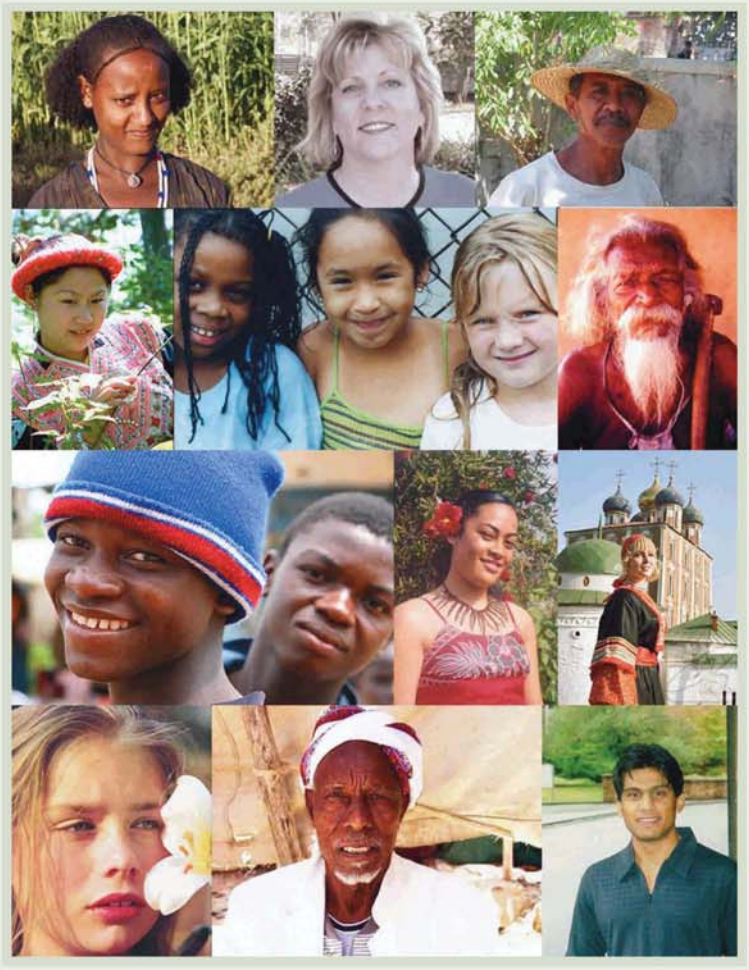
INTERNATIONAL COMPARISONS OF INJURY



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International comparisons of injury

a compilation of reports to the

New Zealand Injury Prevention Strategy Secretariat

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18 September 2007

ISBN: 0-908958-60-9 OR063

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Preface

Comparing injury rates from different countries can suggest priorities for research and intervention, and provide insights into the effectiveness of prevention strategies. With this in mind various organisations and individuals produce published and unpublished reports comparing countries. The issue of validity of such comparisons is often not addressed, or if it is, it is undertaken in a superficial manner. The secretariat of the New Zealand Injury Prevention Strategy thus commissioned IPRU to undertake a programme of research that sought to:

1) Provide an overview of the key threats to validity of international comparisons of fatal and non-fatal outcomes,
2) Review international comparisons of fatal injury for each of the 6 NZIPS priority areas.

3) Develop a strategy for undertaking valid international comparison of non-fatal injury

No international comparisons of non-fatal injury were undertaken as it was agreed at the outset the threats to validity of such an exercise and the difficulties associated with obtaining data precluded this. Rather, the focus was preparing a report on how one might go about this in the future.

The research programme resulted in the production of seven stand-alone reports. The first report in the series dealt with Aim 1) (above). The next five reports dealt with five NZIPS priority areas namely: motor vehicle traffic crashes, assault, work-related injury, intentional self-harm, drowning and near drowning. The final report dealt with Aim 3).

The seven reports have been collated together in this publication to facilitate easy access by those interested in international comparisons of injury. While the focus is on fatalities many of the caveats identified would apply equally well to non-fatal comparisons.

The authors wish to thank Lois Fingerhut, convenor of the International Collaborative Effort on Injury (ICE) Statistics group, for providing international comparisons for this report. The data for these comparisons were provided by members of ICE. Information on ICE activities can be found at: http://www.cdc.gov/nchs/advice.htm

International comparison of injury deaths:

Overview

a report to the

New Zealand Injury Prevention Strategy Secretariat

Prepared by

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30 June 2006

Preface

This report is the first in series aimed at providing briefings to the Injury Prevention Ministerial Committee on recent reports/analyses which compare New Zealand's injury performance with other countries and the potential threats to validity of those comparisons. This programme of research has been commissioned by the New Zealand Injury Prevention Strategy (NZIPS) secretariat.

The programme of research seeks to:

1) Provide an overview of the key threats to validity of international comparisons of fatal and non-fatal outcomes,

2) Review international comparisons of fatal injury for each of the 6 NZIPS priority areas,

3) Develop a strategy for undertaking valid international comparison of non-fatal injury**.**

1. Introduction

1.1. The purpose of international comparisons

Comparing injury rates from different countries can suggest priorities for research and intervention, and provide insights into the effectiveness of prevention strategies.

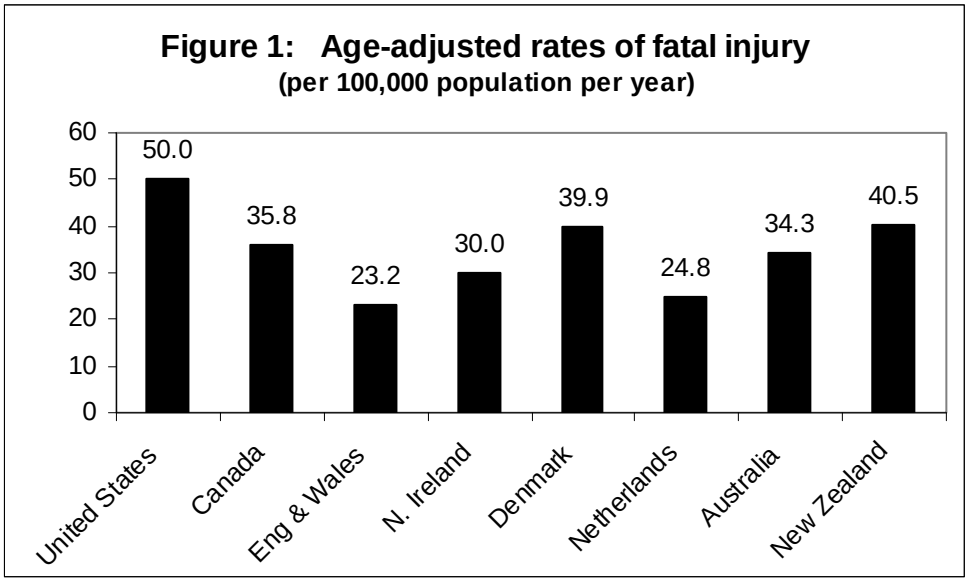
If differences exist in rates of injuries, we need to investigate whether they can be explained by differences in exposure to risk, and whether some countries have intervened more effectively.

1.2. Potential problems

Valid comparisons depend on good quality data and consistent definitions. While counting and comparing deaths from injury is less problematic than comparisons of non-fatal injury rates, it can still produce results that are unreliable or difficult to interpret.

2. A recent international comparison

Figure 1 shows a recent comparison of New Zealand with a selection of other similar countries using data on all fatal injuries combined from 2000-2002[1]. It shows that New Zealand's overall rate of injury death is relatively high in this group, second only to the United States and 75% higher than England and Wales.



These data are recent, have originated from official vital statistics and have been adjusted for differences in the age make-up of the populations being compared. However, interpretation is still complex.

[1] Data provided to IPRU by other participants in Injury ICE (International Collaborative Effort on Injury Statistics) through Lois Fingerhut (personal communication)

3. Potential data / definition problems

First of all, which deaths were included in the statistics may differ between countries. The way an injury-related death is defined, the way it is recorded on a death certificate, and the sources of information used to collate the statistics may all differ between countries and so affect the validity of the comparisons made.

4. Potential problem of comparability

And then, even if the population rates are valid and the age structure of the population has been adjusted for, there will be differences between countries in various determinants of the injury rates that we may want to take into account in order to make a fair comparison.

5. Examples of data problems

For each area of injury that we are interested in there are specific issues to be considered when looking at international comparisons of rates and two brief examples, motor vehicle traffic crashes and falls, follow to illustrate this point.

5.1. Example 1: MVTCs

Motor vehicle traffic crashes are arguably the most studied injury area, and make up a quarter of all injury deaths in New Zealand. While ascertainment and recording of road traffic deaths is more complete and reliable than for other injury deaths in most countries, a recent review of 13 of the world's wealthiest countries[2] showed that the proportion of traffic deaths captured by official traffic statistics varied between 87% and 106% of traffic deaths confirmed by death certificates. A traffic death in these countries was defined by the "30 day rule" (a WHO criterion) that says a death is counted as due to a crash if it occurs within 30 days of the event, and therefore those deaths which occur more than 30 days post-injury are excluded. This will generally underestimate traffic-related death rates by around 3%, but since not all countries have adopted this rule, many comparisons will be even more unreliable. A traffic fatality in Spain, Greece and Portugal is one that occurs in the first 24 hours, in France 6 days and in Italy 7 days.

Other differences in definitions are commonly found, even in countries in the same region. In the European Union, a traffic fatality is counted if it occurs on a public road or on a private road to which the public has access (except in Belgium, the Netherlands and Portugal), involves at least one moving vehicle (except Portugal and the U.K.), and is reported to police. Self-reporting is only possible in five member countries. As well as these differences, confirmed suicides are excluded from traffic deaths in half of EU countries, and natural deaths are excluded in most, but are not defined by standard criteria[3].

This illustrates one source of variation that can arise in injury statistics, even in the countries with the most developed infrastructure, even for the simplest example (road traffic deaths), and without there necessarily being any difference in underlying risk of death from a traffic-related injury.

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[2] Elvik R. Incomplete accident reporting: A meta-analysis of studies made in thirteen countries. *Transportation Research Record* 1999; 1665:133-40

[3] Mackay M. Quirks of a mass accident data base [Commentary]. *Traffic Injury Prevention* 2005; 6:308-10

5.2. Example 2: Falls

Falls make a major contribution to the overall fatal injury rates for most developed countries. The death rate due to falls is highest in older people and accounts for half of all injury deaths in people over 65. In this group, deaths are often due to late complications of the fall and so deaths may not always attributed to the fall but rather to the complication such as pneumonia. In a study that carefully compared injury death rates of older people in New Zealand and the United States, the overall injury death rate in people over 65 was found to be 34% higher in New Zealand than the US. However, out of six injury categories NZ death rates were only higher for falls (almost 3 times as high as the US), and it was found that this was due to differences in the way that death certificates were completed in the two countries. In the US, people who died were much more likely to be recorded as dying from the terminal illness rather than the fall which caused it. Major under-reporting of falls as a cause of death in the US made the New Zealand rate seem very high, even though the incidence of falls was similar in the two countries[4].

6. If data problems have been addressed, what are the next steps?

If international comparisons can be devised that take account of differences in measurement, including definitional differences, and which have adjusted for differences in non-modifiable determinants (eg. age and sex), what remains are differences in the injury experience between countries that have been determined by exposure to hazards, and the extent and effectiveness of intervention in each country. Research would then be necessary to identify those relative exposures, and to describe the extent of use of known safety features and behaviours in the relevant countries compared with New Zealand. This could and should be a stimulus to future prevention activity.

6.1. Differences in exposure and other determinants

The population's average exposure to risk will clearly influence the chance of dying of an injury. By this we mean characteristics such as the average amount of driving people do, how much time people spend near water (swimming or fishing or boating), or the proportion of people working in high injury risk occupations such as farming and forestry. These will vary between countries and affect the amount of time people are at risk of a fatal injury, all other things being equal.

Some of these determinants of injury rates are modifiable and some are not. In the field of injury prevention we are concerned with the determinants of injury that are modifiable, so that injury can be reduced. The modifiable determinants of injury rates (e.g. drinking behaviour, whether we drive to work or use public transport, whether we surgically fix broken hips in the elderly or treat them conservatively) contribute to, or explain, the differences that we see and become the target for further intervention.

6.2. Differences in extent of intervention

Also highly relevant are safety features and behaviours that vary between countries such as the quality of roads, the level of seat belt use, the promotion of home smoke detectors,

[4] Langlois J, Smith G, Baker S, Langley J. International comparisons of injury mortality in the elderly: Issues and differences between New Zealand and the United States. *International Journal of Epidemiology* 1995; 24:136-143

presence of restrictive gun laws, or safety provisions for pedestrians and cyclists. Contrasting NZ experience with the experience of countries whose injury mortality rates are superior is likely to give clues to areas where NZ could do better.

7. Conclusion

The two brief illustrations of threats to validity presented show that to gain more insight into potential determinants of the differences in the overall injury rate it is prudent to first consider the differences in measurement. If comparable data can be attained, differences in injury rates should stimulate research into differences between countries in hazard exposures and the types and levels of interventions used, to inform more effective prevention strategies. The forthcoming series of reports will review the best evidence available for each NZIPS priority area and deal with the validity issues in more detail. A final report in the series will deal with non-fatal injury comparisons.

International comparison of injury deaths: Road traffic

a report to the

New Zealand Injury Prevention Strategy Secretariat

Prepared by

Jennie Connor
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20 September 2006

1. Introduction

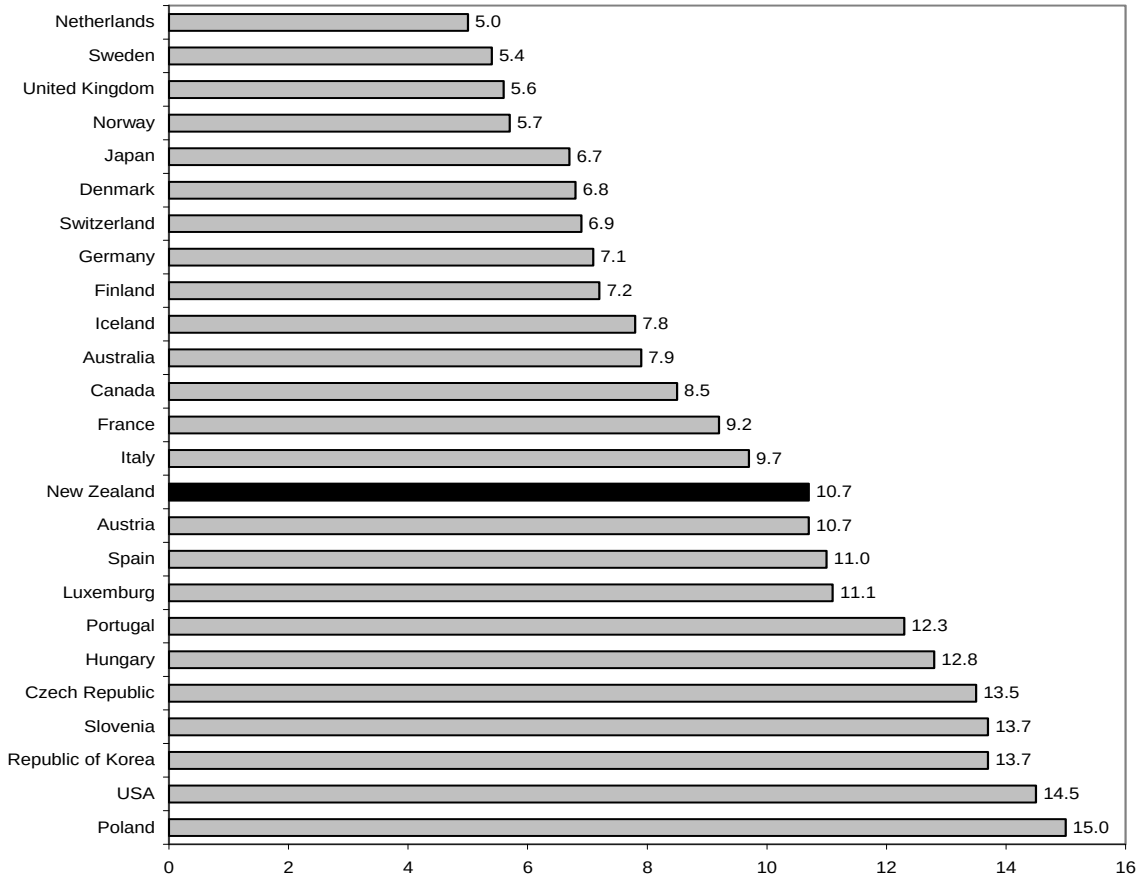
A quarter of all injury deaths in New Zealand are due to road traffic. As well as vehicle occupant deaths these include motorcyclists, cyclists, and pedestrians. Young adults have the highest rates of road traffic injury death, particularly men. In all high income countries the road toll has dropped substantially in the last 20 years. In New Zealand, the number of deaths has decreased by >40% despite increases in population and vehicles.

2. Recent international comparisons

More international data are available on deaths from road traffic crashes than any other area of injury death. In 1988 the OECD Road Transport Research Programme established the International Road Traffic Accident Database (IRTAD) to collect road traffic exposure and injury data directly from national traffic crash systems. They are provided in a common format, based on definitions developed and agreed by the IRTAD Group to enhance international comparability.

Figure 1 shows road traffic death rates per 100,000 population for 2004 using data from IRTAD.

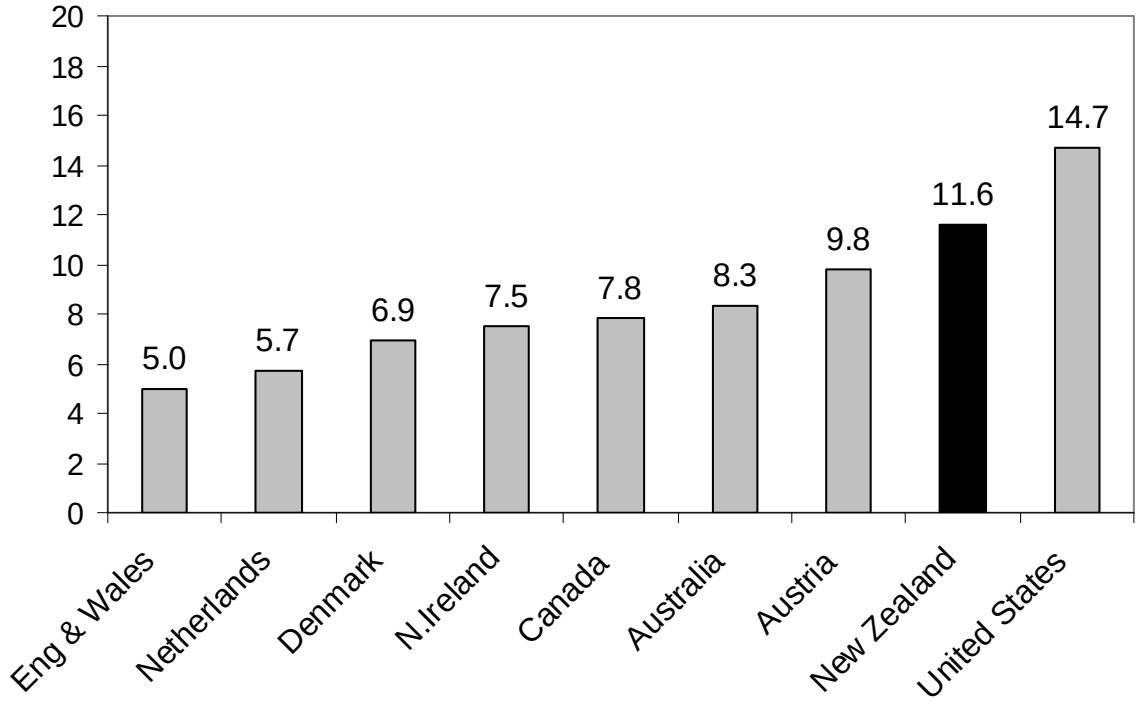
Figure 1: Road traffic deaths per 100,000 population (2004)



Source: International Road Traffic Accident Database

Since road traffic crash risk varies by age, the death rates should be age-standardised to improve the validity of the comparison. Figure 2 shows rates of road traffic deaths in a selection of countries that have been adjusted for differences in the age structure of the populations. These estimates are based on combined data for 2000-2002[5] and come from national mortality data systems, rather than traffic crash reports.

Figure 2: Road traffic deaths per 100,000 population, age standardised rates (2000-2002 aggregated data)



Source: International Collaborative Effort on Injury Statistics

3. Data and definition problems

While ascertainment and recording of road traffic deaths is high in countries like New Zealand[6], there is still country to country variation in completeness of reporting, and some definitions, as outlined in the previous report[7]. These include the time period following the crash in which deaths must occur in order to be counted as traffic deaths. The standard is now 30 days, but it is not universally applied, even in neighbouring countries. A traffic fatality in Spain, Greece and Portugal is one that occurs in the first 24 hours, in France 6 days and in Italy 7 days. Variation also occurs in whether crashes on private roads are included, and

[5] Data provided to IPRU by other participants in Injury ICE (International Collaborative Effort on Injury Statistics) through Lois Fingerhut (personal communication)

[6] Elvik R. Incomplete accident reporting: A meta-analysis of studies made in thirteen countries. *Transportation Research Record* 1999; 1665:133-40

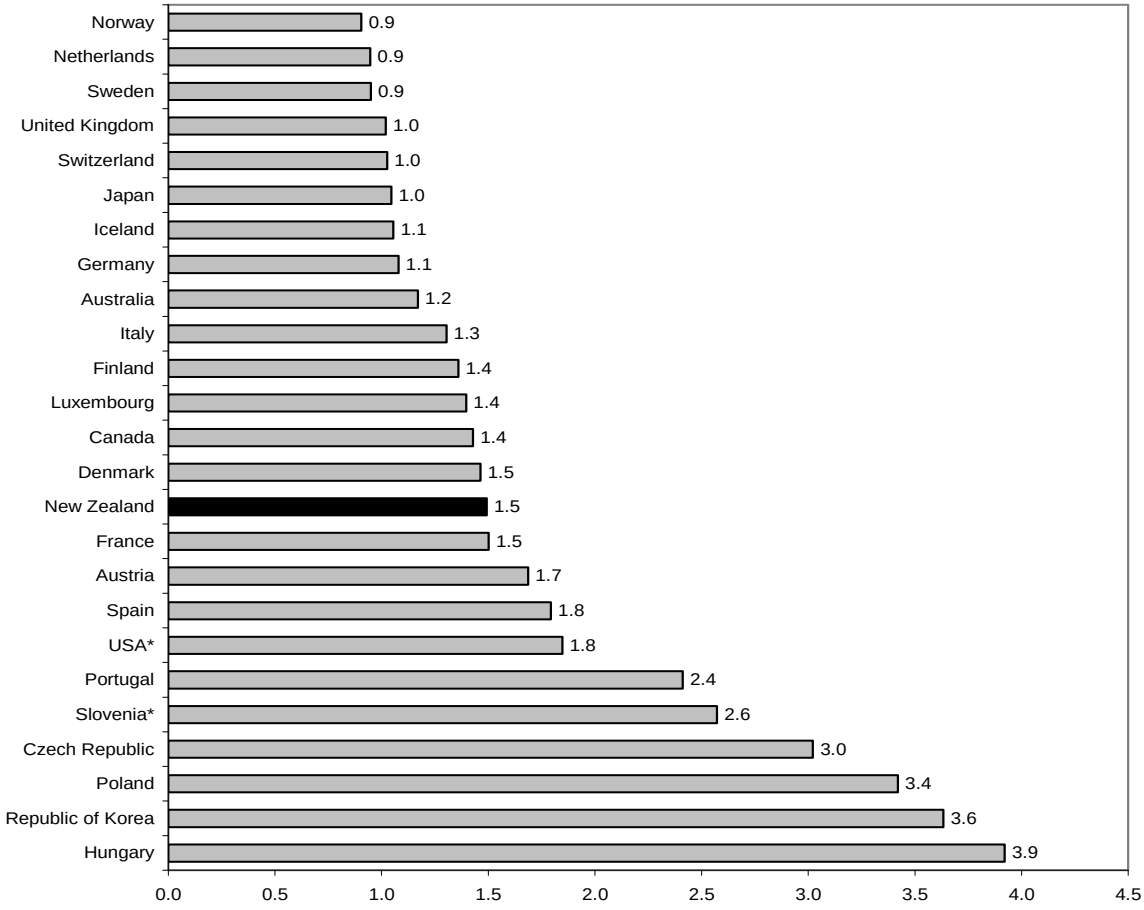
[7] Connor J, Langley J, Cryer C. International comparison of injury deaths: Overview. Report to the NZIPS Secretariat, June 2006

whether confirmed suicides or natural deaths are included. There has been considerable improvement in standardisation of these measures in the past decade in IRTAD member countries.

4. Differences in exposure and other determinants

One of reasons for differences in death rates between countries is differences in exposure to risk. The number of vehicles is a crude but accessible indicator of the level of motorisation or average amount of driving that is done in each country. Figure 3 compares the death rates of IRTAD member countries per 10,000 motor vehicles, to adjust for differences in driving exposure. When comparing this with Figure 1, it appears that much of New Zealand's higher road traffic death rate is due to relatively high levels of vehicle use.

Figure 3: Road traffic deaths per 10,000 vehicles (2004)



Source: International Road Traffic Accident Database

Other determinants of road traffic death rates include characteristics of the road environment, the drivers, and the vehicles themselves. Major contributors are the quality of the roading infrastructure, speed restrictions, the licensing age and restrictions on learner drivers, local drinking culture and attitudes to drink driving, seat belt legislation, vehicle mix (e.g. motorcycle to car ratio), the quality of the vehicle fleet and the level of enforcement of traffic and alcohol regulations. Weather and geography will also have some effect. Case-fatality

may differ depending on the accessibility of high quality trauma services. Some of these are not modifiable (eg. weather and geography), some are modifiable (eg. licensing age), and some relate to existing interventions (eg. speed restrictions, seat belt legislation).

5. Differences in extent of intervention

Most known determinants of the road toll are modifiable to some degree, but the financial costs can be very high, and the death rates will, to some extent, reflect the investment made in interventions.

The geography and sparse population of New Zealand make reducing exposure to driving and driving-related injury hazards a bigger challenge than in many European countries. However, differences in the availability of alternative transport, both within cities and for long distance journeys, will be one determinant of the traffic-related death rates. This is particularly so for younger drivers for whom the risk of a fatal crash is highest.

In the countries shown in Figure 3, known interventions are implemented to varying extents. For example, while New Zealand has a high prevalence of seatbelt usage and a graduated driver's licensing system, it has a relatively low alcohol purchasing age, a very low driver licensing age, and a low proportion of open roads where opposing traffic is separated. In comparison, the US doesn't have mandatory seat belt use legislation in all states but has a minimum alcohol purchasing age of 21. In Sweden, undivided roads are operated at a lower speed limit (90km/h) than motorways (100km/h) and speed limits in residential areas can be as low as 30km/h.

Seat belt use is an example of an intervention where there is substantial evidence of efficacy. Studies of front seat car occupants and various belt types have estimated the risk of dying in a crash is reduced by 42-73% when wearing a seat belt[8][9][10]. Not surprisingly, many countries have made the wearing of seat belts mandatory for all car occupants or at least for those in the front seats. However, a recent international survey of seat belt use[11] revealed two important aspects of mandatory seat belt policy that reduce its effectiveness. The first is the number and nature of exemptions to wearing seat belts, and the second is the widespread perception of poor enforcement of seat belt wearing leading to reduced compliance. The extent to which these two factors are expressed in different countries will have an impact on fatal crash rates, even when similar legislation is in place.

6. Conclusion

New Zealand has a relatively high (per capita) fatal crash rate compared with similar countries, using available information. It appears that this is partly due to the high level of vehicle use in New Zealand. There are several sources of uncertainty about the data and how well they reflect true differences in mortality. Reductions in road traffic deaths could come

[8] Evans L. The effectiveness of safety belts in preventing fatalities. *Accid Anal Prev* 1986;18:229-41
[9] Rivara F. Effectiveness of automatic seat belt systems in motor vehicle crashes. *JAMA* 2000;283:2826-8
[10] Cummings P, et al. Estimating seatbelt effectiveness using matched-pair cohort methods. *Accid Anal Prev* 2003;35:143-9
[11] Weiss H, et al. International survey of seat belt use exemptions. *Injury Prevention* 2006;12:258-61

from both reducing driving exposure and from research into differences in hazard exposure and intervention levels between New Zealand and countries with lower road traffic mortality.

International comparison of injury deaths: Falls

a report to the

New Zealand Injury Prevention Strategy Secretariat

Prepared by

Jennie Connor
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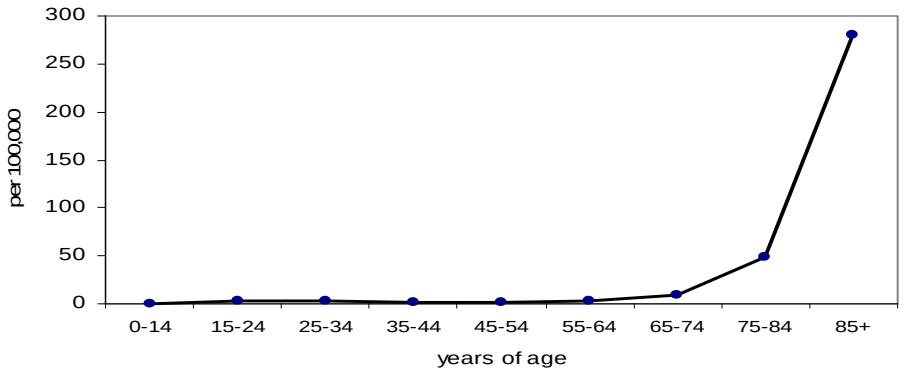
Colin Cryer

20 September 2006

1. Introduction

In New Zealand, falls are a common cause of hospitalisation in children (peaking in the 5-9 year age group) and in adults over 65, increasing sharply at older ages. However relatively few falls sustained by young people result in death. The crude mortality from falls in 2000-2002 was 8 per 100,000 but this was largely due high rates of fatal falls at older ages, as seen in Figure 1. Most fall-related deaths result from complications of a hip fracture sustained in a fall by a person with age-related osteoporosis.

Figure 1: Age-specific mortality due to falls in New Zealand, per 100,000 population (2000-2002 aggregated data)

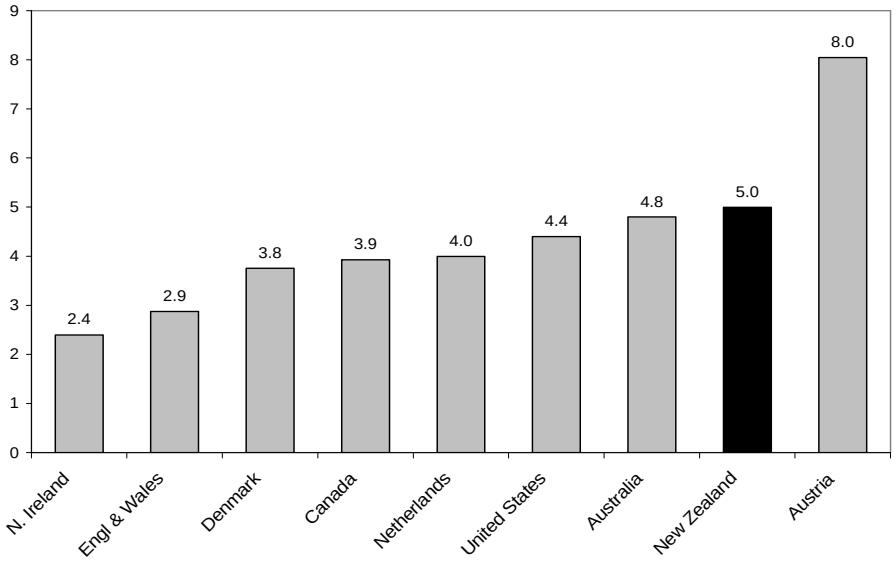


Source: New Zealand Health Information Service

2. Recent international comparisons

Figure 2 shows rates of deaths from falls in a selection of countries, adjusted for differences in the age structure of the populations.

Figure 2: Fatal falls per 100,000 population, age-standardised rates (2000-2002 aggregated data)



Source: International Collaborative Effort on Injury Statistics

These data originate from the International Collaborative Effort on Injury Statistics through Lois Fingerhut (personal communication). Rates for the US and Australia have been adjusted for known differences in coding practice. No other sources of age-standardised or age specific data were identified that would allow comparison between New Zealand and a range of other countries.

3. Data and definition problems

Age standardisation, or adjustment for differences in the age makeup of the populations, is important to the validity of all international comparisons. However, since fall deaths occur mainly amongst older adults and the rates increase rapidly over 65 years of age, crude rates of fall deaths are strongly influenced by the proportion of the population in these groups and are not suitable for making even the most cursory comparisons between countries. Within countries, the proportion of people in the oldest age groups is increasing rapidly enough to make time trends in crude death rates unreliable. Since determinants and circumstances of falls in the young and the old are so different, age-specific rates of fatal falls are the most useful for making international comparisons. Considering that women make up an increasing proportion of the population with increasing age, and have higher rates of fall-related hip fractures than men, it is most appropriate to consider rates in men and women separately or to standardise populations for sex distribution as well.

Ascertainment of deaths is likely to be very high in most high income countries. However, the identification of the death as fall-related is less certain, and varies from one country to another. One reason is that coding practices may differ. For example in France a much greater proportion of injury deaths are coded to "unspecified causes" than other countries[12]. Thus there may be cases missing from the rates of fall deaths when making international comparisons. In addition to this, with the updating of the International Classification of Diseases (ICD) system from version 9 to version 10 there has been a change in the way that some injury deaths are coded when their circumstances are unclear. Deaths that were classified as "fracture unspecified" and assumed to be due to falls in ICD-9, are coded as "cause unspecified" and not counted as falls in ICD-10[13]. This means that trends in fall deaths over the period of transition from ICD-9 to ICD-10 will be unreliable, and also that data from countries using ICD-9 will not be strictly comparable to those countries using ICD-10. One solution to this is to remove the "fracture unspecified" category from ICD-9 coded data when making comparisons with ICD-10. This may then result in some undercounting of fall deaths.

Another important reason why fatal fall rates may not be comparable between countries relates to the way that death certificates are completed and cause of death assigned. As

[12] Smith G, Langlois J, Rockett I. International comparisons of injury mortality: Hypothesis generation, ecological studies and some data problems. Proceedings of the International Collaborative Effort on Injury Statistics, Vol 1. 1995;13:1-15

[13] ICD-9 and ICD-10 are revisions of the WHO's International Classification of Diseases. The system includes a classification for the circumstances of injuries both by intent (intentional, unintentional) and by mechanism (fall, burn etc) within one code (eg. accidental poisoning)

briefly described in the overview paper[14], many fall-related deaths in older people do not occur immediately, but from a complication such as pneumonia. Variation, within and between countries, in attributing such deaths to the fall rather than the 'terminal event' could therefore have a considerable impact on rates of fatal falls. We are aware of only one study that has investigated these issues.[15] In research that carefully compared injury death rates of older people in New Zealand and the United States, the overall injury death rate in people over 65 was found to be 34% higher in New Zealand than the US. However, out of six injury categories NZ death rates were only higher for falls (almost 3 times as high as the US), and it was found that this was due to differences in the way that death certificates were completed in the two countries. In the US, people who died were much more likely to be recorded as dying from the terminal illness rather than the fall which caused it. Major under-reporting of falls as a cause of death in the US made the New Zealand rate seem very high, even though the incidence of falls was similar in the two countries. The difference in recording of cause of death was thought to be partly due to the longer hospital stays of New Zealand patients increasing the likelihood that death would occur in the hospital setting and therefore more likely to be attributed to the fall.

4. Differences in exposure and other determinants

If differences in fatal fall rates are found when comparable data sources are available from different countries, they warrant investigation for differences in causal factors and also the type and level of prevention activity. In the case of fatal falls, the relevant exposures and causes will differ for the younger age groups and the over 65 year olds.

Children and young adults: In children, the physical environment and level of supervision plays an important role, along with the safety culture of the community. Amongst young adults, alcohol use and therefore alcohol policy will also be important, along with exposure to hazards such as ladder use and climbing on roofs, common in countries with a DIY culture but not in all. Living in high rise accommodation also increases exposure to risk.

Older adults: When looking at differences in fall death rates amongst older people consideration must be given to the reasons for falling, the reasons that hip fractures occur when people fall and what determines the likelihood of dying if a person sustains a hip fracture. The reasons that older people fall more often than younger adults include loss of strength and mobility, cognitive impairment, failing eyesight, and the use of multiple medications, leading to poorer balance. The physical environment may also contribute, including ice and snow, and the availability of supervision and assistance. In New Zealand, the rate of falls and hip fractures is higher amongst older people living in institutions than at home.[16] If an older person falls, it is their underlying osteoporosis, or bone thinning, that predisposes them to a hip fracture, as well as how much physical padding they have. In Caucasian populations the incidence of hip fracture in women is about twice the rate in men,

[14] Connor J, Langley J, Cryer C. International comparison of injury deaths: Overview. Report to the NZIPS Secretariat, June 2006

[15] Langlois J, Smith G, Baker S, Langley J. International comparisons of injury mortality in the elderly. Issues and differences between New Zealand and the United States. *International Journal of Epidemiology* 1995;24:136-43

[16] Norton R, et al. Residential status and the risk of hip fracture. Age and Ageing 1999;28:135-9

due to more falls and more osteoporosis[17]. The prevalence of hip fracture varies between ethnicities, both within and between countries. In New Zealand there are much lower hip fracture rates in Maori and Pacific peoples than in Europeans.[18] While this has been partly attributed to greater bone mass in some ethnicities (Maori, Pacific, African Americans), the Chinese population in Hong Kong has both lower bone mass and lower rates of hip fracture, with only 40-50% of Caucasian rates[19]. Nevertheless, there appear to be a range of anthropometric characteristics (height, average weight, muscle mass etc) in addition to bone density that contribute to the large differences in fracture rates by ethnicity. The ethnic mix that makes up national populations will therefore affect risk of fall-related deaths in a way that is not simple to adjust for. Osteoporosis is also accelerated by cigarette smoking and therefore fall death rates in people over 65 will be affected by smoking prevalence in the preceding decades. Once a hip fracture has occurred, medical and surgical options for treatment have an impact on the case-fatality rate, and the chance of recurrence. Variation in these and other determinants between countries will explain some of the variation in the rate of deaths from falls.

5. Differences in extent of intervention

Strategies have been identified that address a number of the risk factors for fall-related death. Their effectiveness and the extent to which they are adopted in different countries will make a contribution to differences in fall fatality rates. Interventions include primary prevention strategies for fall reduction in all ages such as public safety education, modifications to the physical environment (including building regulations), and alcohol policy and enforcement. There is also a range of fall-reduction interventions specifically for older people[20]. Secondary prevention of hip fractures in the event of an older person falling relies on prevention, diagnosis and treatment of osteoporosis (including calcium and vitamin D intake, smoking reduction, exercise promotion and medication), and in some circumstances the use of hip protectors[21]. Some reduction in mortality from hip fractures has been achieved through surgical fixation, early mobilisation, and pulmonary embolism prevention[22]. "Best practice" rehabilitation services help prevent recurrences and their associated high mortality.

6. Conclusion

Few data are available to make direct comparisons of fatal fall rates, particularly by age group. The overall age-standardised rates are heavily influenced by the rates in the oldest groups in the population. In international comparisons these rates are likely to be affected by differences in coding and assignment of cause of death, as well as genetic differences, different levels of exposure to risk, susceptibility to injury, and interventions to reduce mortality when falls occur. There is a large literature on the causes of falls in the over 65 age group and effective means of preventing them, and on interventions to prevent fractures when

[17] Cummings SR, Melton III LJ. Epidemiology and outcomes of osteoporotic fractures. Lancet 2002;359:1761
[18] Norton R, et al. Hip fracture incidence among older people in Auckland: a population-based study. N Z Med J. 1995;108:426-8
[19] Ho SC. Body measurements, bone mass, and fractures. Does the East differ from the West? Clin Orthop Relat Res. 1996 Feb;(323):75-80
[20] NZ Guidelines Group. Prevention of hip fracture amongst people aged 65 years and over. June 2003
[21] ibid
[22] Collins R et al. PEP trial. Lancet 2000;355:1295-302

falls occur. There is evidence of effectiveness of multi-factorial interventions although they are challenging to implement at a population level.

International comparison of injury deaths: Assault

a report to the

New Zealand Injury Prevention Strategy Secretariat

Prepared by

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March 2007

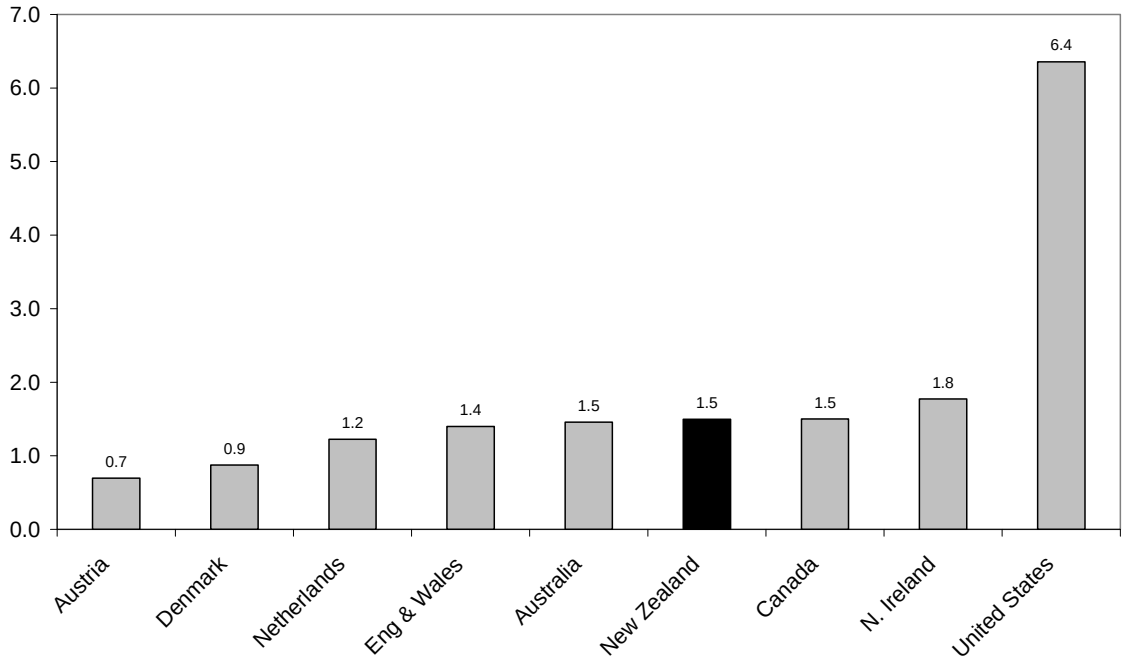
1. Introduction

Deaths from assault (or interpersonal violence or homicide) are those that result from "violence inflicted by another individual or small group of individuals"[23]. In New Zealand, deaths from assault make up a small proportion of all injury deaths (approx 3.5 %) but are of considerable concern to the community. The crude rate derived from national mortality data was 1.4 per 100,000 over the period 1999-2003, with no obvious trend[24]. Intentional injury deaths of children are a particular focus of public attention. In the five years to 2003, 38 of the 278 homicide deaths were children under 15 years of age, which was 12 fewer than the previous 5 year period[25].

2. Recent international comparisons

Figure 1 shows rates of deaths from interpersonal violence in a selection of countries, adjusted for differences in the age structure of the populations. These estimates are based on combined data for 2000-2002 and come from national mortality data systems[26].

Figure 1: Deaths by homicide per 100,000 population, age-standardised rates (2000-2002 aggregated data)



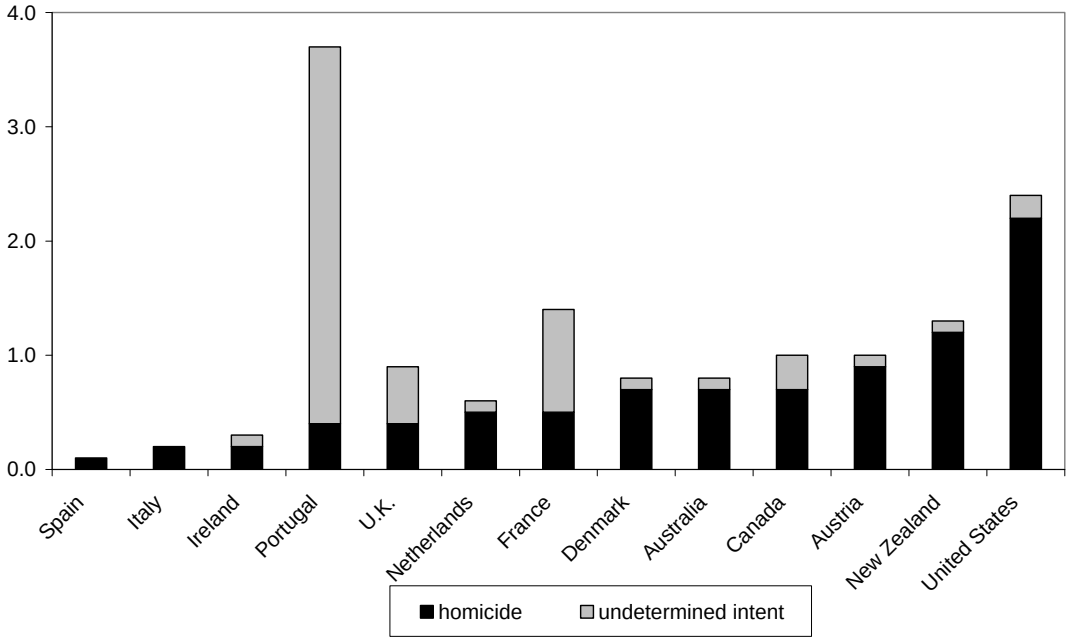
Source: International Collaborative Effort on Injury Statistics

The rates of child maltreatment deaths in a selection of rich nations are shown in Figure 2. These rates come from a UNICEF study which used World Health Organisation data

[23] World report on Violence and Health, Geneva, World Health Organisation, 2002.
[24] New Zealand Health Information Service
[25] Social Report 2006, Ministry of Social Development.
[26] Data provided to IPRU by other participants in Injury ICE (International Collaborative Effort on Injury Statistics) through Lois Fingerhut (personal communication)

and looked at deaths over the most recent 5 year period of the 1990s for which data was available. The rates have been age standardised to a "standard OECD population excluding Turkey" [27].

Figure 2: Deaths by homicide and undetermined intent, per 100,000 population under 15 years of age



Source: UNICEF Innocenti Report Card No 5[5]

3. Data and definition problems

International comparisons of homicide rates will be affected by problems of misclassification of cause of death, and by lack of statistical precision due to relatively small numbers of events.

3.1 Misclassification of cause of death

As in the case of suicide deaths, misclassification of homicide deaths will almost always result in undercounting. That is, deaths may be misclassified by intent, and get counted as 'unintentional' injury deaths or 'injury of undetermined intent' rather than homicide. Given the consequences of homicide for the perpetrator of the violence, there is a strong incentive to conceal the intentional nature of the injuries. For example, some cases of infanticide may be misclassified as SIDS (cot death) and the intent of unwitnessed drowning, poisoning and fatal falls may be difficult to determine without the cooperation of the perpetrator.

The number of homicide deaths misclassified as undetermined intent varies from country to country depending on processes for certifying cause of death and degree of investigation of the cause, which can be highly variable. The grey bars in Figure 2 represent the rate of child

[27] UNICEF, 'A league table of child maltreatment deaths in rich nations', Innocenti Report Card No 5, Sept 2003.

deaths classified as of undetermined intent in each country. The major variation in these indicates how unreliable the comparison of child homicide rates may be.

3.2 Age-standardisation and lack of precision due to small numbers

Different standard populations may be used for the age-standardisation of homicide rates (for example the WHO world population for the data in Figure 1 and the OECD standard population for the data in Figure 3), and this can result in different estimates of homicide rates in the same period. This means that rates calculated using different methods should not be compared.

The rates of homicide are based on very small numbers of events in any one year or even over 5 year periods which are commonly used for comparisons. Reported rates are seldom accompanied by any information about the uncertainty in the rates, such as a confidence interval. While there is a clear difference in rates between the countries at the top, middle and bottom of Figures 1 and 2, it is likely that the rank order and relative differences in rates between the middle ranked countries is uncertain due to this lack of statistical precision. There will be substantial year to year variation in rates due to small fluctuations in the number of deaths simply by chance.

4. Differences in exposure and other determinants

Determinants of homicidal behaviour are complex and unclear. Individual, relationship and community factors all contribute,[28] and high rates of child homicide tend to be associated with high rates of adult homicide within countries[29].

Mental health problems, patterns of alcohol and drug use, disrupted family environments, experience of violence, poverty and unemployment, and stressful life events have been identified as factors associated with increased risk, as they are for many other health problems. In New Zealand, non-European ethnicity is also a risk marker[30]. About half of homicides in New Zealand occur at home, but the next most common place of occurrence is in, or around, licensed premises. It is possible that the culture of drinking places in which homicides occur is a contributory exposure as well as the alcohol involved. An example of the complex cultural determinants (or impacts) of homicide is a recent study that has shown international variation in homicide rates to be associated with cultural differences in attitudes towards the justifications for killing[31].

There are very great differences between very low rates of homicide in Southern Europe and the high rates in the US, which are seen at all ages and in both sexes. However there is little research that has systematically examined differences in risk factors. Within Europe the lower rates in the south compared with the north are in countries with lower alcohol consumption and binge drinking, but there are many other possible contributors[32].

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[28] World report on Violence and Health, Geneva, World Health Organisation, 2002
[29] UNICEF, 'A league table of child maltreatment deaths in rich nations', Innocenti Report Card No 5, Sept 2003
[30] Fanslow et al. Homicide in New Zealand: an increasing public health problem. Aust J Public Health, 1995;19:50-7
[31] McAlister A. Acceptance of killing and homicide rates in 19 nations. Eur J Public Health, 2006;16:230-66
[32] Stone DH et al. Intentional injury mortality in the European Union: how many more lives could be saved? Injury Prevention, 2006;12:327-32

One area that has received attention is the access to firearms as a means of homicide, with the resulting escalation of interpersonal conflict to fatality. A range of epidemiological studies have shown an association between the availability of guns and risk of homicide. Amongst wealthy nations, the US is a clear outlier in terms of both gun availability and gun homicide and, within the US, gun ownership has been shown to be associated with a higher risk of homicide in a number of epidemiological studies[33].

5. Differences in extent of intervention

There is very little evidence to indicate which interventions work[10] and even less that differences in the extent of interventions contribute to differences in rates of violence between countries.

However, in relation to the association of gun accessibility and homicide, a number of ecological studies have shown an association between restrictions on guns and lower rates of homicide and suicide. For example, a comparison between Vancouver and Seattle, similar cities with similar rates of burglary and robbery but very different handgun control policies, showed a 60% higher homicide rate in Seattle which was virtually all explained by the excess risk of homicide by firearms[34]. There is also some evidence from the reform of Australian gun laws in 1996 that more stringent gun control can reduce homicide. The reforms involved the banning of semi-automatic weapons and a buy back of 700,000 firearms from the general population by the government. They followed 13 mass shootings in an 18 year period. Following the intervention, there were no mass shootings in the following decade. There was a significant acceleration of the pre-existing decline in firearm suicides and non-significant acceleration in the decline in firearm homicides following the restrictions[35]. The extent of control over access to firearms varies between countries and increasing restrictions appears to be effective even when the incidence of violence involving firearms is already low.

Other preventive interventions that vary between countries and are likely to contribute to reducing homicide include evidence-based alcohol and drug policy, improving the quality of mental health services, interventions aimed at improving parenting skills and reducing family violence, alleviation of poverty and unemployment, better legal protection for women from their partners, and policies to ban physical discipline of children[36]. As well as initiatives for the whole population to reduce risk, services and interventions for high risk groups (eg. new parents with few resources, offenders in the prison system, and people dependent on alcohol and drugs) will differ between countries. However, the comparability of interventions in different countries may be hard to judge and the effectiveness of these in reducing homicide is unclear.

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[33] Dahlberg L et al. Guns in the home and risk of violent death in the home: Findings from a national study. Am J Epidemiol, 2004;160:929-36

[34] Sloan JH et al. handgun regulations, crime, assaults and homicide. A tale of two cities. NEJM, 1988;319:1526-62

[35] Chapman S, Alpers P, Agho K, Jones M. Australia's 1996 gun law reforms faster falls in firearm deaths, firearm suicides, and a decade without mass shootings. *Injury Prevention* 2006;12:365-72

[36] UNICEF, 'A league table of child maltreatment deaths in rich nations', Innocenti Report Card No 5, Sept 2003; World report on Violence and Health, Geneva, World Health Organisation, 2002

6. Conclusion

New Zealand's overall homicide rate is reported to be the same or slightly higher than other similar countries with the exception of the United States. The child homicide rate appears to be higher than some countries we compare ourselves to (eg. Spain, Italy and Ireland) but similar to the rest of Europe, Australia and Canada. However, there is substantial uncertainty about the international comparability of homicide data and, the availability of guns appears to account for the difference seen with the US. There is little cross-national research on what is responsible for differences in child homicide between countries.

International comparison of injury deaths: Suicide

a report to the

New Zealand Injury Prevention Strategy Secretariat

Prepared by

Jennie Connor
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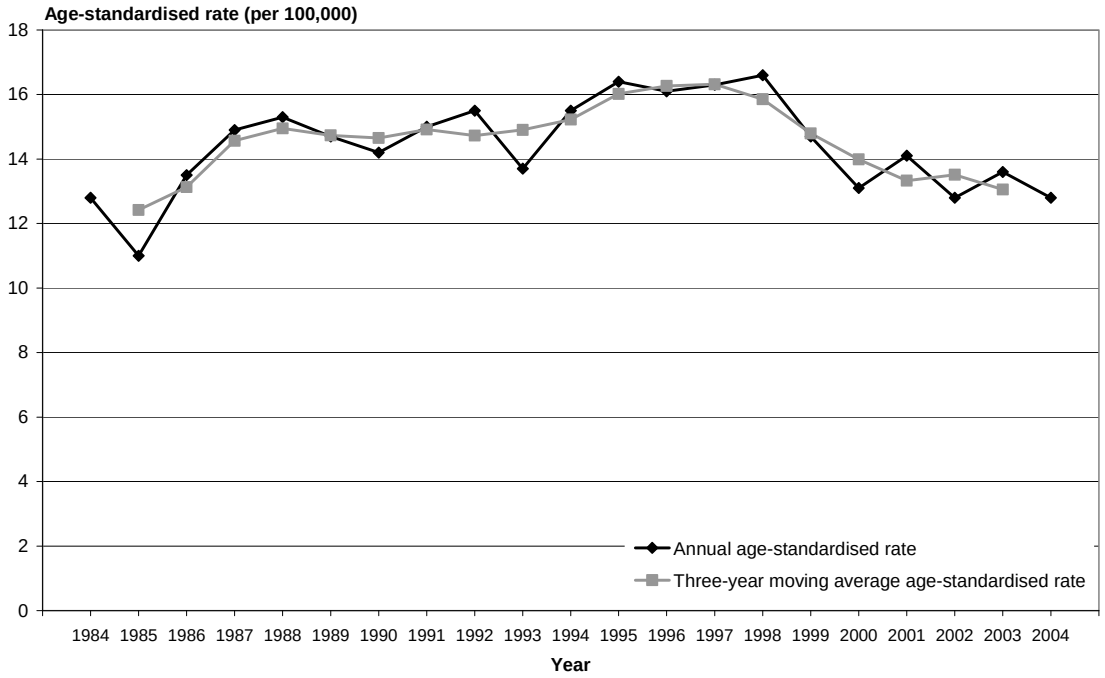
Colin Cryer

March 2007

1. Introduction

In New Zealand, mortality from suicide and intentional self-inflicted injury is higher than for any other major injury cause, including road traffic crashes. The recent trends in suicide death rates are shown in Figure 1. The rates peaked in the 1995-7 period and have declined since, in common with other similar countries.

Figure 1: Suicide death rates, New Zealand, 1984–2004, age-standardised to WHO world population



Source of data: New Zealand Health Information Service[37]

There is a marked gender difference in suicide rates, with an overall ratio of 2.7 male suicides to every female suicide. Amongst young people (15-24) the difference is less with a ratio of 2 to 1.

2. Recent international comparisons

Figure 2 shows rates of deaths from suicide in a selection of countries, adjusted for differences in the age structure of the populations. These estimates are based on combined data for 2000-2002 and come from national mortality data systems[38].

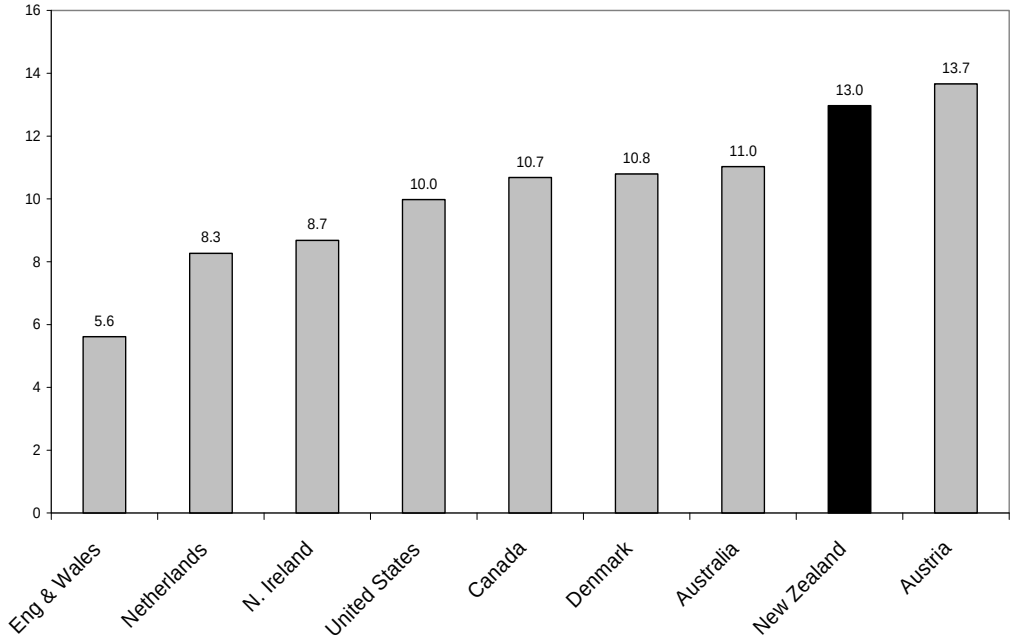
Differences in the gender distribution of suicide deaths in different countries mean that the rankings of countries may vary by gender. This is shown in Figure 3, where New Zealand

[37] Ministry of Health. 2006. *Suicide Facts: 2004–2005 data.* Wellington: Ministry of Health

[38] Data provided to IPRU by other participants in Injury ICE (International Collaborative Effort on Injury Statistics) through Lois Fingerhut (personal communication)

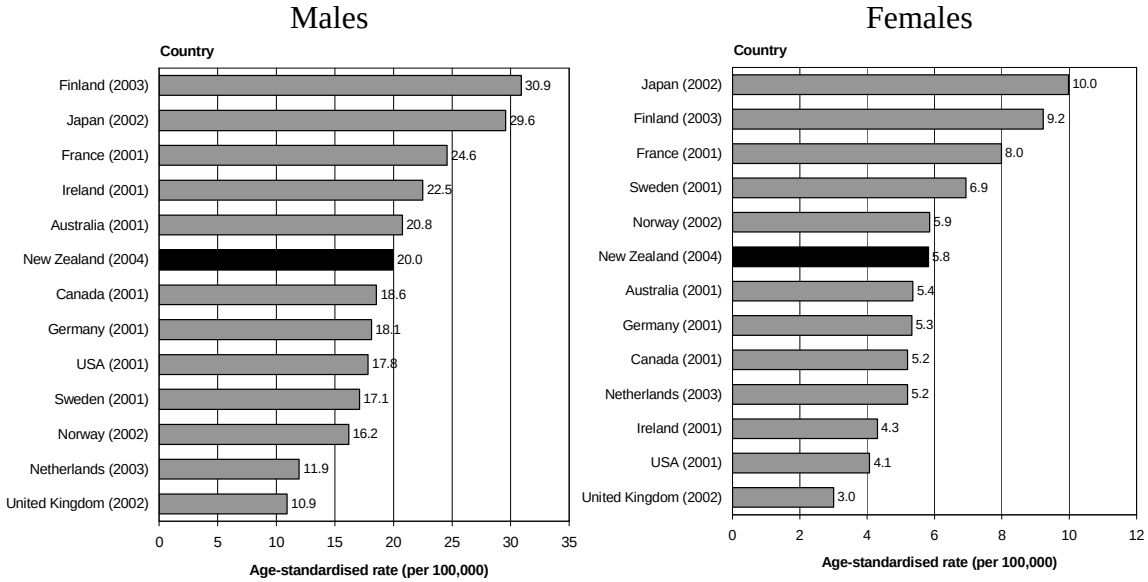
ranks sixth highest for both male and female suicide deaths. These data come from the World Health Organisation and have been age-standardised to the WHO world population[39].

Figure 2: Deaths from suicide per 100,000 population, age-standardised rates (2000-2002 aggregated data)



Source: International Collaborative Effort on Injury Statistics

Figure 3: Male and female suicide rates in selected OECD countries



Source of data: World Health Organisation[3]

[39] Ministry of Health. 2006. *Suicide Facts:2004-2005 Data.* Wellington, Ministry of Health

3. Data and definition problems

International comparisons of suicide rates such as those illustrated above are likely to be unreliable due to misclassification of cause of death. In some instances, the methods of age-standardisation and lack of precision due to small numbers of events also need to be considered.

3.1 Misclassification of cause of death

Deaths may be identified as suicides by a note or other clear statement of intent. When this is not the case the intention of the deceased must be inferred. While many suicides from hanging, shooting or cutting may be clearly identified as such, when someone dies from drowning, poisoning, or a car crash, particularly when alone, it may be difficult to determine whether the death was intentional. When alcohol or other drugs are involved this increases uncertainty. The degree to which deaths of uncertain intent are investigated, and the way they are certified varies a great deal within and between countries. Approximately 1.5% of injury deaths are classified as "of undetermined intent" in New Zealand, while the proportion is about 3% in the United States and 9-10% in England and Wales[40].

Procedures for recording a death as suicide are not uniform. Some countries require corroborating evidence, e.g. a note, while others require an assessment of intent by a coroner, as in New Zealand and the United Kingdom. Police are often involved and the cause of death is unlikely to be assigned by a doctor alone. In the US the determination is made by a medical examiner, on evidence available at the time. In some countries, death certificates can be amended in the light of later evidence[41]. The availability of resources to do the necessary investigation will also affect the numbers of suicides reported. These include autopsy rates, toxicological assessment, the level of training of certifiers and involvement of physicians, and the use "psychological autopsy" methods.

There may also be unwillingness to classify deaths as suicide for a range of social and cultural reasons. These include religious beliefs, stigma, and financial sequelae such as loss of life insurance. These considerations may increase the likelihood for whole communities that a death will be recorded as unintentional, "of undetermined intent" or will be ascribed to a pre-existing mental disorder.

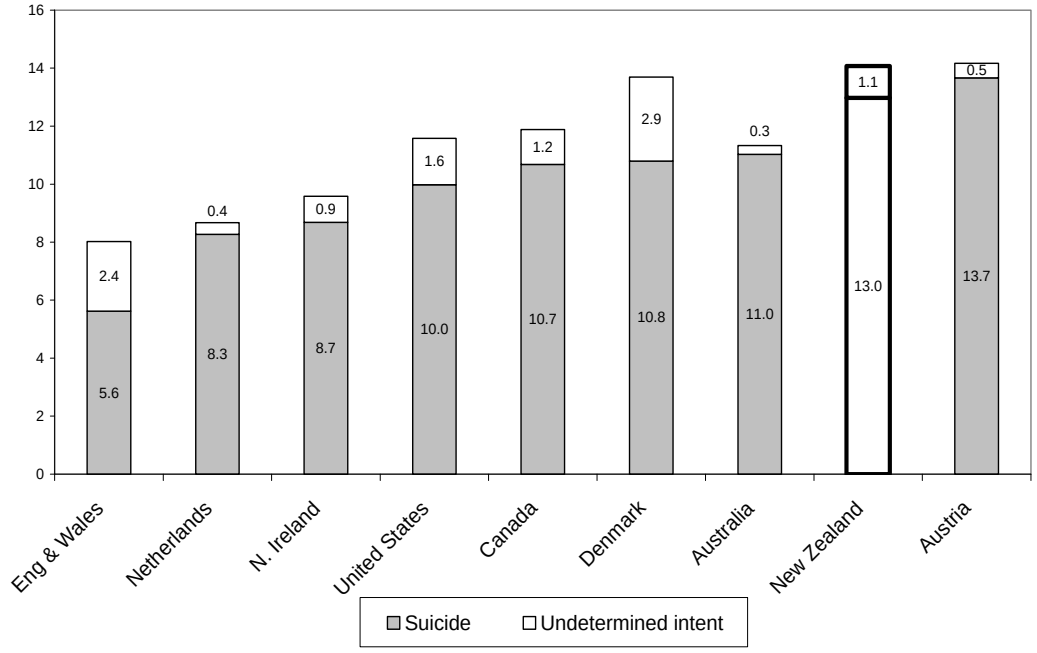
As a result of these factors, suicide deaths will be misclassified in all countries but to a variable extent. The degree of undercounting will vary by the method of suicide used, and may vary by the age, sex, ethnicity and socioeconomic status of the victim. The three cause-of-death categories most known to obscure suicides in mortality data are "injury of undetermined intent", "unintentional poisoning" and "drowning". As poisoning and drowning may be the preferred methods for women compared with men, or older people compared to younger people, this will produce biases in the undercounting within countries. Suicide in traffic crashes appears to be more common amongst young men and is likely to be substantially misclassified[42]. When considering international comparisons, there will be

[40] Data sources: NZHIS, National Vital Statistics Review(US), Office of National Statistics (UK)
[41] Rockett I, Smith GS. Suicide misclassification in an international context. In: Proceedings of the International Collaborative Effort on Injury Statistics Vol 1, DHHS No.95-1252, 1995;26:1-18
[42] Ohberg A et al, Driver Suicides. Br J Psych, 1997;171:468-72

biases due to differences in the most commonly used methods in each country. In many instances, whether deaths are intentional will be subject to more scrutiny in young people than in old, and there is also evidence from the US that deaths in particular demographic groups may be less likely to correctly classified as suicide (black versus white, black women versus black men)[43].

Analyses where suicide deaths are combined with undetermined deaths suggest that, at least in the EU, the rankings of countries may not change very much if suicides were more fully enumerated[44]. Figure 4 shows the rate of undetermined deaths added to suicide deaths for the same countries as shown in Figure 2 above. The potential impact is very evident for England and Wales where the suicide rate increases by more than 40% when deaths of undetermined intent are added. The complexity of untangling misclassification from real differences in rates is illustrated by recent trends in Ireland. Increasing suicide rates have resulted partly from a drop in the number of deaths classified as "undetermined" due to changes in social norms, but also appear to have a component of a real rise in suicide, possibly due to some of the same changes in society[45].

Figure 4: Deaths from suicide and from injuries of undetermined intent per 100,000 population, age-standardised rates (2000-2002 aggregated data)



Source: International Collaborative Effort on Injury Statistics

[43] Rockett I et al. The black-white suicide paradox: possible effects of misclassification. *Soc Sci Med* 2006; 63:2165-75
[44] Chishti P et al. Suicide mortality in the European Union. *Eur J Public Health*,2003;13:108-14
[45] ibid

3.2 Age-standardisation and lack of precision due to small numbers

If different standard populations are used for the age-standardisation of suicide rates (for example the Segi population rather than the WHO world population), this can result in different estimates of suicide rates in the same period. This means that comparisons using different methods should not be combined.

New Zealand has a small population and therefore the annual number of suicide deaths is fairly small. This can result in substantial variation from year to year in reported rates by chance. For this reason, we should use rates for data aggregated over several years (e.g. Figure 2) or moving averages (e.g. Figure 1). Another approach is to make the statistical uncertainty in the rates explicit by using confidence intervals[46]. In this way, groups of countries may be ranked the same, as the rates are not actually precise enough to differentiate between them.

4. Differences in exposure and other determinants

The determinants of suicidal intent are complex and include characteristics of individuals as well as the society they live in. Some of these are long term predisposing factors and others are trigger events. Commonly there is a pre-existing mental health disorder, most often a mood disorder but also substance abuse and antisocial behaviours. Other identified predisposing factors are exposure to recent stress or life difficulty, exposure to childhood adversity or trauma, impulsive and aggressive tendencies under stress, and socioeconomic and educational disadvantage. Two-thirds or more of suicide victims have a mental health problem at the time, usually a mood disorder, and often other immediate stresses[47]. At a country level these are difficult to characterise and compare.

While differences in exposure to risk may have a different meaning for intentional and unintentional injury, there is some evidence that exposure to the most lethal means of suicide may affect risk. Following the reform of Australia's gun laws in 1996 the decline in firearm-related deaths accelerated, and this was most marked for suicides. No substitution effect was seen[48]. There has also been a change in the type of medication prescribed for depression in many countries, from predominantly tricyclic antidepressants to selective serotonin reuptake inhibitors (SSRIs). Due to the relative safety of these newer drugs, this has reduced the risk of dying from an overdose of similar proportions in countries where they are used. The mix of pharmaceuticals prescribed to people with depression as well as the accessibility of other unsafe medications such as barbiturates, and agricultural poisons such as paraquat has been shown to affect the rate of completed suicides.

In New Zealand the predominant means of suicide are hanging (48% in 2002) and carbon monoxide poisoning (22% in 2002) and these have increased relative to firearms (11% in

[46] John Wren, Senior Advisor, Ministry of Health; personal communication.
[47] Beautrais AL et al. 2005. *Suicide Prevention: A review of evidence of risk and protective factors, and points of effective intervention.* Wellington: Ministry of Health.
[48] Chapman S, Alpers P, Agho K, Jones M. Australia's 1996 gun law reforms faster falls in firearm deaths, firearm suicides, and a decade without mass shootings. *Injury Prevention* 2006;12:365-72

2002) in the last 20 years. This leaves little room for prevention by reducing access to the means of suicide[49]

5. Differences in extent of intervention

The evidence base for suicide prevention activities is not as well developed as for some other areas of injury control due in part to the complex nature of the causes. However there is strong international agreement about key components for suicide prevention. These involve improving the quality of services to identify and treat people at high risk (those with mental disorders and suicidal behaviours), improving suicide risk assessment, reducing access to the means of suicide, promoting mental health and well being at a societal level, managing media coverage of suicide, and providing management and support for those affected by suicide or attempts[10]. As alcohol and other drug use contribute to suicide risk, policy and societal norms in these areas will also affect rates.

The extent to which different countries are enacting these suicide prevention measures is variable but evidence of effectiveness and international comparisons are lacking[50].

6. Conclusion

New Zealand's suicide rate is fairly high compared with other similar countries using the best available information. The rate peaked about 10 years ago and is showing signs of declining. However, there is substantial uncertainty about the international comparability of suicide data. This is due to the difficulty of ascertaining whether injuries were intentional or not and how this affects classification of potential suicide deaths in different countries. International comparisons will be unreliable since the extent of this misclassification varies with the mechanism of death, with legislative differences around certification, and with cultural differences in the resources and willingness to ascertain intent.

[49] Rockett I et al. The black-white suicide paradox: possible effects of misclassification. *Soc Sci Med* 2006; 63:2165-75

[50] Stone DH et al. Intentional injury mortality in the European Union: how many more lives could be saved? *Injury Prevention* 2006;12:327-32

International comparison of injury deaths: Work-related injuries

a report to the

New Zealand Injury Prevention Strategy Secretariat

Prepared by

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John Langley
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May 2007

1. Introduction

There are approximately 100 work-related deaths in New Zealand per year including fatal work-related traffic crashes. However, there is currently no data system in place which can provide valid estimates of work-related injuries in New Zealand, and we have to rely on special studies. The Work-Related Fatal Injury Study undertaken by Feyer et al[51] collected and analysed information on non-traffic work-related fatalities between 1985 and 1994 and provides the most recent reliable information available in New Zealand.

Work-related traffic crashes represent the largest single category of work-related death, averaging 31 deaths per year from 1985-98 with no obvious trend over time. A little under half of the traffic deaths occurred while commuting to or from work, the remainder were while working[52].

The rate of work-related fatal injuries, excluding traffic crashes and suicide, declined from an annual average of 7.2 per 100,000 in 1975-1984[53] to 5.03 per 100,000 in 1985-94[1]. In the latter period 98% of fatalities involved men, who made up 58% of the workforce. The highest frequency of deaths was in the 20-39 year age group, but workers over 65 had by far the highest risk. Farmers, forestry workers and fishery workers together accounted for 40% of all deaths.

2. Recent international comparisons

Tabulations of international data on work-related fatalities are published on a regular basis. Those from the International Labour Organisation (ILO) come with caveats on their validity but are still used for comparing countries. These are likely to be poor estimates and misleading comparisons for reasons outlined in the next section.

In 1999, estimates of the global burden of occupational fatal injuries were published[54]. These were based on ILO data that were adjusted for under-reporting, and have been criticised as useful for "demonstrating order of magnitude differences between countries" only, due to concerns about the quality of the source data[55].

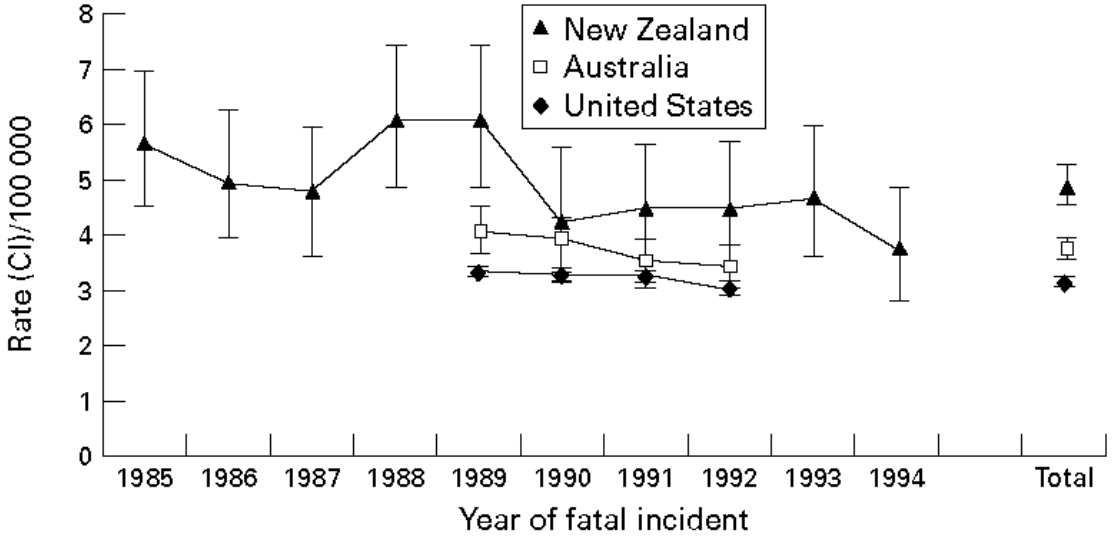
There have been few special studies published that compare work-related fatal injuries in different countries. However, a collaborative project between researchers in Australia, New Zealand and the United States compared data collections based on vital records from 1985-

[51] Feyer A-M et al. The work-related fatal injury study: numbers, rates and trends of work-related fatal injuries in New Zealand 1985-94. *NZMJ* 2001;114:6-10
[52] McNoe B et al. Work-related fatal traffic crashes in New Zealand 1985-1998. *New Zealand Medical Journal.* 2005;118(1227):1783
[53] Cryer PC et al. A review of work-related fatal injuries in New Zealand 1975-84: numbers, rates and trends. *New Zealand Medical Journal* 1987;100:1-6
[54] Takala J. Global estimates of fatal occupational accidents. *Epidemiology* 1999;10:640-6
[55] Feyer A-M et al. Comparison of work-related fatal injuries in the United States, Australia and New Zealand: method and overall findings. *Injury Prevention.*2001;7:22-28

1994 and looked in detail at methodological issues and data quality[56]. This study excluded work-related traffic crashes.

Figure 1 shows that while there was more variability in the New Zealand rates due to smaller annual numbers of deaths, New Zealand had the highest annual rate of work-related fatalities (4.9 per 100,000). The average annual rate was 3.8 per 100,000 in Australia and 3.2 per 100,000 in the United States.

Figure 1: Work-related fatalities in New Zealand, Australia and the United States (1988-1994). Annual rates per 100,000 population, with 95% confidence intervals



Source: Feyer et al.[2]

These figures differ from those reported in the global burden study referred to above, both in absolute rates and relative ranking. The global burden study found that Australia had the highest rate of fatal work-related injury of the three countries, with a rate nearly twice that shown in the figure above. The rates for NZ and the US were identical and about twice the US rates shown in Figure 2.

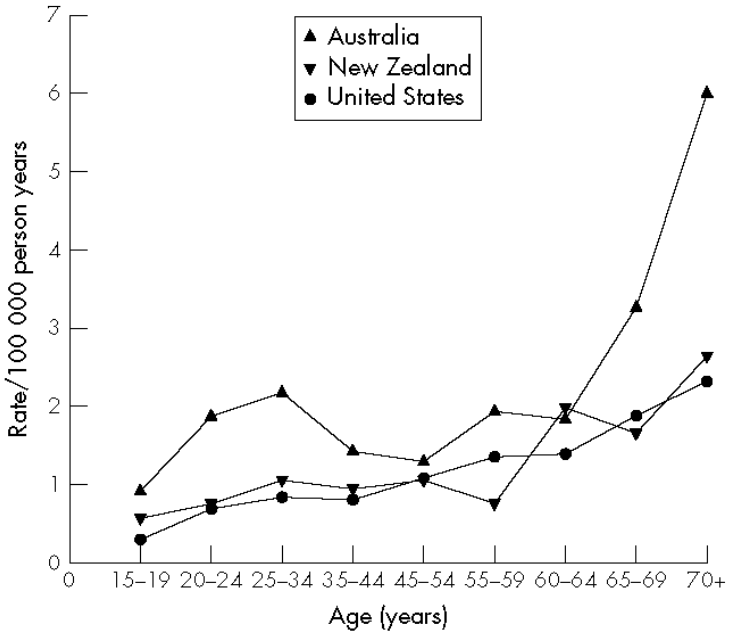
A separate investigation of work-related traffic fatalities in New Zealand, Australia and the United States has also been undertaken recently[57]. This excluded commuter deaths and road bystander deaths, as these are not included in the US data. The study found a higher rate of fatalities in Australia (1.69 per 100,000) compared with New Zealand (0.99) and the US (0.92). Only a small part of the difference could be attributed to differences in industry distribution in the three countries. There was some evidence that undercounting due to lack of information about work-relatedness of crashes in NZ and the

[56] Feyer A-M et al. Comparison of work-related fatal injuries in the United States, Australia and New Zealand: method and overall findings. *Injury Prevention.*2001;7:22-28

[57] Driscoll T et al. Comparison of fatalities from work-related motor vehicle traffic incidents in Australia, New Zealand, and the United States. *Injury Prevention* 2005;11:294-9

US (compared with Australia) may have contributed. However, an unexplained difference remained. Figure 2 shows the rates of work-related traffic fatalities by age group.

Figure 2: Age-specific rates of fatal work-related motor vehicle traffic injuries in Australia, New zealand and the United States.



Source: Driscoll et al[5]

3. Data and definition problems

3.1 Under-reporting

Under-reporting of deaths as being work-related is likely to occur to some extent in all routinely collected data. This has been documented for the National Traumatic Occupational Fatality (NTOF) dataset from the US which is derived from death certificates with the "at work" information being completed by the funeral director[58], and which was used in the comparative studies described above. The extent of under-reporting in the NTOF has been estimated as 10-30%[59]. In New Zealand, where there is no surveillance system, a study was conducted that merged the databases of agencies concerned with work-related injury deaths[60]. It found that this only identified 73% of the cases enumerated in the Work Related Fatal Injury Study and therefore was not adequate to be used as a fatality register. In the comparative study of work-related traffic deaths described in the previous section, 37% of all traffic deaths in New Zealand could not be classified as being work-related or not because of insufficient information about the purpose of the travel. They were therefore excluded from

[58] Driscoll T et al. Assessing the classification of work-relatedness of fatal incidents: a comparison between Australia, New Zealand and the United States. *Injury Control and Safety Promotion*.2002;9:32-9

[59] Feyer A-M et al. Comparison of work-related fatal injuries in the United States, Australia and New Zealand: method and overall findings. *Injury Prevention.*2001;7:22-28

[60] Langley J et al. Work-related fatal injuries in New Zealand: can a reliable electronic work-related fatality "register" be established? *J Occup Health Safety* 2000;16:145-53

the total of work-related fatalities. The extent of under-reporting in routine data for other countries is unknown.

3.2. Differences in case definitions and classifications

Variations in definitions of work-relatedness, and differing applications of the same definitions were found in the comparative study of NZ, Australia and the US[8]. While in the context of research a common "narrow" definition was applied to all three data sets, and small group of researchers made decisions about work-relatedness, in normal circumstances varying inclusion and exclusion criteria would have been applied.

The circumstances in which there was disagreement included injuries involving domestic violence at work, volunteer workers, business trips, social functions connected with work, hobby farmers, and bystander incidents. Not only was there variation in what is considered work-related, but also in the amount and type of information available on which to make a decision, as different sources of data were used.

Traffic crashes, which were excluded from the comparative study, are the leading cause of work-related fatalities but may also be treated differently in different countries. For example, the US surveillance data (NTOF) includes crashes while working but not while commuting. In the NZ work-related fatal injury study, working and commuting traffic crashes were each enumerated separately from non-traffic work-related deaths.

3.3 Differences in classification of occupation and industry

The categories of occupation and industry used in different jurisdictions may differ even when the same international classification systems are used. The comparison of NZ, Australia, and US found differences in inclusions and exclusions for different industries even when highly aggregated. For example the US system, in contrast to NZ and Australia, excluded "logging" from "Agriculture, forestry and fishing" and included it with "Manufacturing". Variation of this kind means that even comparisons between high level industry groups become misleading.

4. Differences in exposure and other determinants

Since some occupations are inherently more dangerous than others, the mix of occupations and industries in different countries will affect overall fatal injury rates. As well as this, workers in the same industries may be exposed to greater risk in some countries than others by virtue of factors such as geography, climate, and road environment. For example, fishermen who operate in extremely cold conditions with large seas (e.g. in Alaska) are more likely to die than those who operate in temperate, protected waters.

The study by Feyer at al found that much of the difference between rates of fatal work-related injury in New Zealand, Australia, and the US was accounted for by differences in industry distribution. In all three countries male workers, older workers and those working in agriculture, forestry and fishing, in mining and in construction were at higher risk. Intentional work-related fatalities were more common in the United States (21%) compared with Australia (5%) and New Zealand (4%), mostly comprising homicides and possibly related to the greater availability of firearms.

In order to make valid comparisons between countries with a different mix of occupations, one of two approaches can be taken. The first is to standardise the overall rates of work-related fatal injury for any major differences in occupational mix, in the same way that rates are standardised for differences in the age-makeup of the populations. The second approach is to compare only industry-specific rates of fatal injury rather than overall rates e.g. forestry-related deaths, fishing-related deaths. This may be problematic for New Zealand however, as the numbers of deaths in some industry groups are very small.

5. Differences in extent of intervention

A wide range of countermeasures for work-related injury are implemented in New Zealand and other countries with which we compare ourselves. We are not aware of any international comparisons of the extent of occupational safety interventions.

6. Conclusion

There are considerable obstacles to gathering comparable data on work-related fatalities in different countries. This is partly because countries differ in their understanding of what constitutes work, and the extent of the responsibility of the employer. However, if the data quality issues could be overcome, the usefulness of international comparisons of overall work-related fatal injuries in identifying hazards and targets for prevention would still be limited. Comparisons need to industry-specific, or at least standardised for the mix of industries in the countries being compared.

International comparison of injury deaths: Drowning

a report to the

New Zealand Injury Prevention Strategy Secretariat

Prepared by

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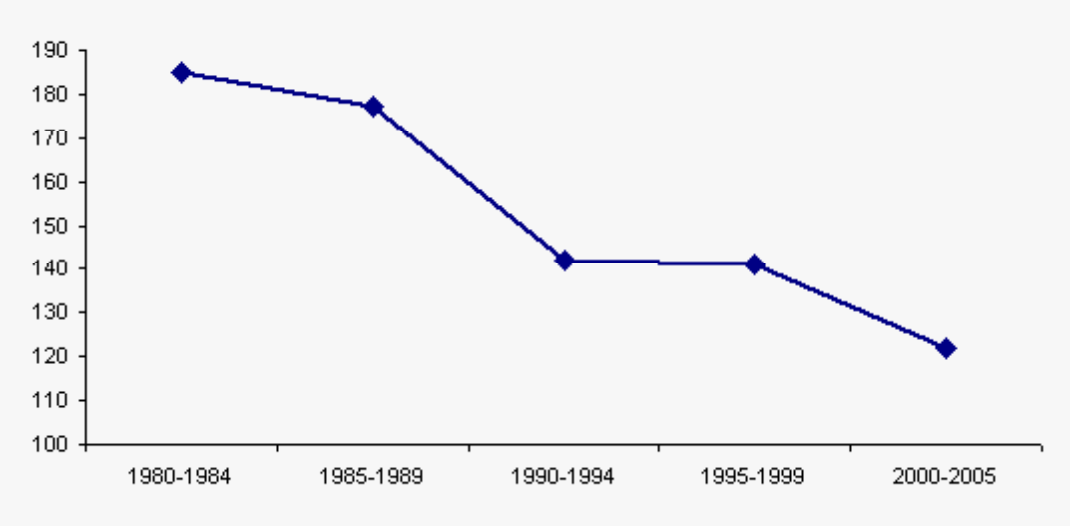
May 2007

1. Introduction

Globally, drowning has been estimated to be the second leading cause of injury death after road traffic injuries. However, 97% of all deaths from drowning now occur in low and middle-income countries, with huge reductions in the rates of drowning in high-income countries over the last 100 years.

In New Zealand, drowning records are available for 1980-2006 from DrownBase, a database of Water Safety New Zealand. The highest annual number of drownings recorded in this period was 214 in 1985. These figures include intentional as well as unintentional drownings; the number of intentional drownings has remained fairly constant at 10-20 per year since 1988 while the number of unintentional drownings has diminished[61]. Approximately 95% of intentional drownings are suicide.

Figure 1: New Zealand Average Drowning Toll 1980-2006



Source: Water Safety New Zealand

For the period 1980-2006, 59% of drownings occurred in situations where there was no intention to enter the water, and 78% involved male victims[62]. One third of drownings occurred in rivers and streams. The highest rates of drowning deaths were in adult men. Maori are over-represented in drowning deaths (21% of all drownings in the past 5 years) but the Maori rate has been declining at approximately the same rate as non-Maori.

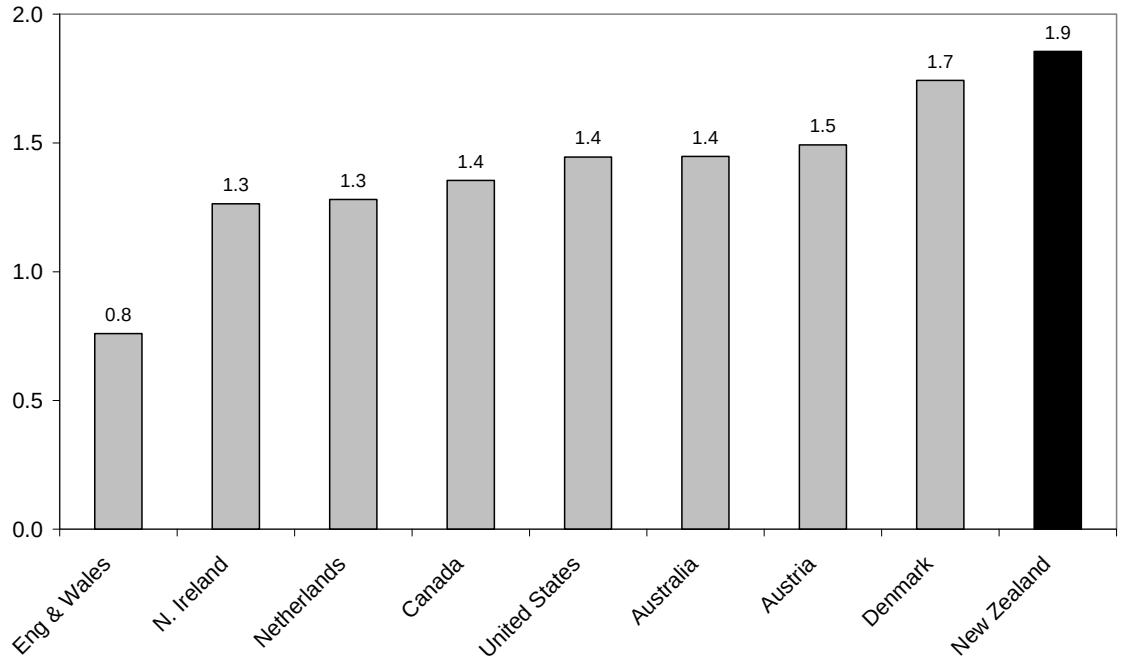
In 2006, the number of drowning deaths was 87, the first time it had fallen under 100.

2. Recent international comparisons

Figure 2 shows rates of deaths from drowning in a selection of countries, adjusted for differences in the age structure of the populations. These estimates are based on combined data for 2000-2002 and come from national mortality data systems[63].

[61] New Zealand Health Information Service. Data accessed via IPRU web based National Injury Query System (NIQS), University of Otago.(http://www.otago.ac.nz/ipru/Statistics/NIQS.html)
[62] Water Safety New Zealand website
[63] Data provided to IPRU by other participants in Injury ICE (International Collaborative Effort on Injury Statistics) through Lois Fingerhut (personal communication)

Figure 2: Deaths from drowning per 100,000 population, age-standardised rates (2000-2002 aggregated data)



Source: International Collaborative Effort on Injury Statistics

3. Data and definition problems

It is now widely accepted that deaths from drowning have been substantially under-reported due to systematic problems with the coding of drowning in the classification systems used in government data collections (ICD-9 and ICD-10)[64]. As well as this, the introduction of a new definition of drowning[65] and subsequent moves towards better enumeration of drowning deaths has created problems with comparability of data from different countries. As with international comparisons of other injury data, the methods of age-standardisation and lack of precision due to small numbers of events may also need to be considered when interpreting the result of comparisons.

3.1 Misclassification of cause of death

The definition of drowning adopted by the World Congress on Drowning in 2002 is "respiratory impairment from submersion/immersion in liquid" without reference to circumstances or intent. However, the drowning data that are routinely reported by developed countries have been based on the ICD-9 or ICD-10 external cause codes for *unintentional* drowning only. Therefore there are many drowning deaths that are not included. A recent study of Australian and US data[66] found the undercounting amounted to 39% of drowning deaths in Australia and 36% in the US. The most significant groups of deaths omitted from the routine drowning count were those with external cause codes of intentional self-harm or water transport-related deaths. In addition, the extent to which

[64] Passmore JW, et al. True burden of drowning: compiling data to meet the new definition. *International Journal of Injury Control and Safety Promotion.* 2007, 14:1-3

[65] Van Beeck EF, et al. A new definition of drowning: towards documentation and prevention of a global public health problem. *Bulletin of The World Health Organisation* 2005;83:853-6

[66] Passmore JW, et al. True burden of drowning: compiling data to meet the new definition. *International Journal of Injury Control and Safety Promotion.* 2007, 14:1-3

drowning deaths are classified as "undetermined intent" varies greatly between countries. In data from the late 1990s, 36% of all drowning deaths in England and Wales were coded as of undetermined intent, while only 5% in the US and NZ were coded as undetermined. If not coded as "unintentional" these deaths have not been counted as drowning, and so the drowning rates in England and Wales appear artificially low.

As injuries may have multiple causes, they are often not adequately described by a single code for "underlying cause of death". The extent to which drowning deaths are classified by other underlying causes of death contributes to under-counting, and when this source of error differs between countries it also erodes comparability. There is a diagnosis code (rather than external cause code) for drowning in the ICD-10 system which can be used to identify drownings in situations where an external cause code other than drowning has been used, such as drowning deaths resulting from land transport crashes. However, these cases are excluded from routine data on drowning identified just by external cause codes.

The impact of these issues on comparisons can be considerable. Using multiple cause of death codes and searching of free text fields from data from the early 1990s[67], it has been demonstrated that motor vehicle traffic deaths comprised 11.4% of drowning deaths in New Zealand but only 0.9% in Denmark. Drowning deaths may also be coded as other injuries, such as falls. Medical conditions were given as the underlying cause of death for 1.9% of drownings in the US, 2.4% in Canada, 5.5% in England and Wales and 4.9% in New Zealand, and WHO coding rules specify that drownings related to epilepsy should be coded as epilepsy rather than injury. All of these are omitted from the routine drowning data when a single underlying cause of death is used to classify them. Complete enumeration of drowning deaths would require the use of multiple cause-of-death data.

3.2 Changes in definition and classification

In the period from 1977 to 1992 there was little change in the number of drowning deaths in New Zealand that were coded with non-drowning codes, although as the drowning deaths decreased they became a larger proportion of the total[68]. However, internationally there have been changes since this time. The definition of drowning agreed upon after the World Congress on Drowning in 2002 was new and previous categories of drowning such as "dry" and "wet" drowning, and "near drowning" were rendered obsolete. The new definition defines drowning to be "the process of respiratory impairment from submersion/immersion in liquid". Outcomes are classified as death, morbidity or no morbidity." As the new definition is adopted and national record systems are adjusted at varying rates across the world to meet it, data from different jurisdictions will not be comparable. In particular, as the moves to deal with ICD-10 coding issues and incomplete enumeration make progress[69] there will data from different countries using different combinations of codes to enumerate drownings. For example, Australian drowning data from 2004 will be based on a wider group of codes than previously but they will be different from those used by CDC in the US, and those to be adopted by WHO[70].

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[67] Smith GS et al. International comparisons of drowning mortality: the value of multiple cause data. *Chapter 20 in Proceedings of the ICE on Injury Statistics, Volume III, Washington DC:April 2000.*

[68] Smith GS and Langley JD. Drowning surveillance: how well do E codes identify submersion fatalities? *Injury Prevention,* 1998;4:135-9

[69] Fingerhut L. The external cause of injury matrix. Report on the WHO Family of International Classifications Network Meeting, Reykjavik. 2004.

[70]Passmore JW, et al. True burden of drowning: compiling data to meet the new definition. *International Journal of Injury Control and Safety Promotion.* 2007, 14:1-3

3.3 Age-standardisation and lack of precision due to small numbers

Comparisons between countries always require data to be age-standardised, and comparisons should not be made using data that has been age-standardised using different standard populations.

As with other causes of injury death, annual numbers of drowning deaths are relatively small in developed countries. Stable estimates may require the use of aggregated data over several years and small differences in age-standardised rates should be interpreted conservatively since measures of precision of the estimates are not usually given.

4. Differences in exposure and other determinants

The determinants of drowning are heterogeneous and vary by time and place and age of the victim. Obviously exposure to liquid, usually a body of water, is a prerequisite and opportunities for exposure vary by age, geography, rurality, occupation, climate, affluence, cultural practices other variables.

Amongst children in high-income countries the highest rates of drowning are in the very young and the context of drowning is usually bath-tubs (infants) and swimming pools (toddlers). Drowning is associated with lack of, or lapses in, supervision. Exposure to swimming pools is greater in warmer climates such as Australia and the US than colder countries such as Canada, and toddler drownings are correspondingly higher in these countries. Farms account for some exposure of children to unprotected expanses of water.

Amongst adolescents and adults drowning usually occurs in natural bodies of water. Apart from differences in geography, exposure will be affected by levels of activity associated with water, particularly occupations such as fishing, and water-based recreation. In New Zealand and Canada, rates of drowning in adult males are higher than in toddlers, who have the highest rates in most other countries including Australia.

It is unknown how much of the difference in international and regional comparisons of drowning rates are due to these differences in exposure.

Drowning rates are higher in men than women, and in the United States, Canada, Australia and New Zealand they are higher in indigenous populations than in the general population. It is not clear whether these differences are due to increased exposure or more high risk behaviour or both.

Other risk factors for drowning that have been identified include:

- Temperature of water and climate. In the US and Australia the rate of submersion resulting in hospitalisation is approximately double the drowning death rate. However, in Canada it is about half, with higher case fatality resulting from colder water and worse weather conditions.
- Alcohol consumption. In New Zealand 28% of young adult drowning deaths (15-24 years) between 1980 and 2002 were considered to be alcohol-related[71]. Amongst adults (15-64) in the Auckland region between 1980 and 1997 40% of all drowning victims had a positive blood alcohol reading and 31% were over the legal driving

[71] McDonald G, et al. Circumstances surrounding drowning in those under 25 in New Zealand (1980-2002). Child and Youth Mortality Review Committee and Water Safety New Zealand, 2005

limit for alcohol (80mg %)[72]. A case-control study of recreational boating fatalities in the US[73] found that alcohol increased the risk of ending up in the water and reduced the risk of surviving the immersion. The risk of dying was elevated even with a blood alcohol concentration of 10mg% compared with zero, and increased with increasing blood alcohol level to fifty times the baseline risk with a blood alcohol of 250mg%. These findings are roughly comparable with alcohol involvement in road traffic fatalities. Alcohol is also considered to be a factor in poor supervision of children who drown.

- Epilepsy
- Suicidal intent
- Risk factors for car crashes and falls

5. Differences in extent of intervention

Interventions to prevent drowning deaths comprise removal of hazards, creation of barriers, protection of those at risk, and resuscitation. Specific measures used depend on the characteristics of the victim, such as age, and the circumstances of the drowning risk, which may vary by region or country.

Commonly employed strategies are water safety education (for children, parents, adults, employees), promotion of life jacket use and carrying of safety equipment on boats, learn to swim programmes, surf lifesavers on beaches, lifeguards at pools and other pool safety regulations, fencing of home pools and other water hazards, and widespread teaching of resuscitation techniques. These strategies attempt to both reduce the number of submersion incidence and reduce case-fatality rates.

There is little epidemiological evidence for the effectiveness of most of these approaches. However, fencing of private swimming pools has been the subject of several studies and a systematic review[74] which concluded that it significantly reduced the risk of drowning in children and that isolation fencing (just the pool) was superior to perimeter fencing (the whole property).

A clear protective effect of learning to swim on the risk of drowning has not been demonstrated. Research has been sparse and equivocal and the protective effect, if any, may be age-related. It seems obvious that, for an individual, swimming ability would be protective in a drowning situation. However, it is likely that the ability to swim also reduces one's natural fear of the water, reduces the likelihood of adequate supervision and affects the choice of activities undertaken. At a population level, especially amongst young children, it is possible that learning to swim may lead to an increase in drowning risk through increased exposure to water without adequate safeguards[75].

Reduction in the use of alcohol in and around the water by regulation or by rendering it socially unacceptable is a general countermeasure that is likely to be effective but has not been vigorously pursued.

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[72] Smith GS et al. The Role of Alcohol in Drowning and Boating Deaths in the Auckland Region. Report to ALAC, June 1999.
[73] Smith GS et al. Drinking and recreational boating fatalities. A population-based case-control study. *JAMA*, 2001;286:2974-80
[74] Thompson DC et al. Pool fencing for preventing drowning in children. *CDSR 2000*, Issue 2.
[75] Brenner R et al. Swimming lessons, swimming ability, and the risk of drowning. *Injury Control and Safety Promotion*2003;10:211-6

We found no research that compared the extent of adoption of countermeasures for drowning in different countries.

6. Conclusion

The mortality rate from drowning in New Zealand appears high compared with other similar countries, but the comparisons are likely to be unreliable. Undercounting of drowning deaths resulting from issues with coding is widespread and is likely to vary markedly between countries. Also, there has been a >25% reduction in mortality in NZ between 2000-02 and 2006. This brings NZ rates down to those of USA and Australia in 2000-02.

New Zealand has a higher rate of male adult drowning deaths compared with toddler deaths than many other countries, including Australia. This may relate to higher exposure to risk for men in New Zealand through geography, occupation, and recreation, and lower risk to toddlers through fewer home swimming pools.

International comparisons: Non-fatal injury

a report to the

New Zealand Injury Prevention Strategy Secretariat

Prepared by

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July 2007

1. Introduction

In discussion with ACC, we agreed that:

"A strategy be identified for undertaking a valid international comparison of non-fatal injury"

and

"…we propose to report on the feasibility of undertaking an all cause comparison of comparable countries using the ICISS (International Classification of Diseases-based Injury Severity Score) approach which was also used for the NZIPS injury outcome indicators, using ICE [International Collaborative Effort on Injury Statistics] as the mechanism to facilitate this".

The following statements, which we wrote in our first report[76], apply equally well to non-fatal injury as to fatal injury:

"Comparing injury rates from different countries can suggest priorities for research and intervention, and provide insights into the effectiveness of prevention strategies. If differences exist in rates of injuries, we need to investigate whether they can be explained by differences in exposure to risk, and whether some countries have intervened more effectively."

"Valid comparisons depend on good quality data and consistent definitions."

One problem with the comparison of fatal injury between countries is that, for a small country like New Zealand, there are a small number of injury deaths annually – so comparisons, particularly for individual priority areas (e.g. falls), have limited precision. The use of non-fatal injury incidence to make comparisons between countries will have increased precision since there are many more events. Such comparisons will also provide an extra dimension. When we compare injury death rates we have to accept that the likelihood of death given an injury is influenced not only by severity of injury but also by access to and the quality of health services. The effect of such extraneous factors, unrelated to the injury itself, can in theory be reduced through intelligent case selection for an international comparison of serious non-fatal injury. This could result in a better reflection of the incidence of serious injury amongst the populations than can be provided by death rates.

2. A recent international comparison

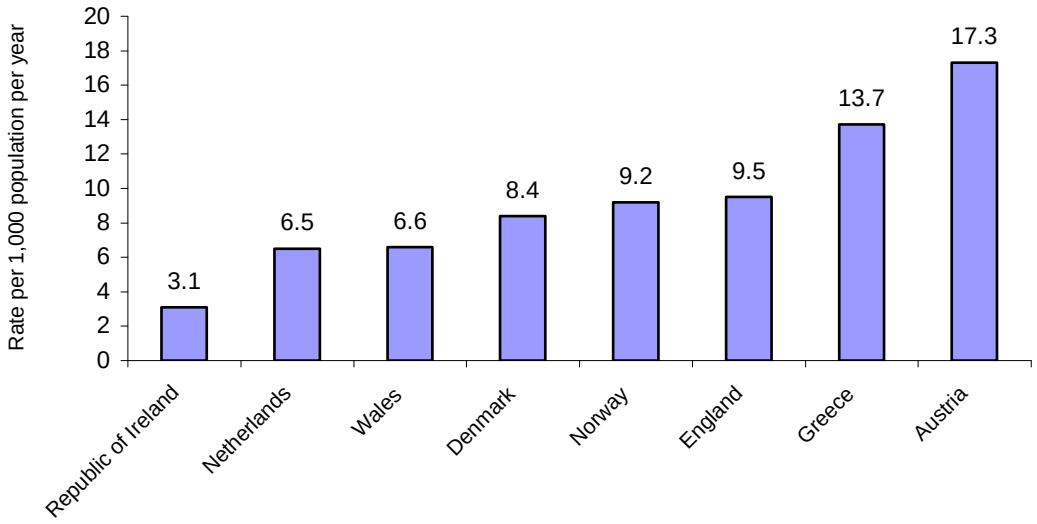
Figure 1 shows an international comparison, published recently, of rates of selected radiologically verified fractures resulting from home and leisure incidents[77]. The restriction to (a) fractures and (b) home and leisure was made in order to make comparisons that were less susceptible to bias and hence more easily interpreted. This comparison is restricted to European countries. It is based on hospital Accident and Emergency (A&E) department data. If New

[76] Connor J, Langley J, Cryer C. International comparison of injury deaths: Overview. A report to the New Zealand Injury Prevention Secretariat. Dunedin: Injury Prevention Research Unit, University of Otago, 2006.

[77] Lyons RA, Polinder S, Larsen CF, et al. Methodological issues in comparing injury incidence across countries. *International Journal of Injury Control and Safety Promotion 2006; 13: 63-70.*

Zealand wanted to contribute to such a comparison in the future, A&E department data would need to be available on a national basis and be of sufficient quality to permit this. A national database does not exist and we have no information on the quality.

Figure 1: Age-standardised emergency department-based rate of selected radiologically verified fractures occuring at home or leisure - 1999



3. Scope and definition

3.1 Definition of injury

For international comparisons, an operational definition of injury needs to be agreed. For example, the WHO Classification of Diseases and Related Health Problems (ICD) is used to code diagnosis and circumstances of injury admitted to hospital in many systems across the world, including New Zealand. So if hospital admissions/discharges were used for a comparison, a code range within ICD could be used to provide an operational definition of injury. For example, for the NZIPS, the case definition of injury was ICD-10 diagnosis codes in the range S00-T78 and external cause of injury codes in the range V01-Y36. This excludes medical injury and the sequelae (i.e. late effects) of injury.

The scope of the data available for comparison could limit the definitions used, for example

- It could be restricted by intentionality (e.g. ACC data excludes some self-harm injury)
- Or restricted by place of occurrence or activity (e.g. the UK HASS/LASS surveillance system, which was restricted to home and leisure)
- Some sources may be restricted solely to traumatic injury, whereas others may also include selected gradual process and disease cases.

Agreed operational definitions for international comparison across participating countries need to take exclusions such as these into account, in order to compare like with like.

3.2 Definition of severity

We have argued in the past that we should focus on important injuries. Important injuries includes those that result in death, significant disability, or loss of quality of life, carry a significant threat to life or threat of disability, or result in significant cost to the individual or society. To do otherwise could potentially result in attention on injuries that are minor (ie. injuries of no importance - eg. cuts and bruises that have no immediate or long term consequences) since these injuries are much more frequent than serious injury.

Severity could be measured, therefore, along the dimensions of threat-to-life, threat-of-disability, quality of life or cost. For international comparisons, what dimension is chosen will depend on, and be restricted by, the availability of suitable data in the countries being compared.

Severity measures are not captured by most national administrative data systems – but have to be derived. It could be argued that length of stay in hospital is a measure of severity. Previous work we have undertaken suggests that indicators based on such measures can result in misleading trends and comparisons[78].

ACC capture time off work, and cost of claim data – each of which could be regarded as a severity measure. More work is needed to investigate these for the purposes of developing indicators for NZ. Due to the unique nature of the ACC Scheme, comparing ACC data with other countries is not straightforward. ACC regularly compares the performance of their Employer's Account with Australian Workers Compensation Schemes, as well as limited comparisons with Canadian worker's compensation schemes[79]. So, ACC data could be the basis of international comparisons, provided that the ACC data and data from comparator countries are fit for purpose and that any significant biases (eg. variations in the cases which qualify for compensation) can be controlled.

For the NZIPS indicators, severity of injury was defined in terms of threat-to-life. A discussion of the particular instrument used to measure threat-to-life is given in section 5, including a potential approach to international comparisons based on serious threat-to-life non-fatal injury incidence.

4. Issues of comparability

4.1 Comparability of sources of injury data

Agreement is needed on what injury data can be used to produce comparable rates in each country. Potential sources include health system and survey data.

[78] Eg. Cryer C, Langley JD, Stephenson SC, Jarvis SN, Edwards P. Measure for measure: the quest for valid indicators of non-fatal injury incidence. *Public Health* 2002; 116: 257-262.
[79] ACC. *Briefing to the incoming Minister for ACC.* Wellington: ACC, October 2005. (http://www.acc.co.nz/DIS_EXT_CSMP/idcplg?IdcService=GET_FILE&dID=7489&dDocName=WCM2_022025&allowInterrupt=1)

4.1.1 Health system data

If using health data, complicating factors are:

- There are very different health care systems in each country

- Accident and Emergency department data (called Emergency Department [ED] data in some countries) capture injury diagnosis codes using differing coding frames to differing levels of specificity and quality.

- Electronic hospital records represent different things in different countries (e.g. records relate to an admission to a hospital, or to a specialty area within a hospital)

- If based on a sample of hospitals, there are differing proportions of hospitals sampled country-to-country, with varying degrees of representativeness of the sample, and using differing methods to extrapolate to the whole population.

For international comparisons of serious non-fatal injury incidence, it is likely that New Zealand would want to use hospital admission / discharge data as the basis – since (a) these provide the most comprehensive and reliable health service data in this country, and (b) there are potentially comparable sources of these data in other countries (e.g. Australia, and England & Wales). Admissions to hospital – particularly for more minor and moderately severe injuries – are influenced not only by severity of injury, but by extraneous factors, e.g. provision of and access to health / hospital services. These extraneous factors differ from country to country, and so comparing "unfiltered" hospital discharges does not result in a valid comparison of injury incidence – but of injury incidence along with these extraneous factors. So, differences in injury discharge rate between countries could reflect differences in these extraneous factors rather than differences in injury incidence.

The methods used for the NZIPS injury outcome indicators essentially "filter" these hospital discharge data to remove the effects of these extraneous factors[80]. This is a potential approach to international comparisons (see section 5).

4.1.2 Survey data

Should it be found that health system data cannot be used, then another option is to use survey data. If survey data is used, data collected under different survey protocols with differing definitions of injury, and unreliable methods of measuring severity of injury have the potential to bias comparisons. In 2004, the authors of the WHO guidelines for conducting community surveys on injuries and violence felt that differences in definitions and coding conventions used in many countries mean that current surveys cannot be compared.[81] However, development work has been carried out by the International Collaborative Effort on Injury Statistics (ICE) aimed a standardising injury questions in national household surveys[82].

[80] Cryer C, Langley JD. Developing valid indicators of injury incidence for "all injury". *Injury Prevention* 2006; 12: 202-207.
[81] World Health Organization. *Guidelines for conducting community surveys on injuries and violence.* Geneva: World Health Organization, 2004.
[82] http://www.cdc.gov/nchs/about/otheract/ice/projects.htm#Household%20Surveys

4.2 Comparability of definitions

Although all care was taken to reduce the influence of extraneous factors in the comparisons in Figure 1, they can never be eliminated. Some potential issues / problems when using health service data for these sorts of comparisons are described below, focusing particularly on the use of hospital discharge data. What is described below is based, principally, on two peer-reviewed papers[83] [84].

It matters whether case selection is based on external cause of injury rather than diagnosis. Within New Zealand, work found that 36% of discharges that had an external cause code did not have a primary diagnosis of injury. We have recommended that either diagnosis on its own, or a combination of diagnosis and external cause code be used to define a case of injury.

4.2.1 Principal diagnosis versus any diagnosis

Countries, including New Zealand, capture multiple diagnoses on their hospital electronic records. The selection of cases based on an injury diagnosis in any of the fields on the record is problematic. In many cases, where the diagnosis occurs in the second or subsequent field, it would be difficult to infer whether the person would have been admitted to hospital if they had only that injury. Secondly, countries are placing increasing emphasis on healthcare costs and recovery of those costs. This has been accompanied by the capture of increasing numbers of diagnoses on the electronic hospital records. So a case definition of injury based on an injury diagnosis in any position on the hospital electronic record would capture increasing numbers of cases over time due to this and so would:

a) bias time trends and

b) potentially bias international comparisons.

For these reasons, we have proposed that the case definition be based on primary diagnosis. The hospital data coder is instructed to include in this field the primary reason for admission to hospital.

4.2.2 Readmissions

People can be admitted more than once for the same injury – e.g. in the acute phase and during the rehabilitative phase. This is another factor that can bias our estimate of injury incidence and hence bias international comparisons. Our "Traps" paper[8] estimated that without their removal, this overcounts incidence in New Zealand by 9%.

4.2.3 Injury due to medical procedures

These cases account for 18% of all patients with a principal diagnosis of injury. This percentage has not been constant over time. It is questionable whether these injuries should be included in a case definition of injury. Many do not comply with a theoretical definition of injury. We have previously argued for their exclusion from a case definition, and they are excluded from the NZIPS indicators. Nevertheless, since these are included in the injury chapter of the ICD (T80-T88), many countries include these events in their case definitions.

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[83] Langley J, Stephenson S, Cryer C, Borman B. Traps for the unwary in estimating person based injury incidence using hospital discharge data. *Injury Prevention* 2002; 8: 332-337.

[84] Langley JD, Brenner R. What is an injury? *Injury Prevention* 2004; 10: 69-71.

4.2.4 Extraneous factors

When using hospital discharges as the definition of a case, factors other than injury incidence will affect case ascertainment. [2] These include health service supply (availability of consultants and beds) and access (e.g. distance from hospital) factors. These will bias time trends and international comparisons if not controlled (see below).

4.2.5 A protocol for international comparisons

All of the above issues need to be addressed when contemplating international comparisons of non-fatal injury using hospitalisation data. In order to achieve valid non-fatal injury comparisons between countries, a protocol needs to be agreed and used in the derivation of indicators for comparison. This protocol is likely to be aimed at selecting incident cases based on those serious injury diagnoses for which, if a person experiences such an injury, they have a high probability of admission (e.g. fractured femur[85]). In these circumstances, the effect of extraneous factors will be minimised. Comparisons of such injuries will be a comparison of injury incidence, rather than of service effects.

4.3 Options for comparison

4.3.1 Selected Radiologically Verified Fractures (SRVF)

The EUROCOST group proposed the use of SRVFs as the basis of an indicator that could be compared.[2] SRVFs comprise fractures of the upper arm, elbow, forearm, wrist (except in children <5), pelvis, hip, femoral shaft, knee, lower leg and ankle. Use of this indicator requires good quality A&E / ED data. The quality and completeness of A&E national data (and other outpatient data) could be investigated in New Zealand in order to determine whether an equivalent indicator could be produced which could be compared with these published data.

4.3.2 Threat-to-life injuries / Probability of admission

A potential alternative approach is to promote to other countries the methods used for the development of valid injury outcome indicators for the NZIPS to produce valid international comparisons. A variant of this would be to use measures based solely on a group of injury diagnoses that have a high probability of hospital admission in the countries that are to be included in the international comparison.

Both of these approaches are considered in the next section.

5. Examples of data problems with some possible solutions

As can be seen from the above, there are major problems with comparing non-fatal injuries between countries. With the exception of the comparison described by Lyons and colleagues [2], comparisons have been scientifically naïve and often misleading.

Typically, we are ignorant about the quality of data in the various countries whose injury rates are compared; and often, those countries are ignorant themselves about the quality of their own data.

[85] Boufous S, Finch C, Close J, et al. Hospital admission following presentations to emergency departments for a fracture in older people. Injury Prevention 2007; 13: 211-214.

The most likely source of data for comparisons between countries is health service utilization data. From New Zealand's perspective, this would need to be restricted to hospital discharge data, since A&E data is not collected nationally and is of uncertain completeness and quality.

We would wish to apply a severity measure to these hospital discharge data, and select serious injury for our comparisons, for two reasons. Firstly, our focus should be on important injury (see earlier). Secondly, minor and moderately severe injuries are far more susceptible to the influence of extraneous factors (e.g. health service provision and access factors) on hospital utilization rates. That is, serious injury cases (using threat-to-life to define serious) invariably get admitted, but not all injuries that get admitted are serious.

The state of the science of using hospital discharge data to create valid indicators is embodied in the NZIPS indicators development report[86]. This work is the first time anywhere in the world where an agency has applied an anatomical severity threshold for the purposes of developing valid injury indicators. ACC and NZIPS should be commended for supporting this development work, and NZIPS and the government should be commended for adopting these indicators. New Zealand, ACC and NZIPS are at the forefront of these developments, and the rest of the world has to have time to catch up.

In theory, this indicator work is the basis for future international comparisons. However, significant groundwork needs to take place before it can happen. Some issues are as follows.

5.1 Issue 1: Using a threat-to-life severity threshold

The NZIPS serious non-fatal injury indicators are based on the frequency of occurrence of injury that exceeds a pre-specified threat-to-life severity threshold. The indicators are based on discharges from hospital for selected diagnoses that represent injury whose severity exceeds that threshold. Those diagnoses are selected since they are associated with an in-hospital mortality rate of 5.9% or worse. For a case, this is measured using ICISS, which measures the likelihood that a person will survive their injuries given hospitalisation. ICISS is constructed from diagnosis-specific survival rates (SRRs), which are calculated from a training set of data. The training set used was New Zealand hospital discharges for the period from the introduction of the latest revision of the ICD (i.e. ICD-10) during 1999, to the end of 2001.

One problem of international comparisons using a case definition based on ICISS is that diagnosis-specific SRRs are not necessarily the same in one country compared with another (e.g. due to differences in the effectiveness of emergency services and different standards of hospital care affecting the likelihood of survival following injury). One way round this problem is to estimate SRRs based on a pooled set of data across countries to be compared. This would result in aggregate estimates of SRRs. The same aggregate SRRs could be applied in each country in the calculation of a patient's ICISS score. A diagnosis-specific SRR would not now be equal to a country's own survival rate for that diagnosis, but rather an approximation to it. (It could be argued that in essence that is what we have done in New Zealand. The SRRs are based on the aggregation of data from public hospitals across the

[86] Cryer C, Langley J, Stephenson S. *Developing valid injury outcome indicators. A report to the New Zealand Injury Prevention Strategy*. IPRU Occasional Report OR 049. Dunedin: Injury Prevention Research Unit, University of Otago. September 2004.

country, and the diagnostic-specific survival rates are unlikely to be identical across the country.)

In the absence of this empirical solution, a second approach would be to agree[87] on a set of 'standard' SRRs that would be applied to each of the country's data. Those standard SRRs would be based on empirical investigations in one or more countries, but these would form the basis for discussion and agreement of the diagnosis-specific SRRs to be used in international comparisons – a combination of empirical and judgment based SRRs. Again, they would not be "exact" estimates of case-fatality rates for New Zealand, unless the New Zealand case-fatality rates were adopted internationally. Nevertheless, fixing a set of SRRs to be used by all target countries is one way forward. (This is in essence what occurred with the development of the Abbreviated Injury Scale (AIS), an alternative approach to ICISS for measuring severity of injury. The severity scores within AIS were allocated by a group a experts reaching a consensus on what level of severity to allocate to each injury diagnosis [e.g. cervical spine cord contusion with fracture and dislocation] based on their clinical experience.)

5.2 Issue 2: Probability of admission

The above only works if the cases (with their accompanying injury diagnoses) captured by the ICISS threshold have a high probability of admission[88]. An alternative approach to international comparisons is to focus on probability of admission directly; i.e. to focus on injuries that have a high probability of admission in all countries as the basis for a comparison. In other words, identify a group of injury diagnoses that have a high probability of admission to hospital as a means of controlling the extraneous factors when making international comparisons. Therefore, a solution is to mount a project to estimate probabilities of admission for each constituent country that we propose to be used in an international comparison – to identify diagnoses that can be used as the basis for such comparisons.

The idea of such a project was discussed at an ICE meeting in September 2006 and agreed to in principle. Countries participating in these discussions, which may be in a position to take part, are Australia, USA, Canada, Denmark, Greece, and Italy. We are currently in discussion with the ACC regarding the funding of work to explore this solution as part of IPRU's 'core' funding.

6. Conclusion

Valid comparisons of serious non-fatal injury rates are fraught. We have the genesis of a proposal for the development of a method for the valid comparison of serious non-fatal injury rates between selected countries. We have support from the International Collaborative Effort on Injury Statistics for this proposal, and from selected countries who would be likely participants. The approach would estimate diagnosis-specific probabilities of admission and then base an injury indicator (for the comparison) on diagnoses with high probability. It is proposed that IPRU / New Zealand would lead such an initiative; developing protocols /

[87] Between the countries to be included in the international comparison

[88] As indicated earlier, for international comparisons, an indicator based on a case definition of injury that includes injuries that do not have a high probability of admission would be susceptible to the biasing influences of extraneous (eg. health service utilization) factors. In which case, in an international comparison, one would be unable to identify whether differences between countries were due to differences in these extraneous factors (eg due to differing health systems) or whether it was due to differences in serious injury incidence.

tools, managing the project, and coordinating the analysis and reporting. It is proposed that comparator countries organise their own funding for accessing, extracting and querying data according to protocols to be developed for this proposed work.

There is a will from several countries, and from ICE, to contribute to this work – although some momentum has been lost whilst IPRU's endeavours have been focused around their own future funding – work which took place over the last 9 months or so. Nevertheless, if that momentum can be regained, and the method we propose results in a valid method for comparing serious non-fatal injury rates - and this is applied across countries - then the differences in injury rates that are found should stimulate research into hazard exposures and the types and levels of interventions used in each country, to inform more effective prevention strategies.

Glossary

A&E	Accident and Emergency
ACC	Accident Compensation Corporation
AIS	Abbreviated Injury Scale
ED	Emergency Department
HASS	Home Accident Surveillance System
ICE	International Collaborative Effort on Injury Statistics
ICD	WHO's International Classification of Diseases and Related Health Problems
ICD-10	ICD 10th Revision
ICISS	ICD-based Injury Severity Score
IPRU	Injury Prevention Research Unit
LASS	Leisure Accident Surveillance System
NZIPS	New Zealand Injury Prevention Strategy
SRR	Survival Risk Ratio
SRVF	Selected Radiologically Verified Fracture
UK	United Kingdom
WHO	World Health Organization

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