passes close attention was paid to the quality of matches when determining the cut-off threshold value. The occurrence of false positives was the prime determinant of where to place the threshold, and records below this point were further examined to determine if good matches had fallen below the cut-off. By examining such low-rated matches, the criteria for the subsequent pass could be modified to increase the overall accuracy of the matching. A thorough clerical review of the final pass (pass 8) was used to establish whether any more cases existed that could still be matched without the inclusion of false-positive results.

8.4. AUTOMATCH Matching Code

```
================================================================================
;            SERIOUS WORK-RELATED INJURY STUDY (SWIS) 2006
;
; Date  : 9 Nov 2006;
; Author: Dan Russell
; IP    : Colin
;
; Match ACC claims (2002 - 2004) to NZHIS morbidity dataset (2002 - 2005)
; ================================================================================


PROGRAM MATCH
DICTA C:\nobackup\swis\acc
DICTB C:\nobackup\swis\hosp



; ================================================================================
;  PASS 1
;   Get the obvious/ easy matches - where nearly all the fields match exactly

BLOCK1 CHAR    SURNAME   SURNAME
BLOCK1 CHAR    INITIAL1  INITIAL1
BLOCK1 CHAR     SEX       GENDER
BLOCK1 CHAR     DOBDATE   DOBDATE
BLOCK1 CHAR     INJDATE   INJDATE

MATCH1 CHAR    NAME1          NAME1     0.99  0.1
MATCH1 CHAR    NAME2          NAME2     0.9   0.1
MATCH1 CHAR    NAME3          NAME3     0.9   0.1
MATCH1 CHAR    NHI            NHI       0.99  0.01
MATCH1 CHAR    M45            ACCCLAIM  0.99  0.01


CUTOFF1 -50 -50 200




; ================================================================================
;  PASS 2
;   Match if they have the same acc M45 claim number

BLOCK2 CHAR    M45      ACCClAIM
BLOCK2 NUMERIC  INJYEAR  INJYEAR

MATCH2 UNCERT  SURNAME        SURNAME   0.99  0.1 700
MATCH2 UNCERT  NAME1          NAME1     0.99  0.1 700
MATCH2 UNCERT  NAME2          NAME2     0.9   0.1 700
MATCH2 UNCERT  NAME3          NAME3     0.9   0.2 700
MATCH2 CHAR    NHI            NHI       0.99  0.1
MATCH2 CNT_DIFF       INJDATE        INJDATE   0.99  0.0001 1
MATCH2 CNT_DIFF       DOBDATE        DOBDATE   0.99  0.0001 1

CUTOFF2 0 0 200




; ================================================================================
;  PASS 3
;   Match on NHI number and injury date

BLOCK3 CHAR    NHI     NHI
BLOCK3 NUMERIC  INJDATE INJDATE

MATCH3 UNCERT  SURNAME        SURNAME   0.99  0.01 700
MATCH3 UNCERT  NAME1          NAME1     0.99  0.1 700
MATCH3 UNCERT  NAME2          NAME2     0.9   0.1 700
```

```
MATCH3 UNCERT  NAME3          NAME3     0.9   0.2 700
MATCH3 CHAR    M45            ACCCLAIM  0.99  0.1
MATCH3 CNT_DIFF        DOBDATE        DOBDATE   0.99  0.0001 1

CUTOFF3 -50 -50 200

; ============================================================================
;  PASS 4
;   Match where we are confident that it is the same person and allowing for 3
;   days difference on the injury date.

BLOCK4 CHAR    SNDXSURN  SNDXSURN
BLOCK4 CHAR    SNDXNAME  SNDXNAME
BLOCK4 CHAR     SEX       GENDER
BLOCK4 CHAR     DOBDATE   DOBDATE

MATCH4 DATE8   INJDATE        INJDATE   0.999 0.00001 3

CUTOFF4 0 0 200


; ============================================================================
;  PASS 5
;   Match where we are confident that it is the same person and allowing for 3
;   days difference on the injury date and char transpositions in date of birth

BLOCK5 CHAR    SNDXSURN  SNDXSURN
BLOCK5 CHAR    SNDXNAME  SNDXNAME
BLOCK5 NUMERIC INJYEAR   INJYEAR

MATCH5 DATE8   INJDATE   INJDATE   0.999 0.00001 2
MATCH5 CNT_DIFF        DOBDATE   DOBDATE   0.99  0.01    1


CUTOFF5 7.40 7.40 200



; ============================================================================
;  PASS 6
;

BLOCK6 CHAR    INJDATE   INJDATE
BLOCK6 CHAR    DOBDATE   DOBDATE
BLOCK6 CHAR    SNDXSURN  SNDXSURN
BLOCK6 CHAR     SEX       GENDER

MATCH6 CNT_DIFF        DOBDATE        DOBDATE   0.999 0.00001 1
MATCH6 UNCERT  SURNAME        SURNAME   0.99  0.01 700
MATCH6 UNCERT  NAME1          NAME1     0.99  0.01 700
MATCH6 UNCERT  NAME2          NAME2     0.9   0.1 700
MATCH6 UNCERT  NAME3          NAME3     0.9   0.2 700


CUTOFF6 16.24 16.24 200


; ============================================================================
;  PASS 7
;

BLOCK7 CHAR    INJDATE   INJDATE
BLOCK7 CHAR    DOBYEAR   DOBYEAR
BLOCK7 CHAR    SURNAME   SURNAME
BLOCK7 CHAR     SEX       GENDER

MATCH7 CNT_DIFF        DOBDATE        DOBDATE   0.999 0.001 1
MATCH7 UNCERT  NAME1          NAME1     0.9   0.1 700
MATCH7 UNCERT  NAME2          NAME2     0.9   0.1 700
MATCH7 UNCERT  NHI            NHI       0.9   0.3 700
MATCH7 UNCERT  M45            ACCCLAIM  0.99  0.5 700

CUTOFF7 100 100 200

VARTYPE INJDATE NOUPDATE

; ============================================================================
```

```
;  PASS 8
;   Match where we are confident that it is the same person and allowing for 1
;   char transposition in the injury date.

BLOCK8 CHAR    SNDXSURN  SNDXSURN
BLOCK8 CHAR    SNDXNAME  SNDXNAME
BLOCK8 CHAR     M45       ACCCLAIM

MATCH8 CNT_DIFF        INJDATE        INJDATE   0.999 0.00001 1


CUTOFF8 0 0 200
```

9. Appendix D: The method of classification of ACC claims into gradual process / disease and traumatic injury claims.

The definition of “gradual process” and “injury” is provided by the IPRC Act. The definition of gradual process has been operationalised (principally by Andrew Burton [actuary] in consultation with Kevin Morris [Chief Medical Advisor]) in the form of code used by ACC to identify gradual process claims. (Tim Boyd Wilson, Personal correspondence, 4 October 2006).

Code to classify claims as gradual process claims was supplied to IPRU by ACC (Chris Taylor, personal correspondence). We were informed that this routine classifies a case as gradual process if any diagnosis on the claims record is a gradual process code. IPRU has amended this code for this project, such that a case is defied as an injury if the primary diagnosis (or in its absence diagnosis 1) was an injury code, even in the presence of a gradual process diagnosis code in another field.

The SAS code supplied by ACC is reproduced below.

```
IF Read THEN Read Code = PUT(Read, Read Code.) ;
  IF Diagnosis in
('11','20','21','22','23','24','25','26','31','60','61','90','91','92','
93','94')
  THEN Grad Proc_Diag = 'Y' ;
  IF  (ICD9Code ne " " and SUBSTR(ICD9Code,3,1) not in (' ','.')) and
      (('010'   le ICD9Code le '018.99') or ('137'    le ICD9Code le
'137.99') or
       ('V01.1' le ICD9Code le 'V01.19') or /*Tuberculosis*/
       ('020'   le ICD9Code le '027.99') or /*Zoonotic bacterial inf*/
       ('022'   le ICD9Code le '022.99') or /*Anthrax*/
       ('023'   le ICD9Code le '023.99') or /*Brucellosis*/
       ('030'   le ICD9Code le '031.99') or /*Leprosy/other
mycobacterium*/
       ('036'   le ICD9Code le '036.99') or /*Meningococcal inf*/
       ('038'   le ICD9Code le '038.99') or /*Septicaemia, various*/
       ('042'   le ICD9Code le '044.99') or (ICD9Code eq '279.10') or
/*HIV/AIDS*/
                                  (ICD9Code eq '482.83') or
/*Legionella*/
       ('051'   le ICD9Code le '051.99') or /*Cowpox/sheep
pox(orf)/paravaccinia*/
       ('070'   le ICD9Code le '070.99') or /*Viral Hepatitis*/
       ('100'   le ICD9Code le '100.99') or /*Leptospirosis*/
```

```
('140'   le ICD9Code le '208.99') or /*Malignant cancer*/
('162'   le ICD9Code le '163.99') or /*Lung Cancer/Meso*/
('173'   le ICD9Code le '173.99') or /*Epithelial skin ca*/
('230'   le ICD9Code le '234.99') or /*Carcinoma in situ*/
('331'   le ICD9Code le '332.99') or /*Cerebral
degeneration/Alzheimers/Parkinsons*/
('337.2' le ICD9Code le '337.29') or /*Regional pain syndrome,
autonomic nerv sys*/
('348.3' le ICD9Code le '348.39') or /*Toxic encephalopathy*/
('350'   le ICD9Code le '353.99') or /*Cranial nerve, nerve root
and plexus disorders*/
('354'   le ICD9Code le '355.99') or /*Upper/lower limb
mononeuropathies, incl. Carpal TS*/
('356'   le ICD9Code le '357.99') or /*Peripheral/Toxic
neuropathies*/
('388.1' le ICD9Code le '388.19') or ('389'    le ICD9Code le
'389.99') or /*Hearing Loss*/
('410'   le ICD9Code le '414.99') or /*Ischaemic Heart Disease*/
('443.0' le ICD9Code le '443.09') or /*Raynaud's Phenomenon*/
('481'   le ICD9Code le '482.99') or /*Pneumococcal/other
bacterial pneumonia, incl. Legionnaires*/
('490'   le ICD9Code le '496.99') or /*CORD etc.*/
('495'   le ICD9Code le '495.99') or /*Allergic Alveolitis from
external agents*/
('500'   le ICD9Code le '500.99') or /*Pneumoconiosis from coal*/
('501'   le ICD9Code le '502.99') or /*Pn Asbestos/Silicosis*/
('503'   le ICD9Code le '503.99') or /*Pn Siderosis/other
inorganic*/
('504'   le ICD9Code le '505.99') or /*Pn from organic/other*/
('506'   le ICD9Code le '508.99') or /*Respiratory conditions
from other external agents*/
('570'   le ICD9Code le '573.99') or /*Hepatic disease*/
('571.4' le ICD9Code le '571.49') or ('573.1' le ICD9Code le
'573.39') or /*Chronic Hepatitis*/
('580'   le ICD9Code le '593.99') or /*Renal disease*/
('585'   le ICD9Code le '585.99') or /*Chronic Renal failure*/
('692'   le ICD9Code le '692.99') or /*Contact Dermatitis*/
(ICD9Code eq '709.01')           or /*Vitiligo/Leucoderma*/
('710.1' le ICD9Code le '710.19') or /*Scleroderma*/
('719.4' le ICD9Code le '719.49') or /*Arthralgia*/
```

```
      ('720'   le ICD9Code le '721.99') or
/*Spondylopathy/Spondylitis*/
      ('722.4' le ICD9Code le '722.79') or /*Intervertebral disc
degen/myelopathy*/
      ('723.1' le ICD9Code le '723.69') or /*Cervical
Neuropathy/Neuritis, incl. neck pain*/
      ('724.1' le ICD9Code le '724.59') or /*Thor, Lumb, Sacc
Neuropathy/Neuritis, incl. back pain*/
      ('725'   le ICD9Code le '727.49') or /*Disorders of muscle,
synovium, tendon and bursa*/
      ('727.8' le ICD9Code le '727.89') or /*Transient synovitis*/
      ('728.6' le ICD9Code le '728.79') or /*Palmar/Plantar fasciitis*/
      ('729.0' le ICD9Code le '729.19') or /*Rheumatism/Fibromyalgia
NOS, pain synd soft tiss*/
      ('729.2' le ICD9Code le '729.29') or /*Neuropathy/Radiculopathy
NOS*/
      ('980'   le ICD9Code le '980.99') or /*Alcohol products*/
      ('981'   le ICD9Code le '981.99') or /*Petroleum products*/
      ('982'   le ICD9Code le '982.99') or /*Non-Petroleum solvent*/
      ('983'   le ICD9Code le '983.99') or /*Corrosives, incl.
Phosphorus*/
      ('984'   le ICD9Code le '984.99') or ('E86.15' le ICD9Code le
'E86.15') or /*Lead*/
      ('985'   le ICD9Code le '985.99') or /*Other toxic metals*/
      ('985.0' le ICD9Code le '985.09') or /*Mercury*/
      ('985.1' le ICD9Code le '985.19') or /*Arsenic*/
      ('985.2' le ICD9Code le '985.29') or /*Manganese*/
      ('985.3' le ICD9Code le '985.39') or /*Beryllium*/
      ('985.4' le ICD9Code le '985.49') or /*Antimony*/
      ('985.5' le ICD9Code le '985.59') or /*Cadmium*/
      ('985.6' le ICD9Code le '985.69') or /*Chromium*/
      ('985.8' le ICD9Code le '985.99') or /*Other metals*/
      ('986'   le ICD9Code le '986.99') or /*Carbon Monoxide*/
      ('987'   le ICD9Code le '987.99') or /*Other gases/vapours*/
      ('989'   le ICD9Code le '989.49') or /*Other chemicals (not food
       or animals)*/
      ('989.6' le ICD9Code le '989.69') or /*Other chemicals (not food
      or animals)*/
      ('989.8' le ICD9Code le '989.99') or /*Other chemicals (not food
       or animals)*/
```

```
      ('990'   le ICD9Code le '990.99') or ('E92.63' le ICD9Code le
'E92.69')) /*Radiation*/
  THEN DO ;
    GradProc_Diag = 'Y' ;
    GradProc_Diag_ICD = 'Y' ;
  END ;
  ELSE IF
      ('A788.' le ReadCode le 'A789z') or (ReadCode eq 'ZV01A') or
/*HIV/AIDS*/
      ('A3A4.' le ReadCode le 'A3A4z') or (ReadCode eq 'H22y2') or
/*Legionella*/
      ('A70..' le ReadCode le 'A70zz') or /*Viral Hepatitis*/
      ('B226.' le ReadCode le 'B226z') or (ReadCode eq 'B81y0') or
/*Lung Cancer/Meso*/
      ('14O3.' le ReadCode le '14O3z') or /*Pn Asbestos/Silicosis*/
      (ReadCode eq 'H432.')           or /*Pn Siderosis/other
inorganic*/
      ('U1AA.' le ReadCode le 'U1AAz') or (ReadCode eq 'SM9C.') or
/*Non-Petroleum solvent*/
      (ReadCode eq 'SM58.')           or /*Corrosives, incl.
Phosphorus*/
      (ReadCode eq 'F29y3')           or /*Toxic encephalopathy*/
      ('M295.' le ReadCode le 'M295z')    /*Vitiligo/Leucoderma*/
  THEN DO ;
    GradProc_Diag = 'Y' ;
    GradProc_Diag_ICD = 'Y' ;
  END ;
  ELSE GradProc_Diag_ICD = 'N' ;
  IF GradProc_Diag ne 'Y' THEN GradProc_Diag = 'N' ;
  IF ICD9Code ne " " or ReadCode ne " " THEN Has_Code = 'Y' ;
                                ELSE Has_Code = 'N' ;
  IF (NOT P) and First.Case_ID THEN Primary_ = 'Y' ;
  ELSE IF P and Primary_ eq 'Y' and (NOT First.Case_ID) THEN DO ;
    OUTPUT ChkP ;
    Primary_ = 'N' ;
  END ;
  IF Diagnosis in ('11','60') and GradProc_Diag_ICD eq 'N' THEN
  GradProc_Diag = 'N' ; *ignore nulls/other icd ;
  ELSE IF Diagnosis in ('20','21','22','23','24','31','61','93') and
  GradProc_Diag_ICD eq 'N' and Has_Code eq 'Y' THEN
```

```
GradProc_Diag = 'N' ; *keep nulls, ignore other icd ;
*keep all for '25','26','90','91','92','94' ;
OUTPUT Inj1 ;
RENAME Primary_ = Primary ;
RUN;
```

10. Appendix E: Checking, understanding, and initial processing of the data

10.1. Linked ACC-NMDS data

This subsection is in 2 parts: part 1 considers inclusion/exclusion criteria; part 2 presents a univariate descriptive analysis of injuries.

10.1.1. Checking for inclusion/exclusion criteria

There were 763,539 claims in ACC data and 297,859 discharges in NMDS satisfying our selection criteria[t]. Of these, 16,098 records were linked. The following information relates to these linked records.

Below is a discussion of the data relative to the selection criteria or a case. It also provides the logic behind decisions made – eg. which data source the key variables should be taken from.

(1A) Accident date should be during 2002 to 2004:

As seen from Table 28, information from the 2 sources were not in exact concordance, but almost so (99% concordant). ACC data were selected such that all incidents took place within 2002-2004, but according to NMDS there were injuries incidents that occurred outside of this period. Injury year (NMDS) was unknown for 60 injury events.

Table 28: Year of injury as classified by ACC and NMDS for the linked ACC to NMDS data

	acc_acciyear			
INJURYYEAR	2002	2003	2004	Total
1991	0	1	1	2
1996	0	0	1	1
1999	0	1	0	1
2000	1	2	2	5
2001	5	1	1	7
2002	5,240	8	4	5,252
2003	7	5,247	6	5,260
2004	2	4	5,496	5,502
2005	0	3	5	8
.	15	16	29	60
Total	5,270	5,283	5,545	16,098

The variable “acc_acciyear” is from ACC, and “injuryyear” is from NMDS.

Due to this discordance, we (the project team) agreed to use ACC information as the source for the date of event.

[t] All discharges were first admissions. All claims were new claims. However, multiple admissions and multiple claims were possible for a person for separate traumatic injury events.

(1B) Age should be between 15 and 84 years:

Age is the 'age at the time of traumatic injury'.

- For the ACC data, age was calculated from the date of the traumatic injury and the date of birth. ACC data were selected such that ages were between 15 and 84 inclusive.
- Traumatic injury date and date of birth were used to calculate age from NMDS.

Ages derived from NMDS and from ACC data did not agree for some cases. There were 5 cases with ages outside the 15-84 age range, and 101 people with unknown ages, due to missing injury date in subset of data used from NMDS. Table 29 shows the distribution of differences in the number of days between the two ages (i.e., age_diff = hospital_age – acc_age). Please note the table tabulates people[u] rather than ACC claims (the total number of people was smaller than total number of claims.)

Table 29: The difference in derived age from ACC and NMDS for the linked ACC to NMDS data

age_diff	Freq.	Percent	Cum.
-30	3	0.02	0.02
-20	4	0.03	0.04
-18	1	0.01	0.05
-12	1	0.01	0.06
-10	6	0.04	0.09
-9	2	0.01	0.11
-8	2	0.01	0.12
-6	2	0.01	0.13
-5	3	0.02	0.15
-4	5	0.03	0.18
-3	7	0.04	0.23
-2	17	0.11	0.33
-1	85	0.54	0.87
0	15,467	97.47	98.34
1	78	0.49	98.83
2	27	0.17	99.00
3	20	0.13	99.13
4	7	0.04	99.17
5	6	0.04	99.21
6	7	0.04	99.26
7	1	0.01	99.26
9	1	0.01	99.27
10	8	0.05	99.32
12	1	0.01	99.33
14	1	0.01	99.33
20	2	0.01	99.34
30	1	0.01	99.35
50	1	0.01	99.36
60	1	0.01	99.36
.	101	0.64	100.00
Total	15,868	100.00	

Given the level of concordance of ACC and NMDS ages, it was an arbitrary decision regarding which source to use for age in the analysis. We decided to use ACC data as the source.

[u] People were identified from the ACC field: acc_person_id. Multiple claims for the same person had the same acc_person_id.

(1C) Should be work-related injuries (see section 1L below):

The operational definition for the work-relatedness was as follows: the ACC account from which the claim was paid should be either Employer or Self-employed, or Residual. If from the Residual account, the work-indicator should be set to "yes". Table 30 shows the data is consistent with this.

Table 30: Work-related status as classified by ACC and the ACC account from claims paid for claims in the linked ACC to NMDS data

```
. tab fundx atworkind

                      | atworkind
                fundx |         Y |     Total
----------------------+-----------+----------
Employers/Other Insur |    12,850 |    12,850
             Residual |         1 |         1
   Self-employed work |     3,247 |     3,247
----------------------+-----------+----------
                Total |    16,098 |    16,098
"fundx" = ACC account from which the claim was paid.
"atworkind" = ACC at work indicators; all set to yes.
```

(1D) Should be claims for traumatic injuries, not or gradual process or occupational diseases

For this study, a traumatic injury was defined as one having a principal diagnosis of injury on the NMDS hospital discharge record from within the ICD-10 code range S00 to T78. 218 "injury" cases with diagnosis codes beyond T78 were excluded. These include "complications of surgical and medical care, not elsewhere classified" (T80-T88) and "Sequelae of injuries, of poisonings and of other consequences of external causes" (T90-T98), previously known as "late effects".

ACC has a field that denotes whether or not a claim is for traumatic injury or whether it is for occupational disease or gradual process (gradual process flag). ACC's gradual process flag is not concordant with the NMDS diagnosis codes. Although 446 claims are labeled by ACC as gradual process claims, for the majority the ACC's own cause codes do not seem to make logical sense with them being gradual process claims (e.g. Struck by person/animal; Slipping, Skidding On Foot, etc). For these 446 cases, the NMDS principal diagnosis was within the range S00 to T88.

(1E) Should be new hospital admissions, not readmissions.

The IPRU derived readmission variable from hospital data was set to "N" for all cases.

(1F) Should be serious injuries

Severity is measured using ICISS. Summary of the distribution of ICISS amongst the linked ACC-NMDS dataset is as follows.

Table 31: The number of claims above and below the threat-to-life injury severity threshold for the linked ACC to NMDS data

ICISS	Number of cases
Missing	0
<0.941	1175
=0.941	0
>0.941	14705

Table 31 shows that 14,705 did not satisfy our serious threat-to-life definition of serious and so were excluded.

(1G) Should be non fatal

We excluded cases for which either source of information (ACC or NMDS 1st admission record) indicated that a person was dead. This information is in the "dischargetype" variable in hospital data, and the "fataltype" variable in ACC data (Table 32). There were 32 cases identified in this way (27 from NMDS, 30 from ACC – with 25 from both sources) which were excluded.

Table 32: Whether a fatal injury as classified by ACC and NMDS discharge status for the linked ACC to NMDS data

DISCHARGETYPE	fataltype N	Total
DA	10	0	10
DD	2	25	27
DF	12	0	12
DI	5	0	5
DO	0	1	1
DR	922	0	922
DS	5	0	5
DT	164	4	168
DW	25	0	25
Total	1,145	30	1,175

dischargetype=DD is the "discharged dead"
fataltype="N" designates a fatal case.

Summary of case selection for linked data analysis

Table 33: Summary of case selection for linked data analysis

Cases in ACC data	763,539
Cases in NMDS data	297,859
Cases linked	16,098
Cases excluded due to diagnoses beyond the range	218
Cases excluded due to non-serious (ICISS≤0.941)	14705
Cases excluded due to fatal	32
Cases remaining in linked dataset for further analyses	1,143
People remaining in the linked dataset	1,140

This is a replication of Table 2 in section 3.2.1.

10.1.2. Descriptive statistics of linked data

The following descriptive analysis includes the above mentioned 1143 claims from 1140 persons that were retained in data set after checking the inclusion/exclusion criteria. It complements what is in section 3.2.1.

Age

Table 34: Number of cases by age group.

acc_age_group	acc_acciyear 2002	2003	2004	Total
15-24	42	46	63	151
25-34	78	74	70	222
35-44	89	88	85	262
45-54	80	77	81	238
55-64	54	75	68	197
65-84	25	24	24	73
Total	368	384	391	1,143

Gender

The distribution of the number of cases by gender and year is shown in Table 35. Note that this is of the number of people who submitted claims. (There are 3 people who submitted 2 claims each; one male in 2003, and two males in 2004).

Table 35: Number of cases by year and gender.

GENDER	acc_acciyear 2002	2003	2004	Total
F	37	39	46	122
M	331	345	345	1,021
Total	368	384	391	1,143

Ethnic group:

The distribution of the number of cases by ethnic group and year is shown in Table 36.

Table 36: Number of cases by year and ethnic group.

ethnicity_level1	acc_acciyear 2002	2003	2004	Total
European	259	269	280	808
Māori	51	62	49	162
Other ethnic groups	36	44	36	116
Pacific Islands	9	4	16	29
Unknown	13	5	10	28
Total	368	384	391	1,143

Employment status:

Table 37: Number of cases by year and employment status.

emplstatus	acc_acciyear 2002	2003	2004	Total
Employers	267	288	301	856
Self-employed worker	101	96	90	287
Total	368	384	391	1,143

Note that the "emplstatus" variable identifies the fund that is used to pay the claim, employees are paid from employers fund.

Diagnosis groups:

See Table 3 in section 3.2.1.

External cause code:

Table 38: Number of cases by mechanism and intent.

Mechanism/Cause	Manner/intent Assault	Other	Unintentional	Total
Cut/Pierce	6	0	22	28
Fall	0	0	390	390
Fire/Hot object or Substance	0	0	57	57
Firearm	2	0	0	2
Machinery	0	0	65	65
Motor Vehicle Traffic	0	0	39	39
Natural/Environmental	0	0	52	52
Other Land Transport	0	0	208	208
Other Specified	0	0	40	40
Other Specified, nec	2	1	0	3
Other Transport	0	0	22	22
Overexertion	0	0	1	1
Pedal Cyclist, other	0	0	1	1
Pedestrian, other	0	0	18	18
Poisoning	0	0	17	17
Struck by or against	31	0	158	189
Suffocation	1	0	1	2
Unspecified	3	0	6	9
Total	45	1	1,097	1,143

One potential concern here is that there were 39 e-codes that relate to "motor vehicle traffic" cases and 208 related to "other land transport" cases. ACC includes motor vehicle cases in a separate account (Motor Vehicle Account) from non-MVTC work-related cases – with the exception of some incidents that occur whilst

commuting (see IPRC Act 2001). Given the above, why do these cases appear in linked data? This was investigated by inspecting event descriptions from NMDS and accident descriptions from ACC data.

Amongst the 39 “motor vehicle traffic” cases, we found that many of these cases are not motor vehicle crashes on public roads; however, some involved passengers falling from a vehicle on a public road, or were crushed by a motor vehicle whilst working on or beside a public road. Several others appeared to be MVTC-related. The total number of MVTCs was too few to cause significant bias to this type of epidemiological description.

Amongst the 208 “other land transport” cases, the vast majority of these occurred off-road; many on farms.

10.2. ACC data alone

There were 763,539 ACC claims data records from 537,580 people supplied by ACC according to the specification in Appendix A.

10.2.1. Checking data for inclusion and exclusion criteria:

Claims should be related to 2002 – 2004 years.

All claims were recorded by ACC as from 2002-2004 years.

Table 39: ACC claims frequency satisfying our data specification by year as recorded by the ACC.

	Freq.	Percent	Cum. Percent
2002	254,281	33.30	33.30
2003	253,492	33.20	66.50
2004	255,766	33.50	100.00
Total	763,539	100.00	

Age should be between 15 and 84 years:

Age at traumatic injury was calculated using the date of the incident and date of birth. 33 claims were dropped due to age being recorded by ACC as below 15 years. All remaining claimants were in the age range 15 to 84.

Should be work-related traumatic injury claims

The ACC account, from which the ACC claim was paid, should be Employer, Self-employed, or the Residual account. If Residual, the work indicator should be set to “Yes”. Table 40 shows that all the claims were work-related according to this case definition.

Table 40: Work-related status of claims and account from which it was paid.

fundx	atworkind Y	Total
Employers/Other Insur	623,708	623,708
Residual	198	198
Self-employed work	139,600	139,600
Total	763,506	763,506

Should be traumatic injury claims, not gradual process claims.

All claims supplied had an ACC flag to identify whether the claim is for traumatic injury (on the one hand), or occupational disease or gradual process (on the other). IPRU used a modified algorithm to re-identify gradual process claims. The ACC algorithm is shown in Appendix 4. The concordance of the acc_gradualprocess flag and ipru_gradualprocess flag is in Table 41.

Table 41: Cross-tabulation of whether a traumatic injury as classified by ACC and by IPRU.

acc_gradproc	ipru_gradproc N	ipru_gradproc Y	Total
N	692,790	27	692,817
Y	20,914	49,775	70,689
Total	713,704	49,802	763,506

There were 49,802 cases classified to gradual process/disease using the ACC algorithm modified by IPRU. Of these, 49,775 cases were also classified to gradual process/disease by ACC. The tabulation of main cause categories for these 49,802 cases is shown in Table 42.

Table 42: Main cause categories for cases classified by IPRU as gradual process / disease claims.

cause_group	Freq.	Percent	Cum.
(A) Lifting/Carrying/Strain	19,658	39.47	39.47
(B) Other Loss Balance/Personal Control	5,236	10.51	49.99
(C) Other Or Unclear Cause	7,782	15.63	65.61
(D) Slipping, Skidding On Foot	1,849	3.71	69.32
(E) Work Property Or Characteristics	11,392	22.87	92.20
(F) Other	3,885	7.80	100.00
Total	49,802	100.00	

Surprisingly, many of these are consistent with a diagnosis of traumatic injury.

Table 43 gives the ACC primary diagnosis codes that are responsible for the majority of these cases cross-tabulated with the external cause codes.

Table 43: ACC primary diagnosis codes for the cases identified by IPRU as gradual process / disease cases by external cause codes

acc_pri_diag_grp	cause_group* A	B	C	D	E	F	Total
H833	6	135	114	1	2,232	96	2,584
M4724	381	114	24	48	92	69	728
M543	307	81	26	42	74	46	576
M65	516	241	1,287	15	745	106	2,910
M702	24	178	65	20	82	129	498
M704	127	330	170	66	275	221	1,189
M751	671	199	325	74	364	176	1,809
M770	328	115	294	15	286	81	1,119
M771	1,477	550	1,122	57	1,428	395	5,029
S134	365	125	109	53	142	126	920
S3350	14,086	2,360	1,475	1,328	2,941	1,888	24,078
S541	435	220	1,231	4	1,264	70	3,224
T146	370	155	803	10	571	106	2,015
other	565	433	737	116	896	376	3,123
Total	19,658	5,236	7,782	1,849	11,392	3,885	49,802

* The key for cause_group (A, B, C, etc) is shown in Table 42.

Over half of the "gradual process" claims had a principal diagnosis coded to S or T codes, ostensibly traumatic injury codes. However, the S and T codes listed are also consistent with gradual process "injury", namely sprains and strains, forearm nerve injury, and injury to muscles and tendons.

The focus of the main analysis is traumatic injury and so these 49,802 claims that were identified by this IPRU modified algorithm as gradual process were excluded from rest of the analysis.

Should be non-fatal injuries:

Fatal injuries were identified using the fataltype variable in the ACC data. A total of 195 claims were excluded.

Should be serious injuries:

Severity is measured using several thresholds of days of compensation (ACC variable "wcdays"), namely: wcdays>0, >7, >14, >21, >49, >84, >175. These loosely relate to the following times off work: 1 week, 2 weeks, 3 weeks, 4 weeks, 8 weeks, 3 months, and 6 months. 600,930 claims were excluded since wcdays information was unavailable (Table 45). (Of these 600,930 claims 539,124 were medical fees only claims, 4 were entitlement claims, and the type of claim was unknown for the remaining 61,802 claims - Table 44).

Table 44: Whether awarded weekly compensation by type of ACC claim.

wcdays_grouped	MOE <blank>	E	M	O	o	Total
>zero	16	72,501	56	16	1	72,590
<blank>	61,802	4	539,124	0	0	600,930
zero	4	15,206	24,065	685	29	39,989
Total	61,822	87,711	563,245	701	30	713,509

The convention for ACC data is that if a field is not relevant then it is left blank. If the claim is an Entitlement Claim but no weekly compensation was paid, then wcdays should be set to 0 (Source: email from Jenny Mason (ACC) on 25May2007).

Additionally, all claims in our data set are accepted claims. However when the MOE[v] field is blank it indicates no payment is recorded against the claim (source: email from Ellen Shi on 24 March 2006). This can happen when the payment is not worked out at claim level (i.e., bulk payments such as from acute health care sources).

Summary of exclusions

Table 45: Summary of exclusions for the analysis of serious disabling work-related traumatic injury.

All claims provided		763,539
Excluded due to under age	33	
Excluded due to gradual process	49,802	
Excluded due to fatal injuries	195	
Claims remaining		713,509

Excluded from different severity thresholds

Severity threshold	Claims excluded	Claims remaining
Claims remaining		713,509
Wcdays > 0	640,909	72,590
Wcdays > 7	11,318	61,272
Wcdays > 14	8,566	52,706
Wcdays > 21	5,937	46,769
Wcdays > 49	22,283	24,486
Wcdays > 84	9,420	15,066
Wcdays > 175	7,836	7,230

[v] MOE: M=Medical fees only claim, E=Entitlement Claim, O=Other