Pilot Injury Outcome Evaluation of the Effectiveness of the FarmSafe™ Programmes for Sheep, Beef and Dairy Farmers – Parts 1 and 2

A report for the
Accident Compensation Corporation of New Zealand

This study was funded and supported by the Accident Compensation Corporation (ACC), Wellington, New Zealand. Views and / or conclusions in this report are those of the project team and may not reflect the position of the ACC.

Injury Prevention Research Unit
Department of Preventive and Social Medicine
University of Otago
P O Box 913
Dunedin
New Zealand

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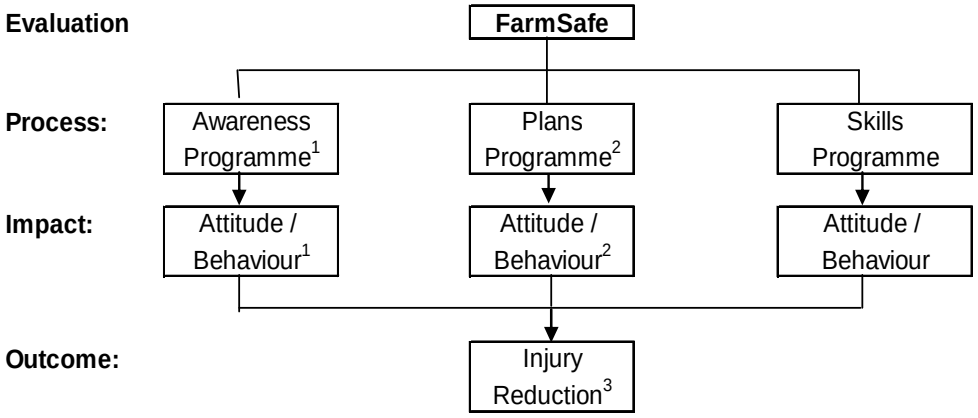
Foreword

Farm work-related injury is a serious public health problem in New Zealand. A national injury prevention effort has been mounted aimed at addressing this problem, namely FarmSafe™ (FS). FS includes elements identified in apparently successful interventions overseas. An effective intervention programme able to reduce the injury experience of the farming community will have considerable benefit. The effectiveness of FS has yet to be established, however.

FS comprises three key workshop components. FS Awareness was piloted from May 2002, was available to all sheep, beef and dairy farmers and farm workers from October 2002. This focused on changing farmer attitudes to farm safety in order to reduce injury and death in the sector. [1] The FS agencies hoped to have 5,000 farmers and farm workers participate per year – and achieved this in the first two years of the programme (see Part 1 Results). The FS Awareness workshop is regarded as a pre-requisite for attending the remaining two: Plans and Skills. The FS Plans and FS Skills workshops were offered to farmers and farm workers from May 2004. The aim of the FS Plans Programme is to enable participants to develop a health and safety plan that is simple to understand, easy to use, effective in reducing the risk of injury, and is compliant with their legal obligations. FS Skills focuses on the practical skills required by farmers and farm workers. The six Skills workshops are: riding ATVs; riding motorbikes; using chainsaws; animal handling; driving tractors; and using agrichemicals. [1]

In September 2004, John Wallaart (Programme Manager, Injury Prevention, Accident Compensation Corporation - ACC) asked the Injury Prevention Research Unit (IPRU) to develop proposals for the process and impact evaluation of the FarmSafe **Plans** programme, and the outcome evaluation of the FarmSafe **Awareness** and **Plans** Programmes. This we did, and submitted proposals in the first quarter of 2005. Work to that date to evaluate FarmSafe in New Zealand had focused on the process and impact evaluation of the **Awareness** programme. This work was being completed by Kate Morgaine, IPRU at the time of this outcome evaluation – and is currently being written up as part of her PhD thesis. How each of these pieces of work fit together is illustrated by the figure below.



1. Process and impact evaluation of the 'Awareness' Programme – Kate Morgaine, IPRU, University of Otago.
2. Process and impact evaluation of the 'Plans' Programme – unfunded proposal.
3. Pilot outcome evaluation of the effectiveness of FarmSafe programmes – this current
   pilot work (Colin Cryer, IPRU).

The work that focused on the outcome evaluation was funded by ACC, albeit a cut down version of the original proposal. It is the results of that work, and some follow-up work, that are presented in this report.

The initial work funded (Part 1) was a pilot to investigate the feasibility of a proposed method for the outcome evaluation of FS Awareness and Plans, using ACC claims and levy data, as well as FS enrolment data collected by Telford Rural Polytechnic.

The original proposal had the following aims:
Primary aim:

- To investigate whether exposure to the **Awareness and Plans** FarmSafe programmes is associated with a reduction in (a) ACC claims rates; (b) serious injury rates; (c) ACC claims costs.

Secondary aims:

- To investigate the validity of the methods used to address the primary aim
- Investigate exposure to other safety initiatives (that could contaminate the proposed observed effects).
- To compare what changes have been made on farms, with the aim of improving safety, between those who attended at least one FarmSafe™ Programme and those who have not.

The secondary aims were to be investigated using a survey of sheep, beef and dairy farms and were included to help explain any findings (positive or negative) that were

identified as a result of the outcome evaluation (primary aim). This part of the study was not funded and so was not carried out. It will be seen in Part 1 of this report that the results of this pilot evaluation for the FS Awareness Programme show higher rates of earnings-related ACC claims in the FS Awareness group than for those not exposed to FS. These results remain largely unexplained, but are likely to be due to uncorrected bias. If work from the original proposal had been funded and carried out, this would have provided more information enabling greater insight into this surprising result. As it was, ACC funded a further analysis of the ACC claims and the New Zealand Health Information Service's (NZHIS) National Minimum Data Set (NMDS) of hospital discharges, with an aim of gaining further understanding of these results. This further work is presented in Part 2 of this combined report.

The outcome evaluation proposal (Part 1) that was funded was for a 12 month pilot study, aimed at identifying feasible methods for the valid outcome evaluation of the FarmSafe programmes. This is the work that we present in Part 1 of this report. As seen from Part 1, we have achieved this aim. This work represents one step along the way to evaluating the effectiveness of FarmSafe.

There are no firm conclusions that can be made about the effectiveness of FS from the results provided in this report. The results that are presented should not be taken on their own – the method provides an evaluation based on an observational study design and as such is not a strong enough design to permit, on its own, inference to be made regarding effectiveness. You should not jump to any conclusions on the basis of just this one report. Further investigation still is needed to provide a more complete picture of the effectiveness of FS for preventing injury.

It was originally envisaged that the evaluation described in Part 1 would encompass the cost of claims, as an outcome, as well as rates of all ACC claims for injury. The latter was subsequently addressed and is described in Part 2 of this report. However, uncertainties and limitations with the cost of claims data used for the evaluation (see later) reduced the scope of the evaluation originally envisaged. Nevertheless, we believe that the methods used for the evaluation presented in this report are a major step forward and are optimal in the sense that they are least prone to bias of all the options considered – within the limits of the data.

Executive summary

Background

This is a combined summary of the original pilot FarmSafe™ (FS) outcome evaluation work (Part 1), and also the follow-up analysis (Part 2) that was subsequently commissioned.

FS comprises three key workshop components. FS Awareness was piloted from May 2002, and was available to all sheep, beef and dairy (SBD) farmers and farm workers from October 2002. This focused on changing farmer attitudes to farm safety in order to reduce injury and death in the sector. The FS agencies hoped to have 5,000 farmers and farm workers participate per year – and achieved this in the first two years of the programme.

The FS Awareness workshop is regarded as a pre-requisite for attending the remaining two programmes: Plans and Skills. The FS Plans and FS Skills workshops were offered to farmers and farm workers from May 2004. The aim of the FS Plans Programme is to enable participants to develop a health and safety plan that is simple to understand, easy to use, effective in reducing the risk of injury, and is compliant with their legal obligations. FS Skills focuses on the practical skills required by farmers and farm workers. The six Skills workshops are: riding all terrain vehicles (ATVs); riding motorbikes; using chainsaws; animal handling; driving tractors; and using agrichemicals.

Work to evaluate FarmSafe in New Zealand initially focused on the process and impact evaluation of the Awareness programme. This work was carried out, and was being completed, by Kate Morgaine, IPRU (PhD student supervised by Professor John Langley and Associate Professor Rob McGee) at the time of this outcome evaluation. The work aimed to answer the question: “has the FarmSafe Awareness Workshop been effective in changing farmers’ and farm workers’ attitudes towards, and practice of, farm safety?” The results of the impact evaluation (currently unpublished) indicate that FS Awareness “has a positive effect on attitudes to safety”, but that the attitude change “did not translate into measureable changes in personal safety practice or the farm environment”. [2]

Subsequently IPRU carried out a pilot outcome evaluation of the FS ‘Awareness’ and ‘Plans’ programmes (Part 1 of this current work). The aim of this was to investigate

whether a method could be identified for evaluating the effect of attendance at the FS programmes on injury outcomes; a method that uses secondary data sources, and with bias controlled to a sufficient degree that the results should not be misleading. A method was identified that provides some control for the effect of selection bias. Selection bias would result if the people who attended FS in these early years ("early adopters") were different from the rest of the population of SBD farmers / workers in important ways (eg. different history of work-related injury) – which was the case.

The authors were able to use the pilot method to investigate the association between FS Awareness attendance and subsequent rates of claim to the ACC for injury. The results suggested that those attending the FS 'Awareness' workshops had an increased rate of ACC earnings-related compensation (ERC) claims. The concern was that this increase was caused by information bias – ie. for farmers / workers who had attended FS Awareness, that attendance did not increase rates of injury, but rather that it encouraged an ERC claim following the occurrence of an injury.

Further work was commissioned to better understand these counter-intuitive results (Part 2). The remainder of the executive summary outlines the methods used in both Parts, the results of that work, interpretations, limitations, and our conclusions.

Methods

The work described in Part 1 investigated the effect of FS using ACC claims data for injury occurring in the period July 2001 to June 2005. The target population for this investigation was sheep, beef and dairy (SBD) famers and farm workers in New Zealand. From the 2001 and 2006 Censuses, we estimate that there were around 70,000 SBD farmers / workers in New Zealand during the period under study.

From the Census data, these SBD farmers / workers were distributed across the constituent groups as follows: dairy (48%), beef (13%), sheep (25%), and sheep & beef (13%). Between the 2001 and 2006 Censuses, there was a substantial increase in people reporting their main occupation as beef farmers / workers, and a small decrease in reported dairy farmers. 13% of SBD farmers / workers were under 25, 29% under age 35. 45% were aged between 35-54, 16% aged 55-64, and 9% over 64, of which 2% were over 75.

Up to the end of 2005, there had been almost 20,000 attendances at a FS programme, of which 13,000 were to the Awareness programme, 1,500 to the Plans programme, and 5,500 to a Skills programme. The main Skills workshops attended were agrichemical skills (3,100) and ATV skills (1,150).

The investigation of the effect of FS (described in both parts 1 and 2) had 3 components:

1. A matched comparison of those attending and those not attending using ACC claims outcomes;
2. Investigation of changes to ACC claims rates from before to after FS Awareness attendance;
3. Investigation of changes to hospitalisation rates and serious threat to life injury from before to after FS Awareness attendance.

The methods used for each of these are outlined below.

Component 1: Matched comparison using ACC claims outcomes.

We compared the rates of ERC claims and medical fees only claims for work-related injury following attendance at FS Awareness with matched controls. Work-related injury claims were identified from the Self-Employed and Employer accounts, and so excluded most motor-vehicle traffic crashes (MVTCs). Claims for gradual process / occupational disease were also excluded.

For this component, the methods used in Parts 1 and 2 were consistent. We selected only those attendees who had had an ACC claim (the "index" claim) prior to attendance at FS. People who had not attended either Awareness or Plans were eligible to be selected into the unexposed group. For every farmer / worker exposed to FS Awareness, 5 unexposed farmers/workers were selected into the comparison group. An unexposed farmer/worker could be selected if (s)he had had a claim within 30 days of the index claim for the exposed person to which (s)he was matched.

Exposed and unexposed people were followed for 24 months. Follow-up started immediately after Awareness attendance for the exposed. For the unexposed, people were followed up over the same calendar period as the exposed person to which they were matched.

In the analysis in Part 1, the outcomes considered were: (a) ERC claims; and (b) ERC claims as a result of being off work for over 28 days. In Part 1, we investigated 2,611 people who had attended Awareness, compared with 14,310 who attended neither Awareness nor Plans. In Part 2, we considered all ACC claims, and medical fees only claims as the outcomes. We investigated 2,867 people who attended Awareness, compared with 14, 335 who attended neither Awareness nor Plans.

In the statistical analysis, the comparison was made after adjusting for age, sex, ethnic group, industry group, occupation group, amount of earnings of their enterprise, whether employees or self-employed, when the exposed person attended FS Awareness, prior claims history and type of skills course the person had attended, if any.

Component 2: Changes to ACC claims rates from before to after FS Awareness attendance.

In Component 1, we considered only a subset of FS Awareness attenders in order to control for selection bias. For Component 2 we considered all 11,500 Awareness attenders during the period mid-2002 to mid-2005.

Four ACC claims-related outcomes were considered: (i) all ACC claims, (ii) medical fees only claims, (iii) all ERC claims, and (iv) ERC claims for people off work for over 28 days. Rates of claims were estimated for 4 12-month periods: 1-2 years before attendance, 0-1 year before attendance, 0-1 year after attendance, and 1-2 years after attendance.

This was contrasted with rates for each of the 4 ACC outcomes for all 70,000 SBD farmers / workers in the 4 12-month periods: July 01 to June 02, July 02 to June 03, July 03 to June 04, and July 04 to June 05.

All rates were adjusted for any changes to the age distributions year on year, and were presented with confidence intervals. A narrow interval indicates a precise estimate.

Component 3: Changes to hospitalisation rates and serious threat to life injury from before to after FS Awareness attendance.

Like component 2, we considered all 11,500 FS Awareness attenders during the period mid-2002 to mid-2005 in this work.

Two hospital discharge-based outcomes were considered: (i) discharges from hospital following admission for injury that resulted in at least one days stay in hospital (referred to in the figures as “DayStay”); (ii) serious threat to life (TTL) injury identified as those diagnoses which are associated with at least a 6% chance of death (referred to in the figures as “ICISS”[1]). The diagnoses associated with the second outcome are almost always admitted to hospital. That outcome is derived from hospital data and is not

[1] ICISS = ICD-based Injury Severity Score.

influenced by ACC claims making behaviour. The effect of extraneous factors that can influence admission to hospital are minimised when using this outcome.

Rates for these two outcomes were estimated for 4 12-month periods: 1-2 years before attendance, 0-1 year before attendance, 0-1 year after attendance, and 1-2 years after attendance.

There were a total of 470 injury discharges from hospital amongst SBD farmers / workers following at least one days stay, from which we identified 310 that were work-related non-motor vehicle traffic (non-MVTC) related injury. There were a total of 78 serious threat to life injury discharges amongst SBD farmers / workers, from which we identified 38 that were work-related non-MVTC related injury.

All rates were adjusted for any changes to the age distributions of SBD farmers / workers year on year, and were presented with confidence intervals.

Findings

Component 1: Matched comparison using ACC claims outcomes.

We found that attendance at Awareness was associated with an increased rate of all ACC claims, medical fees only claims, earnings-related compensation (ERC) claims, and ERC claims for absences from work of over 28 days, for work-related injury, during the 12 and 24 months follow-up post-attendance. The rates were 42% higher in those attending Awareness compared with matched unexposed farmers / workers for medical fees only claims, and over 60% higher for both all earnings related claims, and for earnings-related claims for over 28 days off work. The increased rates were unlikely to be due to chance alone.

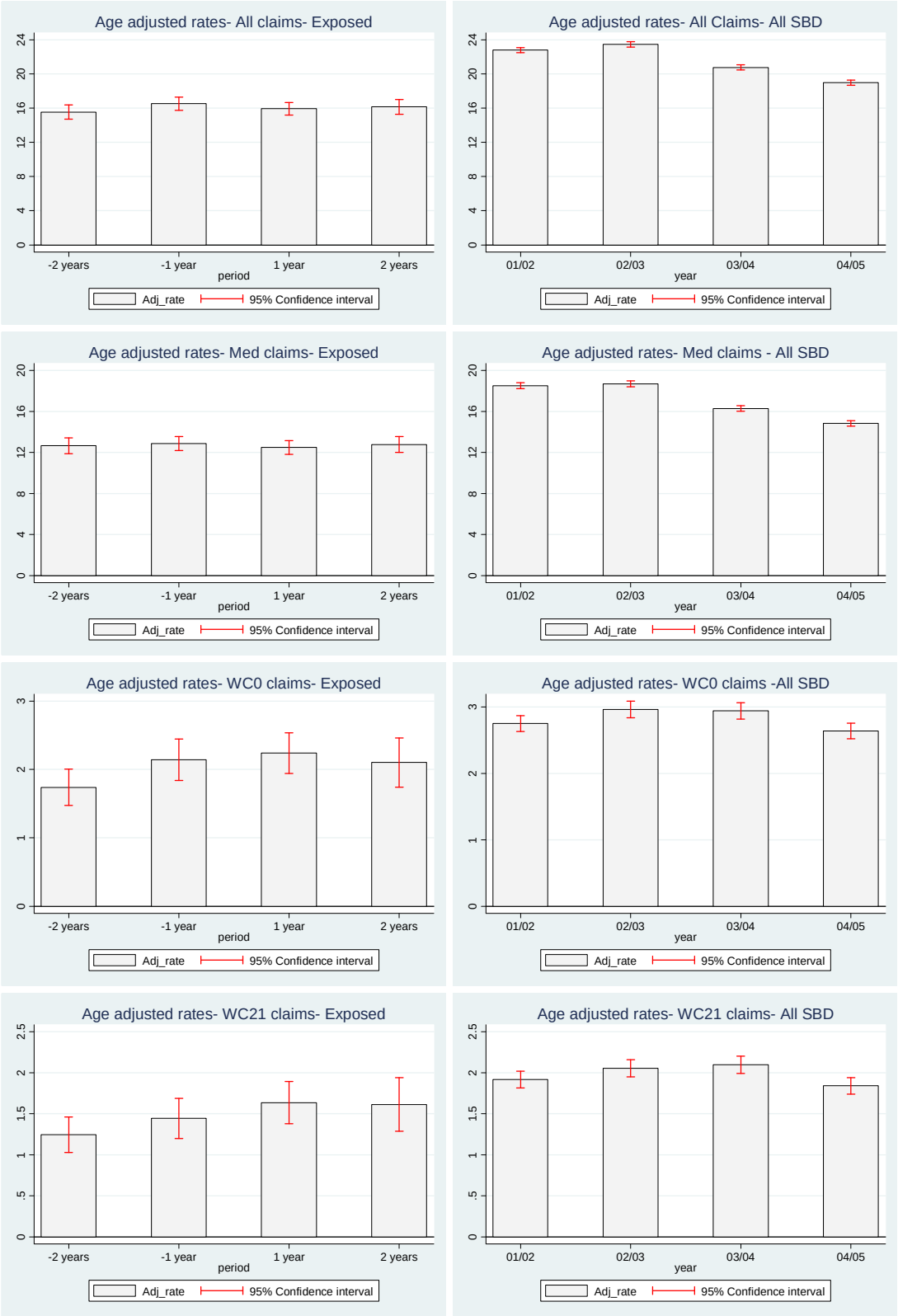
Component 2: Changes to ACC claims rates from before to after FS Awareness attendance.

Figure 3 (reproduced here from the Part 2 Results) show the trends in age-adjusted rates for the 4 ACC based outcomes, for people who attended FS Awareness (exposed), and for all SBD farmers / workers.

For Medical Fees Only claims, there is no suggestion of a change in rates following attendance at FS Awareness for the exposed, but there appears to be factors within the industry that are resulting in the underlying trend across all SBD farmers / workers of reducing Medical Fees Only claims rates during the same period.

For the earnings related claims outcomes, there appears to have been a small increase in the rates of claiming following attendance at FS Awareness for the exposed, although the start of this change seemed to occur prior to attendance. This is within the context of little change (or perhaps a small reduction in the last year) in rates across all SBD farmers / workers.

Figure 3: Age adjusted rates and confidence intervals for exposed people and all SBD farmers / workers at 4 time periods (note different scales in each panel).



Component 3: Changes to hospitalisation rates and serious threat to life injury from before to after FS Awareness attendance.

Figures 5 and 7 (from the Part 2 Results) show the before-after comparisons in age standardised rates for the exposed group for two outcomes based on hospital discharges. Figure 5 shows the comparison for exposed SBD farmers / workers injured during any activity (work or non-work), whereas Figure 7 gives this information for work-related non-MVTC related injury only.

Figure 5: Age adjusted rates for exposed people for the in-patient outcomes

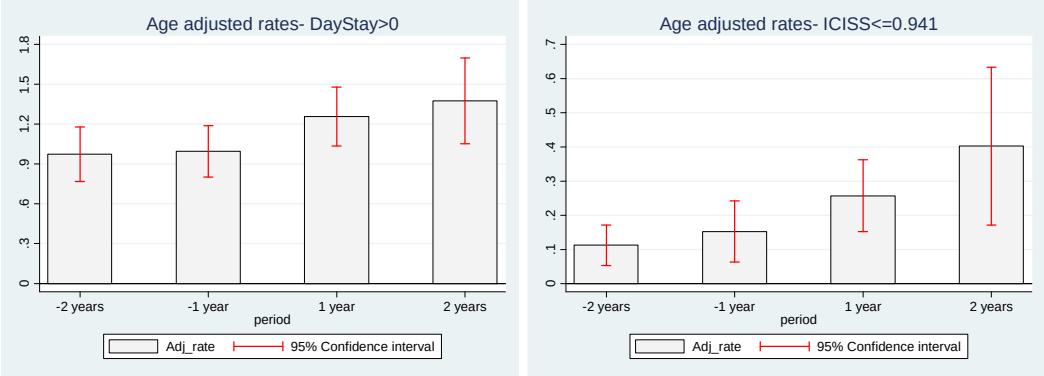


Figure 7: Age adjusted rates for exposed people for the work-related non-MVTC related in-patient outcomes

These results show, for people who attended FS Awareness, an increased rate of injury resulting in (a) at least one days stay in hospital, and (b) serious TTL injury – following attendance. The results show a statistically significant difference when making the comparison for injury occurring during any activity (Figure 5), but not when restricted to work-related injury (Figure 7). However, the trends appear very similar, and the lack of statistical significance in the latter case is likely to be due, at least in part, to the smaller

number of work-related non-MVTC related injury outcomes leading to lower precision in the comparisons.

Summary of the results

The consistency of all of the findings, using these various methods of analysis and data sources, is reassuring. They are consistent with the following:

- the rates of ACC claims for exposed increased relative to the unexposed during this 4-year period;
- the rates of ACC ERC claims and discharges / serious TTL injury increased after exposure.

However, there exist the following caveats:

- the rates of claims for the exposed were all less (and remained less throughout the period of investigation) than for the unexposed;
- the rates of discharges / serious TTL injury are at their highest in period 4.

The first caveat relates to the fact that the exposed were different to the unexposed in terms of their injury rates. It seems that these early adopters had a lower injury rate before attendance than the average SBD farmer / worker. So in this respect, we are not comparing like with like. We have minimised this source of selection bias in our matched comparison (Component 1).

For the second caveat, the hospital discharges and serious TTL injury exhibit a steady increase year on year from 2 years before exposure to 2 years after exposure. If this phenomenon was demonstrated in a longer time series (ie. steady increase over time), one would not attribute the increase in rates to the intervention.

Limitations

The results based on the ACC claims outcomes, either in the matched analysis or in the analysis of time trends for 2 years before to 2 years after attendance at FS Awareness, could be biased if the effect of attendance at FS increased the likelihood of either making a claim, or attending a medical practitioner, or both. This does not explain the observed increase in rates of ERCs in the period prior to attendance - before this group of farmers / workers had attended FS.

The results based on hospital discharge data are less likely to be influenced by changes in claims-making behaviour. They are, however, based on a before-after comparison – a weak study design. The period for which we have data is too short to carry out a time series analysis. With a longer time period, a more sound analysis would be possible.

This is a retrospective evaluation employing observational study methods. Although we have endeavoured to control bias, and have used several approaches to do so, there may be sources of bias (that we can only speculate about) that are driving these results. These trends and comparisons could be affected by changes in the farming industry that have occurred in the period under consideration. The results could be obtained if there were differential trends, for the exposed and unexposed, in, for example:

- the changing proportion of sheep and beef farmers / workers compared with dairy farming;
- the trend towards bigger farms.

Conclusions

The rates of ERC claims and hospitalisations were higher after attendance at FS Awareness; however, the results suggest that, for the most serious outcomes investigated, the upward trends were apparent before attendance.

For the group of SBD farmers / workers who attended FS Awareness, although their rates of ACC ERC claims for injury increased markedly over the four years, their claims rates remained less than the whole cohort of SBD farmers / workers over the whole period.

The association between attendance at FS Awareness and increased rates of claims and hospitalisations cannot be regarded as causative. Our results are inconsistent with previous published work evaluating educational interventions, which have shown no change in injury rates (upwards or downwards). The most likely explanation for our results is some unexplained bias.

FS Awareness was not designed and introduced to prevent injury, but rather to change the safety climate. It is the full FS package of Awareness, Plans and Skills that aims to reduce injury in the farming population. The full package is yet to be evaluated for its effect on injury rates.

References

1. Rogers H. *A FarmSafe guide for the Federated Farmers call centre team.* New Zealand: FarmSafe(TM) and Federated Farmers of New Zealand (Inc), 2006:1-9.
2. Morgaine KC, Langley JD, McGee RO, Grey A. Evaluating farm safety interventions. *6th Farm Health and Safety Conference*. Adelaide, Australia, 2007.

Identifying a feasible method for the valid outcome evaluation of the FarmSafe programmes

A report for the
Accident Compensation Corporation of New Zealand

This study was funded and supported by the Accident Compensation Corporation (ACC), Wellington, New Zealand. Views and / or conclusions in this report are those of the project team and may not reflect the position of the ACC.

Colin Cryer
Ari Samaranayaka
Daniel Russell
Kate Morgaine
Gabrielle Davie
John Langley

Injury Prevention Research Unit
Department of Preventive and Social Medicine
University of Otago
P O Box 913
Dunedin
New Zealand

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Abbreviations

ACC	Accident Compensation Corporation
AgITO	Agricultural Industry Training Organisation
AgNZ	Agriculture New Zealand
ANZSIC	Australia and New Zealand Standard Industry Classification
AO	Attendance at only the FarmSafe™ Awareness Programme (Awareness Only)
AP	Attendance at the FarmSafe™ Awareness Programme followed subsequently by Plans (Awareness and Plans)
ATV	All Terrain Vehicle
CI	Confidence Interval
CPI	Consumer Price Index
DoL	Department of Labour
EC	ACC Entitlement Claim
FFNZ	Federated Farmers of New Zealand
FS	FarmSafe™
ICD	WHO International Classification of Diseases
IPRC Act	Injury Prevention, Rehabilitation and Compensation Act 2001
IPRU	Injury Prevention Research Unit, University of Otago
IRD	Inland Revenue Department
nec	not elsewhere classified
NZQA	New Zealand Qualification Authority
PCU	Premium Classification Unit (based on ANZSIC)
PPE	Personal protective equipment
RCT	Randomised Controlled Trial
S/B/D farms	Sheep, Beef and Dairy farms
StatsNZ	Statistics New Zealand
Telford	Telford Rural Polytechnic
WCdays	Number of days for which earnings-related compensation was paid
WHO	World Health Organisation

1. Background and aims

1.1. Background

1.1.1. Introduction

Farm work-related injury is a serious public health problem in New Zealand. A national injury prevention effort has been mounted aimed at addressing this problem. The FarmSafe™ (FS) Programmes include elements from international interventions, although much of that international evidence of effectiveness is weak[a]. An effective intervention programme able to reduce the injury experience of the farming community will have considerable benefit for that community.

This work focuses on the outcome evaluation of the **Awareness** and **Plans** FS Programmes. Work to date to evaluate FS in New Zealand has focused on the process and impact evaluation of the **Awareness** programme. This work was carried out by Kate Morgaine, Injury Prevention Research Unit (IPRU), University of Otago – and is currently being written up by Kate as part of her PhD thesis. The current work described in this report will complement that process and impact evaluation.

The work reported here is a 12 month pilot study, aimed at identifying methods for the valid outcome evaluation of the FS programmes. In the original proposal it was recommended that, if valid methods of evaluation were identified by the pilot, these be applied on an annual basis for the duration of the FS programmes aimed at this population of sheep, beef and dairy (S/B/D) farmers.

1.1.2. Relevance to ACC

The FS Programmes were initiated by the ACC in collaboration with the Federated Farmers of New Zealand (FFNZ). Reducing the injury experience of the farming community will have considerable benefit for that community as well as achieving a reduction in ACC compensated claims and costs. Considerable financial and staff resources, at both a national and local level, have been committed to the FS Programme. Understanding its effect on injury rates will enable ACC to evaluate its own role in the programme and assess its future input into the programme.

[a] Strong evidence is produced from well conducted experimental trials such as randomised controlled trials (RCTs). Weak evidence is produced in evaluations that are likely to be subject to some significant bias. Designs such as uncontrolled before-after studies produce weak evidence. Non-randomised controlled studies, although better than uncontrolled before-after studies, can still be subject to significant bias.

1.1.3. FarmSafe™

Prior to FS, prevention programmes in New Zealand had been localised and the impact on injury rates was minimal. FFNZ had lobbied ACC about the high cost of levies paid by farmers. Together they agreed that a co-coordinated, national response to reduce the level of injury was required through a national training programme, and began to work towards that in 2001. [1]

The result was the FS Programmes sponsored by ACC and FFNZ. The delivery of the Programmes is administered by Telford Rural Polytechnic on behalf of the FS consortium – a consortium that also includes the Agricultural Industry Training Organisation (AgITO) and Agriculture New Zealand (AgNZ). When a person enrolls and attends one of a FS programme, funding is forthcoming from the Ministry of Education. To retain funding, each workshop must achieve at least a 50% pass rate. This contributes to FS being offered free to farmers and farm workers. It also offers New Zealand Qualification Authority (NZQA) credits to the farmer or farm worker.

FS drew on the practical experience and published information available at the time. Significant time and resource were devoted to its development before the programmes commenced. FS comprises three key workshop components. FS Awareness was piloted from May 2002, and was made available to all sheep, beef and dairy farmers and farm workers from October 2002. This focused on changing farmer attitudes to farm safety in order to reduce injury and death in the sector. [1] The FS agencies hoped to have 5,000 farmers and farm workers participate per year – and achieved this in the first two years of the programme (see Results). The FS Awareness workshop is regarded as a pre-requisite for attending the remaining two: Plans and Skills. The FS Plans and FS Skills workshops were offered to farmers and farm workers from May 2004. The aim of the FS Plans Programme is to enable participants to develop a health and safety plan that is simple to understand, easy to use, effective in reducing the risk of injury, and is compliant with their legal obligations. FS Skills focuses on the practical skills required by farmers and farm workers. The six Skills workshops are: riding ATVs; riding motorbikes; using chainsaws; animal handling; driving tractors; and using agrichemicals. [1]

Plans or audit type approaches to safety in farming have been applied (in some form or another) for decades without demonstrated success in New Zealand in terms of reducing injury. FarmSafe is aimed at bringing about a culture change to motivate farmers to make changes to reduce risk of injury – so that farmers believe that safety changes are the appropriate actions to take, rather than to make changes to comply with perceived legislation (compliance approach). It is believed that this has the most likely benefit in the long term.

FarmSafe programmes deliberately focus on only the key issues that result in the main injuries on farms - it attempts to focus intervention on just 4 or 5 key issues that may differ from one

type of farming to another (e.g., dairying versus sheep and beef). (The evaluation described in this report focuses on all cause injury outcomes, which assumes that safety knowledge and attitude is applied beyond these 4 or 5 issues.)

The Awareness and Plans Programmes, the focus of this evaluation, are described in some more detail below.

1.1.4. Awareness Programme

A combined working party…

> *"… was sent on a study tour to Australia to look at the FS programme which had been operating there for approximately 10 years. They visited the Australian Centre for Agricultural Health and Safety, where the Australian FS programme is based, as well as other universities which conduct research into farm safety. Together they developed the outline of the FS Awareness Programme. ACC and FFNZ commissioned the FS Consortium to develop the educational aspect of the programme.."* (Kate Morgaine, personal correspondence, 2006)

The Awareness Programme is a one day workshop comprising teaching, group discussion and assessment. It covers the size, cost and consequences of injuries on farms; ACC cover; causes of, hazards and risk factors for injuries; and hazard control including practical solutions to prevent injuries. Models of prevention are presented along with control / action checklists relating to preventing injury for the main causes of injury in sheep, beef and dairy farming that result in most claims to ACC – namely: livestock-related, vehicles and machinery (principally focusing on ATVs and motorbikes), lifting, slips / trips / falls, workplace noise, and occupational overuse syndrome. The key messages include:

- The high costs (both direct and indirect) of injury to farmers;
- That injuries are preventable;
- That the inclusion of safety as part of the workplace culture is good business practice;
- That farmers should choose as initial safety priorities the most important problems in terms of frequency and severity of injury; and
- Reducing injury comes from owning the problem and introducing and maintaining good safety practices.

1.1.5. Plans Programme

Feedback from the early adopters was encouraging, and there was a desire to take the training further. In response to this demand, two further Programmes were developed: the Plans and

Skills Programmes. These were launched in 2004. [1] The focus of the Plans Programme is on the development of a safety plan. In the development phase of Plans, both ACC and Department of Labour (DoL) had templates for the development of a safety plan. Over a six to nine month period, agreement was reached between these agencies on the elements to include. This formed the focus of the Plans Programme, and the desired outputs from that programme.

The aim of the FS Plans Programme is to enable participants to develop a health and safety plan that is simple to understand, easy to use, effective in reducing the risk of injury, and is compliant with their legal obligations. The Plans workshop covers: designing a Health and Safety Plan specifically for their farm business; the farmer's responsibilities regarding health and safety on their farm; and training on how to apply for the ACC Health and Safety Discount Scheme. [1] Specifically, the content of the workshop includes[2]:

- Reinforcement of the material from the FS Awareness workshop (with case study and questions);
- Material relating to the effectiveness of safety plans in a farming context;
- Health and safety policies - and what should be in one;
- Hazard identification and the construction of a hazard register;
- Induction / orientation of new staff;
- Training needs analysis of staff – and records of staff training;
- Contractors' and subcontractors' health and safety agreement;
- Emergency planning;
- First aid and first aid kits; and
- Incident and injury reporting, recording and investigation.

Many of the topics include the farmer's legal obligations, as well as presenting the wherewithal to produce policies and plans.

There are two assessments (for academic credits) relating to this workshop: one relating to the review of the Awareness workshop material and one relating to the development of a health and safety plan – to identify and record farm hazards, and develop a plan to eliminate, isolate or minimise these. These are marked by Telford. If the safety plan is not up to standard, the farmer is given feedback and given the opportunity to revise and resubmit. If the plan is up to standard, the farmer is assessed as competent, and NZQA credits are awarded. Should they accumulate 40 credits, a safety certificate is awarded. This can be achieved by a combination of attendance at the Awareness and Plans Programmes and Skills workshops (FS consortium, personal correspondence, 6 October 2006).

The Plans Programme does not include (the facilitation of) the implementation of the safety plans on the farm.

1.1.6. Perceived impact and effectiveness

The FS agencies had hypothesised that the FS Awareness Workshop would raise awareness of, and change participants' attitudes to, safety thereby encouraging them to make changes to their personal safety practice. Attendance at subsequent FS Plans workshops, were intended to address the environmental workplace hazards.

There were mixed expectations about which of the Awareness and Plans Programmes were likely to be most effective in reducing injury. It is the perception of some that the Awareness workshop is simply there to raise awareness, but it is the Plans Programme that is most likely to result in behaviours that will change exposure to hazards and reduce risk. When the first author (CC) met with members of the FS consortium, the expectation was that both Awareness and Plans would reduce risk. The FS Project Manager indicated that it is Awareness that is expected to drive the culture change, and the members of the FS consortium (with whom this was discussed) indicated that they expected that Plans would further reduce risk (personal correspondence, 6 October 2006). The feeling was that the Programmes would have a reinforcing / synergistic effect on behaviour with a resultant reduction of injury.

Within the timeframe for this pilot evaluation, we were able to investigate the impact of FS attendance on the risk of injury for the individuals who attended (with the mechanism for change being behaviour change, and through modifications they made to the environment as a result of attendance). Members of the FS Consortium indicated that the goal of FS is to change the general safety culture for all Sheep, Beef and Dairy farmers and farm workers, ie. both attenders and non-attenders would reap a benefit. This would require repeated exposure over a sustained period of time, and would require a substantially larger proportion of farmers and farm workers being exposed than was current at the time of this pilot evaluation. That being the case, this enhanced effect cannot be expected to be detected by an evaluation carried out so early in the lifetime of FS.

The type of study design, that it was possible for us to use within the constraints of the data that were available, is potentially susceptible to various types of bias, most notably selection and information bias. The latter could be introduced if attendance at FS had an impact on claims-making behaviour. These are touched on further below.

The expectation amongst these FS consortium members was that the early adopters were likely to be more safety conscious (and their perception was that the farmers and farm workers who attended the early workshops gave this impression). Consequently, prior to their attendance at FS, it was expected that these early adopters were likely to have lower rates of injury than non-attenders (FS consortium, personal correspondence, 6 October 2006).

It was also the perception of these selected members of the FS consortium that attendance at the programmes could affect claims-making behaviour. For example, it was felt that amongst farmers / workers who had attended a FS Programme, following an injury event, the farmer / worker was more likely to attend a doctor, in case the injury has an affect on their ability to work at a later stage. The perception was that this was more likely to affect medical fee only claims, rather than earnings-related compensation payments (KB/CS/GH, Personal correspondence, 6 October 2006).

1.2. Previous literature on the prevention of farm injury

Engineering design in particular has resulted in preventive solutions, such as roll-over protective structures for tractors, and there exists some evidence that regulation has been used effectively (as shown through ecological study and before-after evaluation) to have a significant influence on uptake and injury rates. [3] [4]

The literature considered in this section is limited to papers that have focused on the evaluation of farm-related injury prevention interventions aimed at changing the safety culture of adult workers (consistent with the focus of FS Awareness and Plans) but excluding those that focused on agricultural health or gradual process problems that did not include injury. In this context, injury is defined as follows:

> *"Injury is tissue damage resulting from either the acute transfer to individuals of one of five forms of physical energy (kinetic or mechanical, thermal, chemical, electrical, or radiation) or from the sudden interruption of normal energy patterns to maintain life processes."* [5]

This is often operationalised through reference to the International Classification of Diseases (ICD) injury diagnosis and external causes chapters. [6]

A total of 11 studies were identified that provided some form of evaluation of injury prevention initiatives on farms. [7] [-17] For five of these, some form of farm safety education was used, and for six, multi-faceted interventions were evaluated.

The five educational interventions were aimed mainly at farming families. Two were aimed at specialist farm groups, namely reindeer herders and farmer-loggers. [7] [8] Interventions that were associated with a measurable improvement in knowledge, attitude, awareness, or behaviour, or in injury rates are shown in Table 1. The validity of the results of these studies was compromised by the weak designs that were used.

The multi-faceted interventions were aimed at farmers and farm workers. Typically they involved a farm audit carried out by a specialist who made recommendations of safety improvements. Interventions that were associated with a measurable improvement in knowledge, attitude, awareness, behaviour, or in injury rates are shown in Table 2. Again, the choice of study design was weak for all of the above, except the West-Jutland study. This provides the strongest evidence of an effect.

Table 1: Farm injury interventions - educational.
Intervention: Safety education and training for farmer-loggers in Sweden. This was delivered as 15 one-day courses with demonstrations over a 3-week period. Design: Intervention group compared to control; post intervention assessment (no pre-intervention assessment). Outcome: Behaviour change Results: 71% reported changing their working methods. Use of protective leg guards and boots increased. [7]
Intervention: Reindeer herders in Finland were educated on 34 safety measures that could be used (face-to-face and by letter). These included use of personal protective equipment (PPE). Design: Pre- and post-intervention assessment (no control). Outcome: Knowledge Results: Increased knowledge to between 58% to 77% correct responses, depending on the topic. [8]
Intervention: A rural church-based farm safety health fair in Kentucky, USA. Design: Post-event questionnaire completed by a selection of attendees, who were asked to self-complete a checklist of hazards and safety changes. Outcome: Self-reported safety changes. Results: 50% of participating families indicated that they had made safety changes on their farm. [9]
Intervention: Farm safety booklets distributed to selected farm families in Iowa, USA. The booklets provide a guided walk-through of a farm to identify hazards and safety changes. Design: Three groups: (1) and (2) were community groups, (3) health professionals. Group (1) had a structured follow-up by a community group to encourage safety changes. Each participant had a post-test assessment. Group (1) had face-to-face interviews, whilst groups (2) and (3) self-completed. Outcome: Changes to behaviour and the farm environment. Results: There was an improvement in behaviour for all 3 groups – but no significant differences between the results for the 3 groups. [10]
Intervention: Safety messages through newspapers and the radio, as well as publications on farm safety distributed through the post – to farmers in Iowa. Design: Telephone surveys at baseline and post intervention (before-after only) Outcome: Scales measuring safety awareness, safety concern and behaviour – self-reported. Results: Very small improvements in each of the outcomes. [11]

Table *2*: Farm injury interventions - multifaceted
Intervention: Farm visit / interview, safety assessment of the farm, education of the farmer and recommendations for safety change (Finland). Design: Intervention group and control, with pre- and post-intervention assessments. Outcome: Increase in knowledge, purchase and use of PPEs, environmental change, and change in work practices. Results: Improvement, compared to control, in knowledge and purchase / use of PPEs. [12]
Intervention: Funding made available to farmers from the Swedish Working Life Fund for safety improvements to the physical environment and to equipment. Design: Assessment following intervention (no control group, no pre-intervention assessment) Outcome: Injury incidence rates, and work-time lost. Results: Reported a 22% decrease in injury rate, and a 16% decrease in work-time lost. [13]
Intervention: Agricultural Hazard Abatement and Training (AHAT), New York State, USA. On-site safety audit, following which farmers were asked to make safety changes aimed at 5 identified hazards. Also training given to farmers to provide safety training for their farm workers. Rebate in their compensation payments to encourage full participation. Design: Intervention and control groups. Controls received the safety audit but nothing else. Pre- and post intervention assessment. Outcome: Compensated injuries (control group injury rates not compared). Number of training sessions carried out by the farmer. Farmer's attitudes and beliefs regarding the safety training. Results: There was a 27% decrease in compensated injuries. Average of just over 6 training sessions given per farmer during the 6 months . Attitudes and beliefs about training improved. [14]
Intervention: Pennsylvania Central Region Farm Safety Pilot Project: – interventions were youth education programme (30 farms), community coalition programme (41 farms), a self audit of the farm with feedback from an agricultural extension agent about what needed to be addressed within a timeframe for completion (73 farms). Design: Quasi-experimental design within four counties. Two counties with interventions. Two counties acted as controls – one had usual agricultural safety programme, one had no intervention. Pre- and post intervention assessment. Outcome: Hazard Score - hazard audit of farm carried out by an independent person. Results: Youth education initiative was not very effective regardless of baseline hazard score. Community coalition process was more effective for farms that scored a low hazard score at baseline (13% reduction in score). Self-audit was effective for both low and high hazard scoring farms. 13% / 30% reduction in hazard scores for farms which were low / high scoring at baseline. [15]

Intervention: West-Jutland Farm Injury Prevention Study (Denmark). Farm safety inspection (taking approximately ½ day) and one day safety course for all adults who work on the farm.

Design: Randomised trial. Ongoing assessment of injury occurrence and exposure.

Outcome: Safety attitudes and behaviours. Injury incidence rates.

Results: Statistically significant improvement in safety behaviours for 66 work activities, and a considerable decrease in injury rates in the intervention group (49% decrease in all injuries and 46% decrease in injuries requiring medical treatment), with a lesser change in the control groups (26% decrease in all injuries, and 6% decrease in injuries requiring medical treatment). The injury rate decrease in the intervention group was not statistically significant. [16]

Intervention: FarmSafe Australia

Design: Mixed methods – comparison of activities between Victoria and Queensland; two random cross sectional surveys of farms in Victoria in 1998 & 2001

Outcome: self reported knowledge, behaviour and non-fatal injury

Results: Statistically significant increase in:

a) the proportion of farm owner/operators attending farm safety training;
b) properties undertaking a formal safety check;
c) frequency of wearing seatbelts on tractors with ROPS;
d) frequency of using respiratory protection when handling chemicals; and
e) frequency of wearing goggles during workshop tasks.

Statistically significant decrease in:

i) others on the farm attending farm safety training;
ii) hearing about farm safety;
iii) following manufacturers instructions for maintenance;
iv) installation of ROPS on tractors (this is attributed to there being very few left to do).

Statistically significant reduction in self reported injury (14%). [17]

There are relatively few studies of interventions to change safety culture and prevent injury on farms. With one exception (the West Jutland study), the evaluation studies identified and outlined above, use weak methodological designs or have methodological weaknesses, and so one should be cautious about concluding that any particular intervention is effective. On the other hand, the West Jutland study used an RCT design with outcomes collected prospectively. This is a much stronger design and so has the potential to provide strong evidence of an effect.

Rasmussen and colleagues (The West Jutland study) have indicated that, despite their results not being statistically significant, the observed injury reduction was so great that the plan was to roll out the intervention across the country (Denmark).[16] Additionally, the FS Australia intervention has been implemented for several years and continues in most States in Australia.

There is still the need for evaluation of farm safety interventions using strong (e.g. randomised controlled trial - RCT) designs. The stage at which this current evaluation was commissioned, as well as the funding that was available, meant that it was only possible to pilot a non-randomised controlled (i.e. intervention versus control) design employing before and after measurement of injury rates. When planning future work, the feasibility of an RCT design should be considered as the first option. As indicated by De Roo and colleagues [14]:

> *"To achieve a reduction in farm injuries, there is a need for sound scientific evidence that farm safety education and risk reduction programs have a beneficial effect on the knowledge and safety practices of farmers and their families. The results of well conducted evaluations can increase our understanding of farm injury prevention by documenting what works and thereby help determine how public funds and resources for farm safety can be best used in the future."*

1.3. Scope of the current work

Aim:

To develop a feasible method to investigate whether exposure to the FS **Awareness and Plans** Programmes are associated with a reduction in injury outcomes amongst sheep, beef and dairy farmers and farm workers.

Injury outcomes

The injury outcomes we considered in this work were serious injury rates. Serious injury was operationally defined as any injury resulting in earnings-related compensation for time-off work / reduced duties[b]. Two measures of serious injury were considered, namely (i) any ACC earnings-related compensation claim for injury, and (ii) ACC earnings-related compensation payment of over 21 days duration.

Limitations in the data (see later) meant that we were unable to investigate fully the total ACC claims rates (treatment only and entitlement claims combined) and ACC claims costs as outcomes.

Target population

The target population for this work was sheep, beef and dairy (S/B/D) farmers and their farm workers in New Zealand.

Ethics /Privacy

The IPRU have Research Ethics Approval from the Multi-region Ethics Committee for research that involves the analysis of the administrative data sources used in this study. This work was also approved by the ACC's Research Ethics Committee.

[b]Earnings-related compensation is paid for injury that results in over 7 days absence from work. Earnings-related compensation is also paid if the person returns to work on reduced duties.

2. Methods

2.1. Methodological approach

The methodological approach included the following:

- Methods description
- Linking the data
- Checking and understanding the data
- Exploratory analysis of:
  - FS enrolment data
  - ACC levy data
  - ACC claims occurrence
- Development of modeling methods
- Application of the modeling methods

2.2. Methods description

2.2.1. Source Data

The source data for this work were:

- Telford Rural Polytechnic FS enrolment data
- ACC levy data
- ACC claims data

The requests for these data are shown in Appendix 1.

The Telford enrolment data was requested for the period from the inception of FS to the end of 2005. ACC levy data was received for the period 2001 through to 2006. ACC claims data was requested for injuries occurring in the period 1 July 2001 to 30 June 2005. The first attendees at the FS workshops was mid-2002. Data were requested for this period to permit a description of the claims experience both before and after attendance at FS.

2.2.2. Definition of a farm, farmers and farm workers

An agricultural entity (i.e. a farm in the context of this work) in the 2004 Statistics NZ Agriculture Production Survey is described as follows:

> *"… all businesses engaged in 'agricultural production activity' (including livestock, cropping ….) with the intention of selling that production and/or which … owned land that was intended for agricultural activity."*
> (http://www2.stats.govt.nz/domino/external/omni/omni.nsf/outputs/Agriculture+Production+Survey+-+30+June+2004#Glossary)

In the ACC data, a lifestyle block / hobby farm was counted as a farm. Any work-related claim is allocated to the classification unit (PCU[c]) that the employer is using, no matter what the turnover. An injury to a farmer or farm worker from a sheep, beef or dairy farm would be counted even in the instances where the employer made a loss. (There would be no incentive to make an earnings-related claim, without other provision, in the latter circumstances, however.)

Shareholder milkers were included and were allocated to the same Primary Classification Unit (PCU) as "dairy cattle farming".

For the analysis, the operational definition that was used was sheep, beef and dairy farmers, managers and farm workers. Sheep, beef and dairy farms (and hence the workers on these farms) were identified by PCU = 01220, 01230, 01240, 01250, and 01300. Farms and farmers belonging to PCU=01590 (Livestock farming nec) were not included. In 2005, there were 4347 levy invoices[d] for "Livestock farming nec", compared with a total of 87,904 for the PCUs listed above. For practical reasons, claims that we were unable to link to ACC levy data via the ACC EmployerID (see "IPRU's understanding of ACC data") were excluded.

2.2.3. Linking the data

The description of the method used and the results of the data linkage procedure are presented in Appendix 2.

c ACC uses the business industry description to determine the classification unit (formerly PCU). The business industry descriptions are based on the Australia and New Zealand Standard Industry Classification (ANZSIC). [18]

[d] "Levy invoices" designate annual payments made to the ACC by employers.

2.2.4. Checking and understanding the data

Checking the data

Simple frequency distributions and / or charts of the variables were produced, along with a commentary. This commentary included a description of any lack of understanding of the data.

For the FS enrolment data, the charts of frequency of attendance, by FS Programme and by month, were shared with John Wallaart (Programme Manager, Injury Prevention, ACC) for his views on whether the patterns of attendance were consistent with his expectations.

For the ACC data, our data checking provoked correspondence with the ACC aimed at understanding the data we were analysing.

Two important data issues identified early in the project were:

1. The many missing ACC employer numbers from the FS enrolment data supplied by Telford.
2. The PCU codes that were supplied by ACC on both the levy data and the claims were at the 4 digit level rather than 6 digit (as listed in the business industry description and code manual). [18]

The former meant that we had to have a fundamental re-think about the method of evaluation. The originally proposed method was dependent on our ability to link the vast majority of records from the FS enrolment data to the ACC levy data using ACC employer number – in order to construct a cohort of S/B/D farms, with information on whether any farmers or farm workers on the farm had attended FS. This would have given the flexibility to estimate rates by period and by exposure to FS. However, for the many FS enrolment data records that had a missing ACC employer number, we were unable to link the FS enrolment data to the levy data, since there were no other variables (including combinations of variables) that provided a linkage key. Of the 19,748 FS enrolments, ACC numbers were available only for 8317 enrolments (42% of enrolments). The result was that a cohort could not be constructed based around the levy data as originally planned. A new method of outcome evaluation needed to be developed, therefore. The approach that was used to identify the evaluation method is described in section 2.2.6.

The second data issue was less fundamental. It meant that the data from PCU 01590 (“Livestock farming nec”, where nec = not elsewhere classified) could not be used. It was a theoretical possibility that some farmers, for which part of their activities were either sheep, beef or dairy farming, could be allocated by ACC to PCU code 01590. It may have been possible, through using the full six digit code (if it was available) as a filter, to distinguish these.

However, with PCUs available at only the 4-digit level, these farms could not be distinguished from other livestock farms (e.g. goat or rabbit farming). Given the above, we decided to exclude PCU 01590 from our operational definition of a farm and the pilot evaluation.

Understanding the ACC data

A great deal of this project's work, time and effort has been expended in understanding the claims and levy data, supplied by the ACC. This was necessary since ACC could not supply IPRU with up-to-date data dictionaries for their data. The lack of data dictionaries and / or user guides meant that our understanding has been developed through correspondence with various members of the ACC information team – principally Chris Taylor, and Ellen Shi before him. As a result of this work, IPRU have developed an in-house user guide to ACC data as part of the project. This is an organic document - in that when additional information on ACC data becomes available, it is added to that document. This is a significant output from the study. The user guide is being developed as a separate document.

Despite a great deal of correspondence with various ACC employees, there were a number of data issues and problems that remained unresolved. Some of these are outlined in the results section 3.2.

One particular issue that we investigated were the ACC claims that we were unable to link to the ACC levy data. We investigated in what ways claims that don't link to Levy data are different to ones that do using the following method. We investigated the relationship between the 2960 claims and the 122 EmployerIDs that could not be linked using a frequency table of claims by EmployerID. We then investigated, through cross-tabulations, how the claims that do not link differ from claims that do in terms of demographic variables (age, sex, ethnicity), employment (PCU, occupation, ACC_Suffix), claim type (med fee only/entitlement/other), whether an injury or gradual process/ disease, circumstances of injury, and number of days for which earnings-related compensation was paid. Only selected tables are presented in this report (see section 3.1.2).

2.2.5. Exploratory Analysis

FS enrolment data

There were a total of 19,753 enrolment records supplied by Telford. Five of these were excluded since they were not FS courses. Histograms, cumulative histograms, and charts derived from these data, were produced based on the remaining 19,748 enrolments for

(a) all programmes combined (Awareness, Plans and Skills),
(b) For Awareness,
(c) For Plans,
(d) For all Skills[e] (agrichemicals, ATV, tractor, chainsaws, and animal handling,
(e) For the agrichemicals Skills,
(f) For the ATV Skills

(Agrichemical and ATV workshops were the most frequently attended Skills workshops). Please see section 3.2.1 for the results of these analyses.

Levy invoices

Frequencies, histograms, and line graphs of the total number of levy invoices by year were produced. This was repeated for each PCU. See section 3.3.2 for the results of these analyses.

Claims occurrence

Trends in the claims over the 4 year period were investigated by firstly producing frequencies and line graphs for:

- All claims (medical fees only, entitlement claims, and other combined)
- All entitlement claims (which includes earnings-related claims, claims for walking aids, etc.)
- Entitlement claims that had been active for over 30 days (ie. the duration of compensation payments was greater than 30 days).

Project month was defined by date of injury (rather than date of claim).

These trends were then adjusted to take out seasonal effects (i.e. seasonally de-trended) using a moving average method.[19]. This was done by taking monthly frequencies of claims

[e] Although the Skills programme was not the focus of this evaluation, data on the Skills enrolments were part of the same database as the Awareness and Plans enrolments. These data were summarised in a similar way for each programme in this exploratory analysis.

occurrence for each of 48 months in the project period, and using 12-point centered moving average with equal weightings. 12-point was used because yearly cyclical variations were observed, and these variations may hide the overall trend. Individual seasonal effects, for each month, were calculated as the difference between monthly frequency and moving average. This produces only three individual seasonal effects for each calendar month because centered moving averages are not available for first and last 6 months of the project. Then seasonal effect for each calendar month was calculated as the average of these three individual seasonal effects. Finally, de-seasonalized (i.e., de-trended) frequencies were obtained for all 48 months by subtracting these average seasonal effects from each corresponding monthly frequency. This was repeated for each PCU.

See section 3.3.3 for the results of these analyses.

2.2.6. Development of the modeling methods

Although the FS enrolment data could not be linked to the ACC levy data, it was possible to link FS enrolment records to ACC claims, based on personal information of the FS attendees and the claimants. The ACC claims data could also be linked, in most instances, to the ACC levy data. This was the starting point for the development of an alternative method of outcome evaluation using statistical modeling.

The process was as follows. One of the project team (CC) proposed an alternative method of evaluation. He then shared it with the remaining members of the project team. Following written feedback and discussion, the proposal was revised and the process repeated. Using this method, the proposal went through five revisions before the proposal was agreed. The fifth revision of the proposal was sent for comment to Lesley Day (Monash University, Australia) and Gordon Smith (Liberty Mutual, USA), who both have professional interest and expertise in farm injury research. Both regarded the proposal as the best design possible given the constraints.

The agreed proposal is described in the next section.

2.2.7. Modeling

Aim

To investigate whether exposure to the **Awareness and Plans** FS programmes are associated with a reduction in injury outcomes.

Study population

The study population includes all people working on S/B/D farms who were compensated by the ACC for injury or gradual process / disease that occurred during the period 1 July 2001 to 30 June 2005.

That is, we used all of the 61,056 claims (Medical fees only, Entitlement, Other, and Unknown) to identify people in the study population. (This is because we had identifying information on these claimants which could then be used to link to the FS enrolment and the levy data.)

Cohort:

- People were not eligible for the cohort until they had any type of ACC claim for an injury or gradual process / disease during the period 1 July 2001 to 30 June 2005.
- If their first ACC claim in this period was for an injury / gradual process that was subsequent to attendance at a FS workshop, then they were not included in the cohort[f].

Exposure

The ACC interest is in the effect of attendance at the FS Awareness and Plans Programmes on injury rates. These Programmes aim to increase the safety culture, including promoting safety behaviours on the farm. It is hypothesised that this will result in a positive effect on all injury outcomes.

In contrast to this, the FS Skills programmes are aimed at improving skills in handling chemicals and potentially dangerous machinery and animals on farms. For example, the Skills Programme relating to ATVs is expected to improve safety when using ATVs – rather than preventing injuries that occur in circumstances other than when using an ATV. That being the case, the methods proposed here are not efficient for the evaluation of the effectiveness of the

[f] The assumption is that a farmer or farm worker does not leave S/B/D farming during the 'm' months of follow-up. This assumption is given some credence from the study data from the process and impact evaluation of the FS Awareness programme, which indicates that the vast majority of people stay working in S/B/D farming for 5 or more years.

Skills Programmes. Nevertheless, attendances at the Skills Programmes were included in the models since these attendances are markers of exposure to hazards and potentially confound the effect of exposure to Awareness and Plans Programmes.

Exposure data came from the FS enrolment data supplied by Telford. Consistent with the definition of the cohort, an exposed person could not be included in the cohort (and hence in the analysis) unless they had an ACC claim during the period 1 July 2001 to 30 June 2005 that pre-dated their attendance at FS. (There were 4,959 occasions where a person attended a course subsequent to a previous claim during this period.)

It was assumed that exposure to Awareness and Plans workshops had differing effects. The analysis has two exposures, therefore:

1. Awareness with no Plans (AO), and
2. Awareness followed by Plans (AP)[g].

Case selection for exposed and non-exposed groups

The procedure for case selection is shown in Figure 1.

- Exposed workers (E) - (4) in Figure 1 - are people who had a claim (the "index" claim) before attending FS, and who subsequently attended FS at time y.
- Control workers (NE) - (5) in Figure 1 - are people who had a claim and had not attended a FS programme. A control worker is chosen as one that matches to an exposed worker in the sense that they had a work-related injury/disease that resulted in a claim within 30 days of the exposed case's index claim.
- 5:1 (NE: E) matching was used. A matching ratio of 5 was chosen since there is little benefit, in terms of statistical power, of having more than a 5:1 ratio. Matching was carried out without replacement.

Outcome

The outcome was restricted to ACC earnings-related entitlement claims (EC) for **injury only** (i.e. not including gradual process - for the operational definition, see Appendix 4). Two main outcomes were considered:

- An injury that results in an earnings-related EC (WCdays>0)
- An injury that results in earnings-related compensation for over 21 days (WCdays>21).

In the statistical modeling, we considered the following measures:

- Whether the outcome occurred during follow-up – yes or no (logistic regression).

[g] In our dataset, there were a small number of people who attended Plans but they appeared not to have previously attended an Awareness workshop. These cases could not be included in the analysis, however, since there were too few and they had no subsequent ACC claims during follow-up.

- Time to outcome during the period - i.e. if z represents the time of the injury resulting in the outcome, then time to outcome = (z-y), where the meaning of 'y' is given in Figure 1 (Cox's regression).

Using injury outcome measures in the ways described above, we did not need to concern ourselves with adjusting denominators for time off work following EC – since with these analyses, follow-up stopped once an injury outcome occurred.

Follow-up time

Follow-up was 'm' months, where m = 12 or 24 months. Follow-up started immediately after attendance at Awareness for people exposed to AO. It started immediately after attendance at Plans for people exposed to AP. Matched control follow-up was over the same calendar period as the exposed individual to whom they were matched.

The smaller the follow-up time, the less concern there was about people moving out of S/B/D farming, unknown to us, during the follow-up period. However, the smaller the follow-up time, then the fewer workers will make an Entitlement Claim during the follow-up period, which could result in lower power to detect an effect. The optimal 'm' also depends on the duration of the effect of FS. Given the period for which data were available, 12 and 24 months represented the practicable lower and upper limits of follow-up.

Injury – operational definition

For the operational definition of an injury earnings-related EC, we used all ECs but excluded those whose primary diagnosis[h] was coded to gradual process / disease using the algorithm supplied by ACC and adapted by IPRU (see Appendix 4).

Analysis

The models below were applied for:

- Two follow-up times
- The two outcomes

Models

For a given follow-up time and outcome:

1.1 Logistic regression analysis was used to investigate whether there was an effect of exposure to FS workshops on incidence, after adjusting for confounding variables.

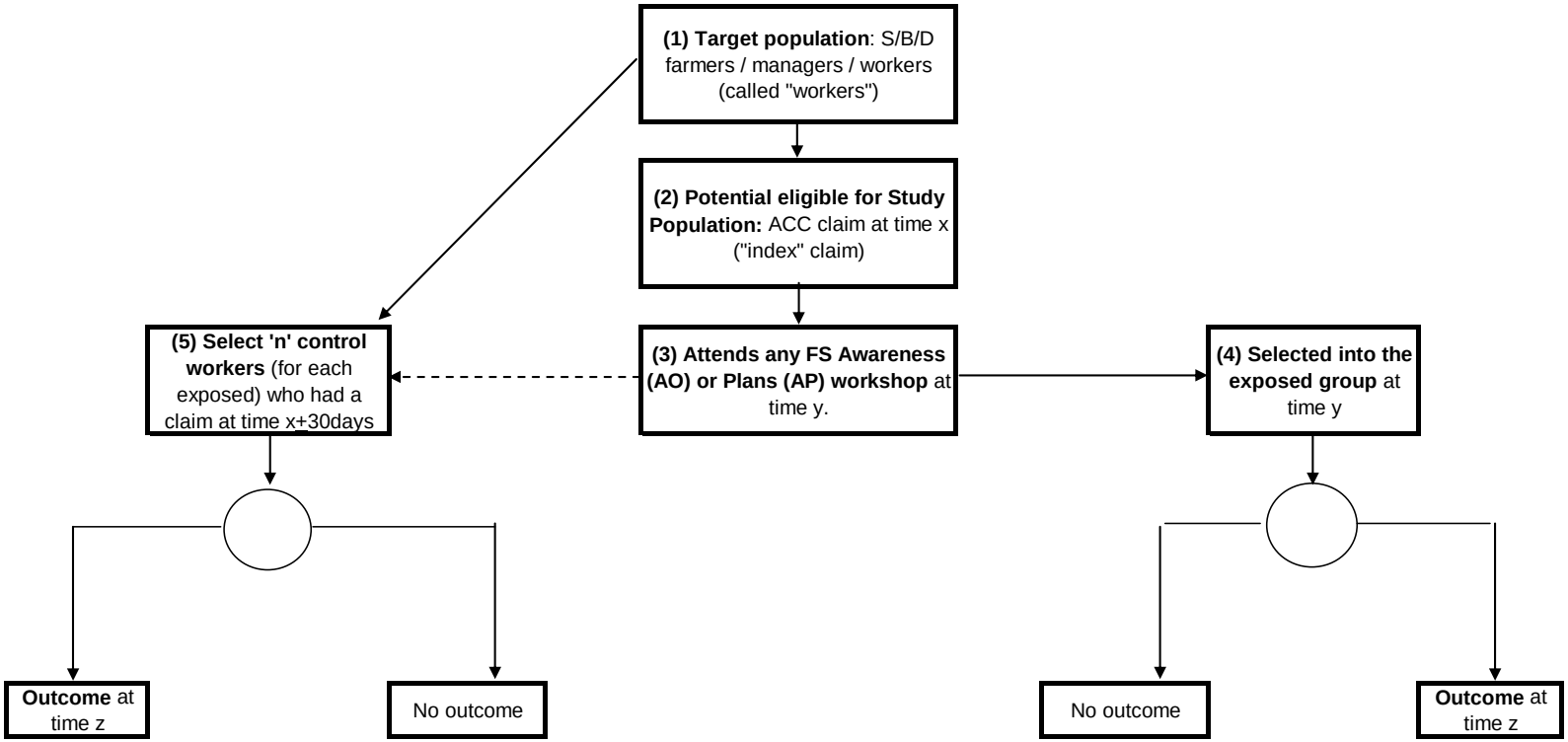
1.2 Cox's regression analysis was used to investigate whether there was an effect of exposure to FS workshops on time to outcome, after adjusting for confounding variables.

[h] If no primary diagnosis was present, then we used the diagnosis with injury sequence=1

Potential confounders

The following variables were included in the model as potential confounders: quarter of follow-up, gender, premium class unit (synonymous with industry class), fund code (Employers, Self-employed), type of employer (self-employed without employees, self-employed with employees, shareholder employees), age group, liable earnings, occupation (livestock workers, mixed livestock workers, crop and livestock workers, other agricultural workers, other occupations), ethnicity (level 1), injury claims history, and Skills course attended. The latter was used as a marker of hazard exposure.

Figure 1: Schema showing the selection of exposed and non-exposed workers.



3. Results

Note that in the results, PCU has been stated without the leading “0”. For example PCU 01220 has been presented as PCU 1220.

3.1. Linking the data

3.1.1. Linkage results

The method used for record linkage and the linkage results are shown in Appendix 2. Figure 2 (page 35) shows the linkage of claims to levy invoices through the variables EmployerID1 and EmployerID2 (see “IPRU’s understanding of ACC data”).

3.1.2. ACC claims that do not link to the levy data

After excluding the data associated with PCU 1590, there were 2,960 claims that did not link to the levy data. These were associated with 122 EmployerIDs. We investigated the relationship between these 2960 claims and the 122 EmployerIDs.

2815 (95%) of all unlinked claims were associated with 5 EmployerIDs. The explanation given for this was that many of these were gradual process claims (Chris Taylor, personal correspondence, 12 July 2006). For this type of claim, it is often impossible to attribute exposure that resulted in the gradual process claim to one employer. In this case, ACC use dummy EmployerIDs. Amongst S/B/D farmers and workers, 64% of the unlinked claims and 8% of the linked claims were gradual process claims (Table 3).

***Table 3*: Proportion of gradual process claims amongst that did / not link to the levy data.**

Link to levy	Gradual Process N	Y	Total
No	1,041 35%	1,919 64%	2,960 100%
Yes	55,854 91%	5,202 8%	61,056 100%
Total	56,895 88%	7,121 11%	64,016 100%

The proportion of entitlement claims was substantially larger amongst the unlinked claims than the linked claims (Table 4).

Ta*ble 4*: Number and percentage of claims of each type by whether the claim linked to levy data.

	Link to levy data		
Claim type	no	yes	Total
Med fees only	1271 (43%)	48496 (79%)	49767
Entitlement	1630 (55%)	9557 (16%)	11187
Other	11 (0%)	79 (0%)	90
Unknown	48 (1%)	2924 (5%)	2972
Total	**2960 (100%)**	**61056 (100%)**	64016

Amongst the claims that did link to levy data through the EmployerID, there were 15 employers that also had a large number of claims (618 non-gradual process claims) associated with them (over 25 each over a 4-year period). Nevertheless, these represent only 1**%** of total linked claims. The total number of entitlement claims among these 15 employers was 106, and the median number was 7 (range = 1-16). The total number of earnings-related ECs among these 15 employers was 98, with a median of 6 (range = 1-15). Explanations include that this large number of claims is a real phenomenon and that these 15 employers have large numbers of employees. Using earnings from levy data as an index for the size of the farm, this explanation appears plausible.

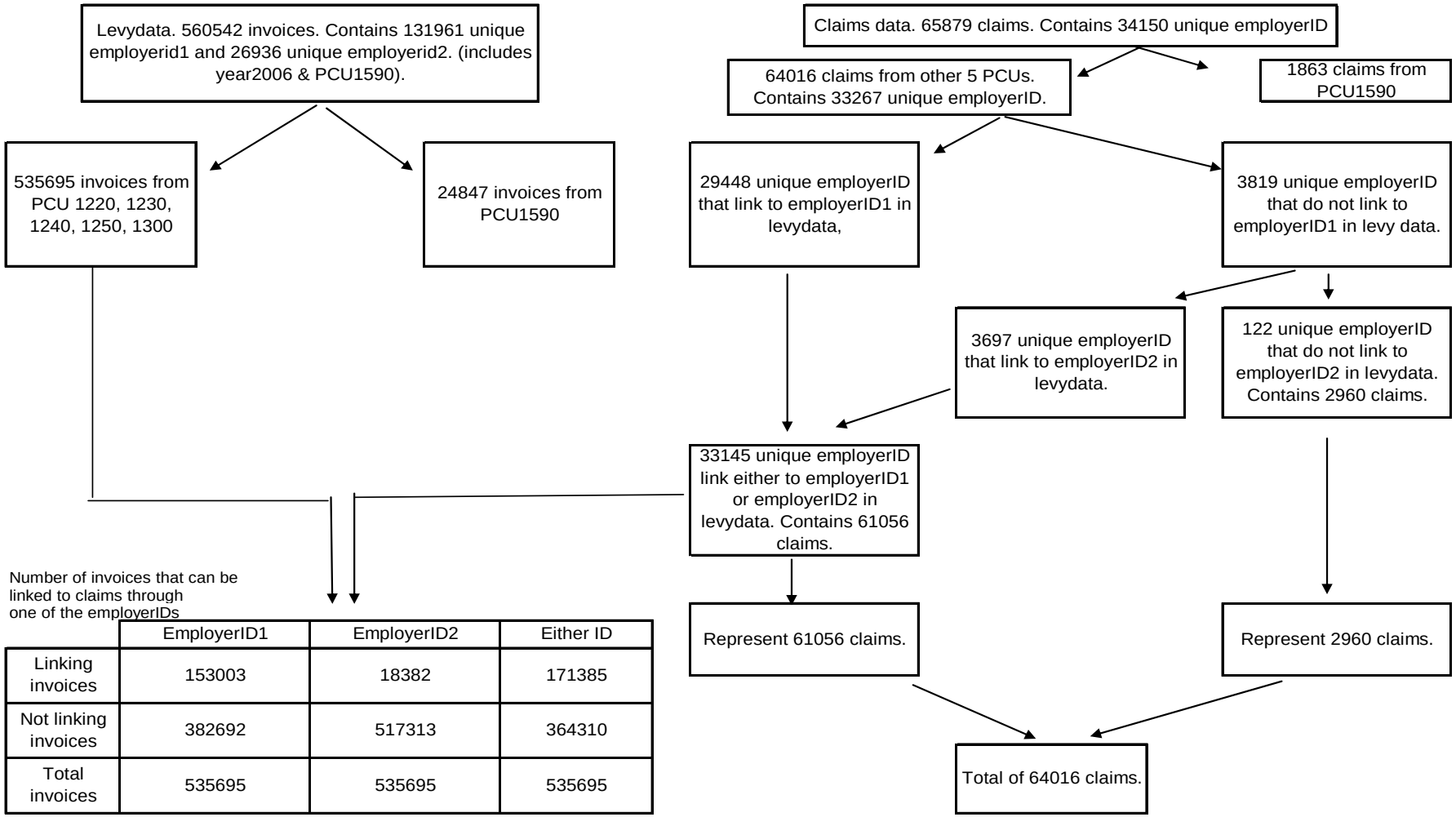
Table 5 shows the number and percentage of claims in the unlinked and the linked groups by age group. Age was calculated from the year of birth and the year of the incident. There was an association between linking success and age – the mean age of the unlinked cases was greater than the linked.

Table *5*: Number and percentage of claims in the unmatched and the matched groups by age group.

agegroup	non Matched Number	%	Matched Number	%
0-14	1	0.03	41	0.07
15-24	242	8.18	6072	9.94
25-34	265	8.95	9232	15.12
35-44	320	10.81	15478	25.35
45-54	339	11.45	15464	25.33
55-64	467	15.78	10258	16.80
65-74	723	24.43	3587	5.87
75-84	521	17.60	854	1.40
85-94	81	2.74	61	0.10
95-104	1	0.03	8	0.01
>105 or over	0	0.00	1	0.00
	2960	100	61056	100

Figure 2: Matching claims to levy invoices through employerID1 and employerID2

See overleaf



Number of invoices that can be linked to claims through one of the employerIDs

	EmployerID1	EmployerID2	Either ID
Linking invoices	153003	18382	171385
Not linking invoices	382692	517313	364310
Total invoices	535695	535695	535695

3.2. Checking and understanding the data

Checking the data principally involved producing univariate statistics (tables and charts). With a few exceptions, these are not presented here. Information on ACC claims and levy data that we are developing is reported in a companion document: “IPRU’s understanding of ACC data”:

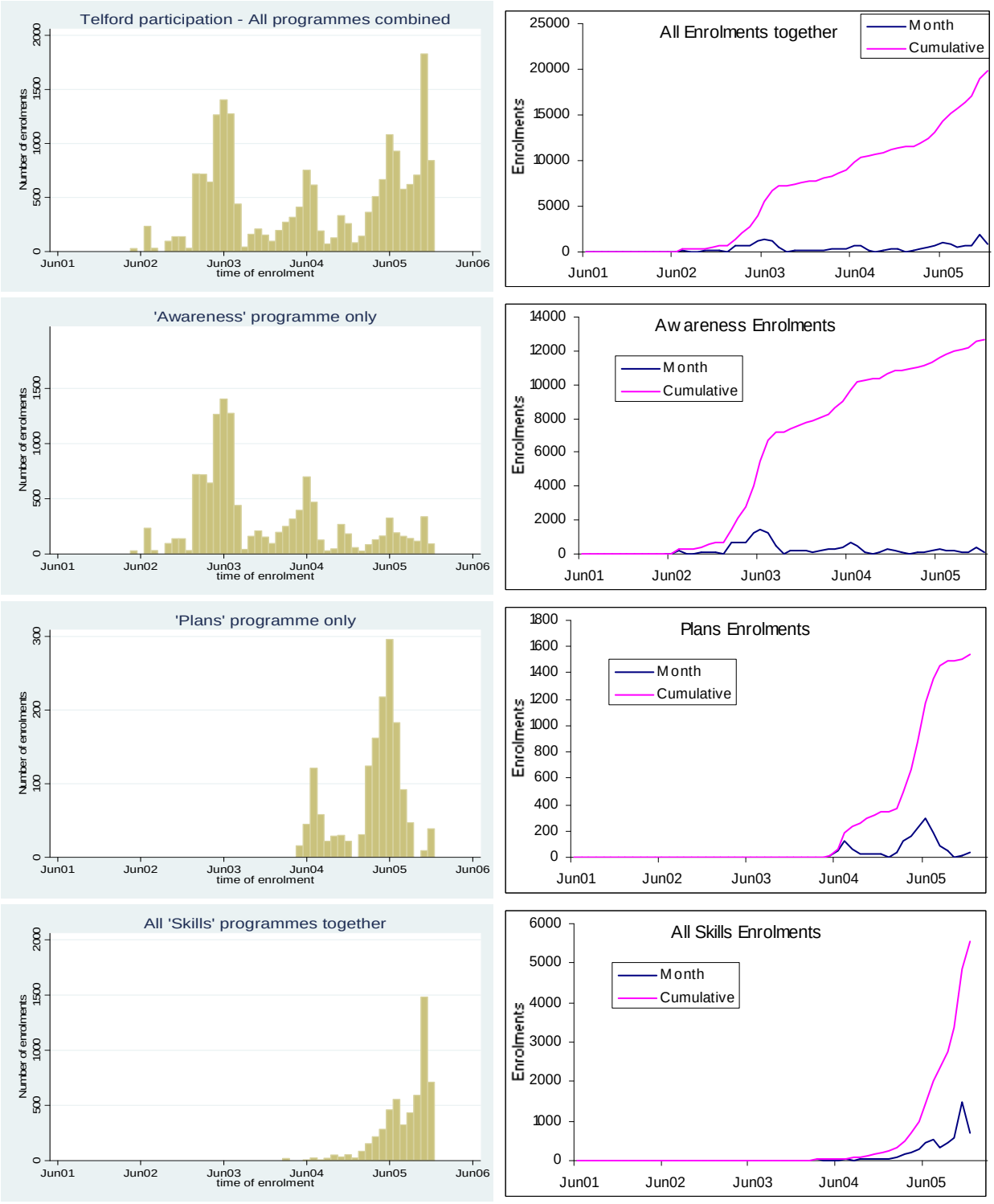
3.2.1. FS enrolment data

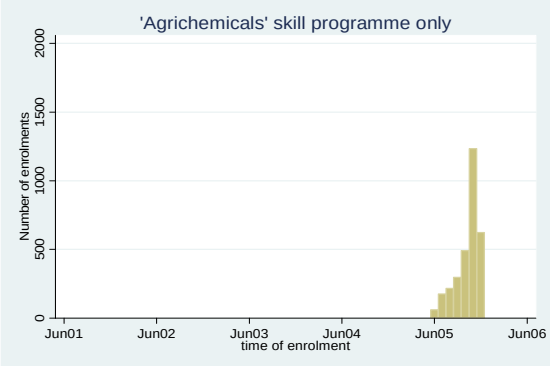
The histograms shown in Figure 3 relate to the 19,748 enrolments on FS workshops. Please note that the scales in these histograms change according to the frequency of enrolments.

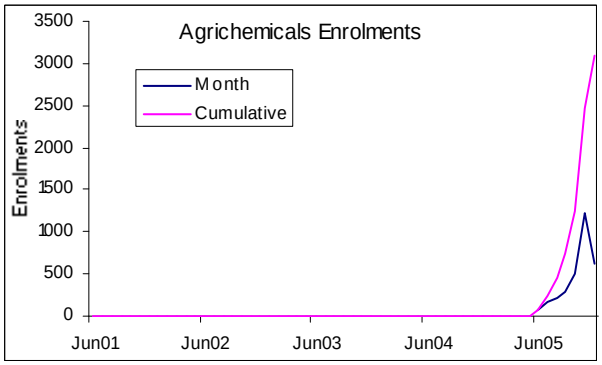
John Wallaart (ACC) indicated that these figures were consistent with his expectations (personal correspondence, 19 July 2006).

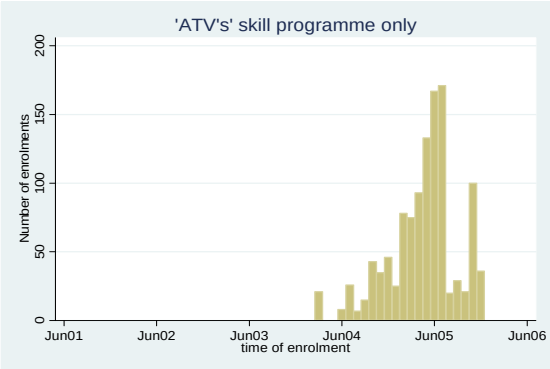
Figure *3*: Histograms and cumulative histograms of attendance at FS programmes

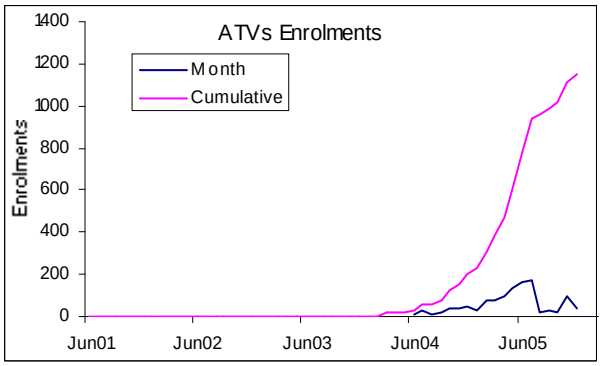
For (a) all Programmes combined (n= 19,748); (b) Awareness Programmes. (n= 12,658); (c) Plans Programmes (n = 1,544); (d) all Skills Programmes together (n = 5,546); (e) Agrichemicals Skills Programme (n= 3,102); (f) ATV's Skills Programme (n=1,149).




'Agrichemicals' skill programme only
Number of enrolments
0
500
1000
1500
2000
Jun01
Jun02
Jun03
Jun04
Jun05
Jun06
time of enrolment


Agrichemicals Enrolments
Month
Cumulative
Enrolments
0
500
1000
1500
2000
2500
3000
3500
Jun01
Jun02
Jun03
Jun04
Jun05


'ATV's' skill programme only
Number of enrolments
0
50
100
150
200
Jun01
Jun02
Jun03
Jun04
Jun05
Jun06
time of enrolment


ATVs Enrolments
Month
Cumulative
Enrolments
0
200
400
600
800
1000
1200
1400
Jun01
Jun02
Jun03
Jun04
Jun05

3.2.2. ACC levy data

The exclusion of PCU 1590 resulted in the exclusion of 4% of the farms. We expect that the vast majority of these will not be involved in sheep, beef of dairy farming.

Table *6*: Number of ACC levy invoices by year and Premium Classification Unit for sheep beef and dairy farms.

		Levy Year					
PCU Code	Industry	2001	2002	2003	2004	2005	Total
1220	Grain Sheep & Grain Beef Farm	3207	3205	3124	2949	2705	15190
1230	Sheep-Beef Cattle Farming	34770	35738	34278	32433	29933	167152
1240	Sheep Farming	7709	7887	7469	6988	6438	36491
1250	Beef Cattle Farming	10821	11393	10985	10439	9512	53150
1300	Dairy Cattle Farming	41961	42727	42107	38940	34969	200704
1590	Livestock Farming (NEC)	3844	4369	4495	4607	4347	21662
Total		102312	105319	102458	96356	87904	494349

NEC = not elsewhere classified

Understanding the levy data – unresolved issues

Number of levy invoices

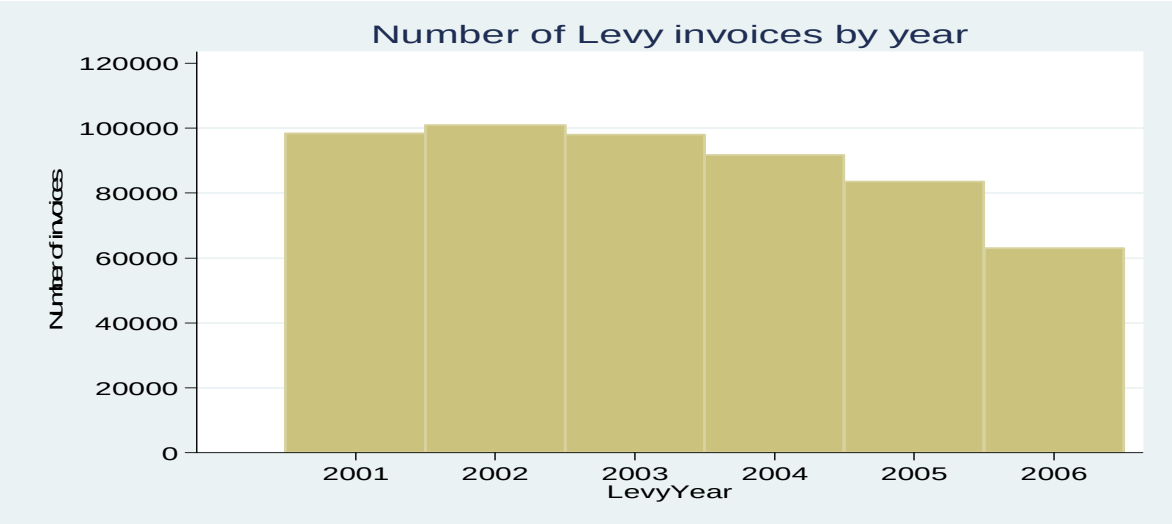
There were approximately twice as many ACC levy invoices for sheep, beef and dairy farms, than would be expected from the data available from Statistics New Zealand (StatsNZ). One informant from ACC suggested that a contributor to this is that ACC collects liable earnings by payroll. These payrolls are set up by the Inland Revenue Department (IRD). Employers often set up more than one payroll – in some instances there can be several. (Tim Boyd Wilson, Personal correspondence, 4 October 2006). This does not appear to explain the difference for the following reason, however. StatsNZ have worked towards creating a sampling frame of business entities for their Agricultural Production Census and surveys. The source of the data for the construction of the sampling frame is many-fold and, like the ACC, includes the IRD[i] (Andrew McLaren, SNZ, personal correspondence, 6 October 2006). This unresolved matter warrants further investigation.

[i] The Agricultural Production Census and Surveys sampling frame was all businesses identified on Statistics New Zealand's Business Frame or Inland Revenue's (IRD) Client Register as being engaged in agricultural activity (as defined above). The Business Frame is a list of businesses in New Zealand registered for goods and services tax (GST) with the IRD, while the Client Register consists of all businesses registered with that department. The frame also incorporates relevant feedback received from previous Agricultural Production Census and Agricultural Production Survey.

Trend in levy invoices

Figure 4 shows the number of levy invoices by year. Note that levy years run from April to March (i.e., levy year for 2002 spans the period from April 2001 to March 2002). Hence, the number of levy invoices in the following histogram covers 15 months before and 9 months after the project period.

Figure 4: The number of levy invoices by year



The number of levy invoices for 2006 is provisional.

There is a clear and substantial downward trend in number of levy invoices over the years shown (even excluding the 2006 provisional data). ACC informed us that they thought this was due to farm size increasing, with a commensurate reduction in the number of farms over this period (John Wallaart, personal correspondence, 23 May 2006; Tim Boyd Wilson, personal correspondence, 4 October 2006). Data from the Agriculture Production Census and Surveys gives some support to this position. They show that there has been a long term trend during which time the average land area of farms has increased. However, over the project period, data from this same StatsNZ source suggests that land area of farms has not been increasing, although the number of farms does appear to have decreased by around 7% between the 2002 Agriculture Production Census and 2004 Agriculture Production Survey. (Andrew McLaren, SNZ, personal correspondence, 6 and 7 October 2006). During the same period, there was a reduction of 9% in ACC levy invoices.

3.2.3. ACC claims data

The total number of claims received from the ACC for the period 1 July 2001 to 30 June 2005 was 65,879. Excluding PCU 1590, the number reduced to 64,016. Excluding those claims that did not link to levy data reduced this further to 61,056 (Table 7).

***Table 7*: The number of linked claims received from the ACC for the period 1 July 2001 to 30 June 2005 by PCU.**

	Premium class							
Linked	1220	1230	1240	1250	1300	**sub total**	1590	Total
No	152	1194	185	166	1263	**2960**	175	3135
Yes	2054	21629	3541	3802	30030	**61056**	1688	62744
Total	2206	22823	3726	3968	31293	**64016**	1863	65879

Understanding the ACC claims data

Operational definition of work-related claims

Within the ACC data, work-related claims were classified from the responses to ACC45 (which includes questions about whether the injury was experienced whilst at work). For this study, work-related cases were identified from whether they were paid from Fund 6 (Employers/other insurers), Fund 10 (Self-employed work) or the Residual fund (for the years of interest, cases paid from the residual fund tended to be gradual process claims).

Fund code and ACC_Suffix (see "IPRU's understanding of ACC data")

In general, claims identified from Fund 10 are claims made by employers, and those from Fund 6 from employees. However, a farmer who (jointly) owns the farm will not necessarily be paid from Fund 10. For example, they may be joint owner of a family company, and be an employee of the company – even though they are essentially the employer. In this case they would be compensated for an injury from Fund 6. They would be designated, however, as code 'D' (shareholder employee) by the ACC_Suffix. Consistent with the above, the S/B/D claims and levy data that we received showed that the claims compensated from Fund 10 had an ACC_Suffix of "S" and claims compensated from fund 6 had an ACC_Suffix of "D" or "E".

3.3. Exploratory analysis

The process of checking and understanding the data used the results of the exploratory analysis. Consequently, some of the results of the exploratory analysis were presented in the previous section. This section presents selected other results.

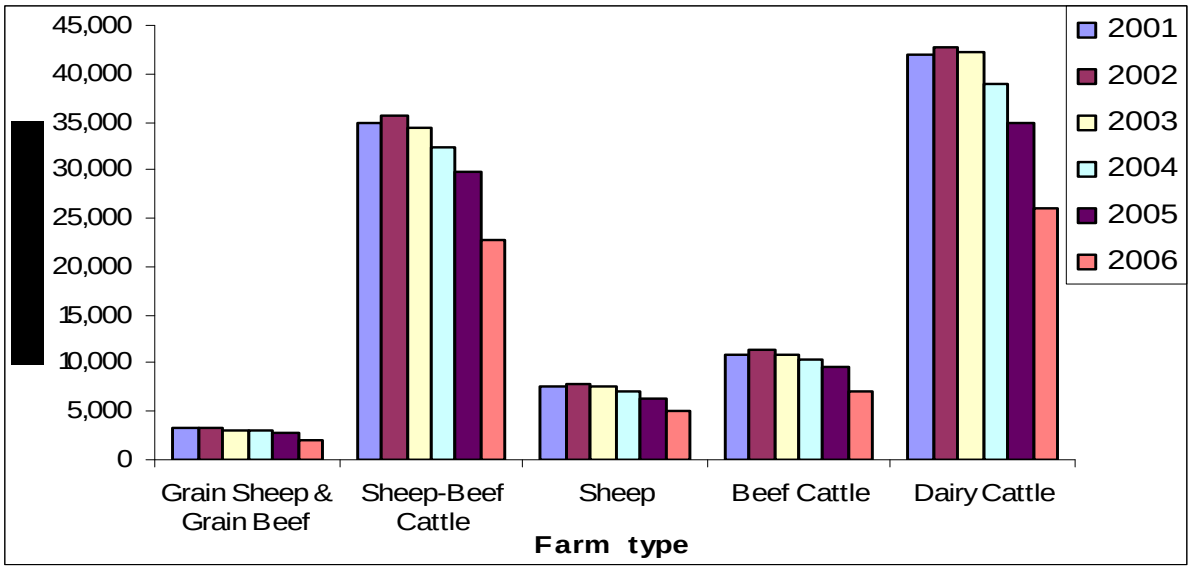
3.3.1. FS enrolment data

Histograms, and cumulative histograms, of attendance at the FS programmes are shown in Figure 3 in section 3.2.1.

3.3.2. Levy data

The breakdown of the 535,695 invoices, that fell within our study population, by year and industry class are shown in Table 6 (page 37, section 3.2.2) and Figure 5. The downward trend in invoices is visible in each of five industry groups. (Note data labeled 2001 relates to the period April 2000 to March 2001.)

Figure 5: ACC levy invoices by year and industry class.



Earnings

Earnings, in this section, relates to the farm income on which the ACC levy payments were based. Univariate statistics for earnings for 2001 to 2006, over all employers as well as broken down by PCU, are shown in Table 8.

***Table 8*: Earnings on which ACC levies are based by PCU**

Premium Class	Invoices (no.)	Percentiles of earnings 0th	25th	50th	75th	100th	Mean	sd
1220	17335	0	4108	16640	38042	716594	27734	35098
1230	189929	0	780	14560	32164	9263941	23877	55913
1240	41495	0	0	6580	20291	1389574	15779	27979
1250	60227	0	0	1506	14770	1298404	10791	24201
1300	226709	0	8642	24270	50538	2449479	34687	42604
Total	**535695**	**0**	**1270**	**16016**	**37566**	**9263941**		

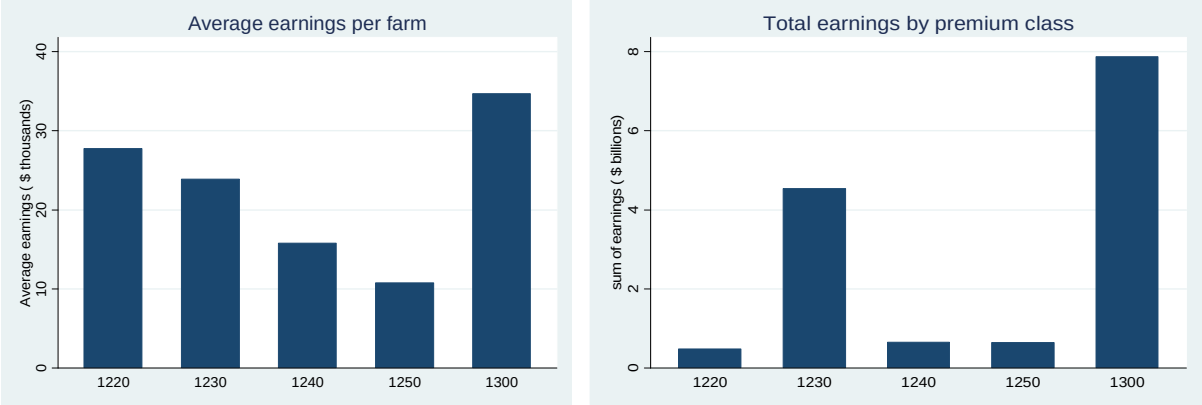
sd = standard deviation

There were 106,943 invoices based on zero earnings (about 20% of invoices). These were considered as observations when calculating the statistics shown in Table 8.

Figure 6 shows:

- The relative size of each farm type as measured by the average earnings over all farms in the PCU over the 6 years.
- The total earnings for each farm type accumulated over the 6 year period for which we have data.

Figure 6: Average and total earnings by farm type.

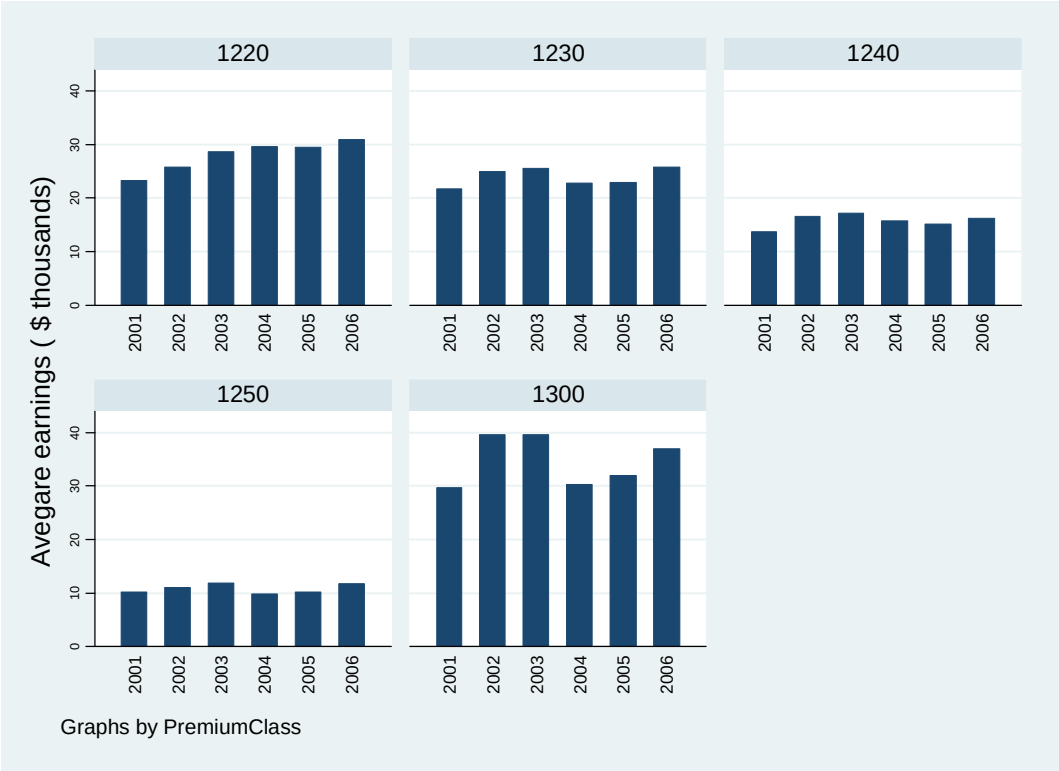


Total earnings, for all farms, show a downward trend, over the period of the study (Figure 7). This is consistent with the downward trend in number of invoices.

Figure 7: Trend in total earnings across all farms over the period of the study.

There is no obvious decline in the trends in average earnings within PCU (Figure 8).

Figure 8: Trend in mean earnings for each type of farm by levy year.



Earnings after adjusting for inflation

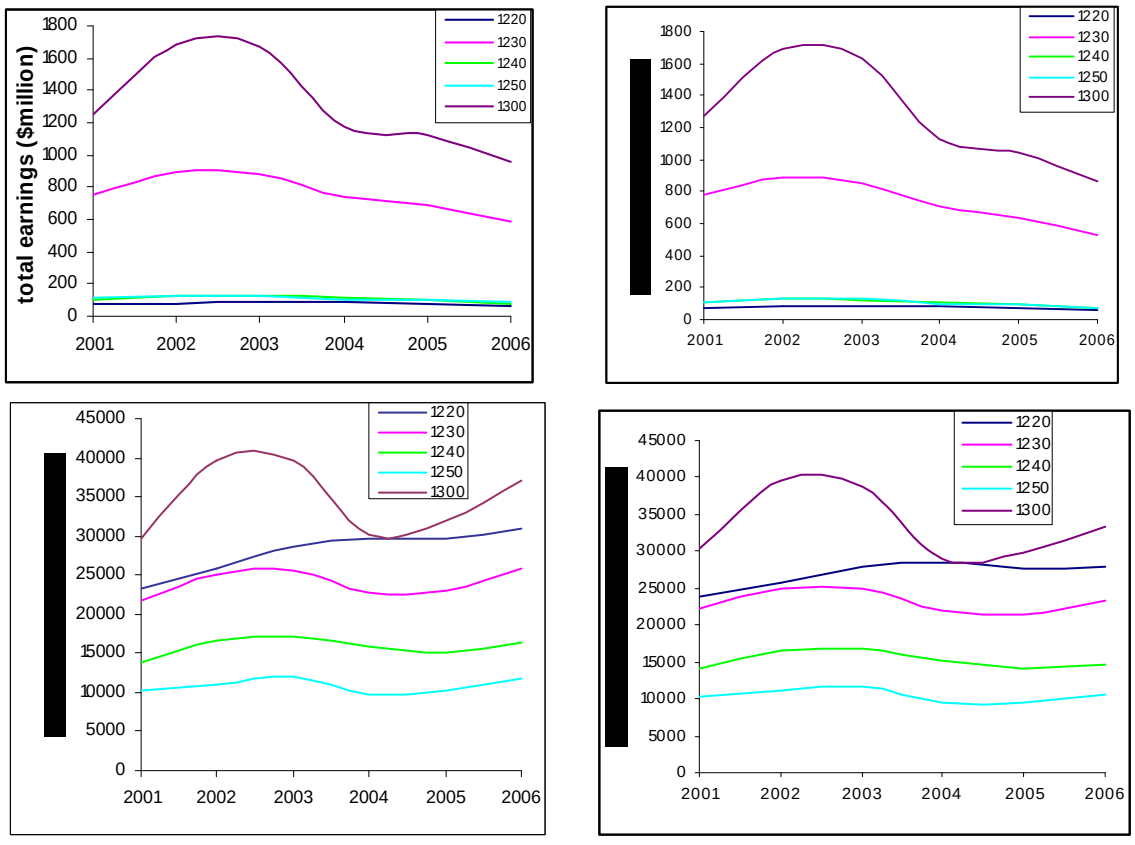
Figure 8 shows the trends in raw earnings across levy years (i.e., without any adjustment for possible inflation). Figure 9 shows the same trends after adjusting for inflation, using the Consumer Price Index (CPI). March 2002 was used as the base year. [This was also done using the Labour Cost Index with similar results.] Earnings were only available on a yearly basis and so could not be adjusted for within year inflation.

In Figure 9, the left panels show the earnings before adjustment, and panels on right show earnings after adjusting for inflation. There was little change in the trends following these adjustments.

Figure 9: Earnings after adjusting for inflation.

Unadjusted

Adjusted for CPI



3.3.3. Claims occurrence

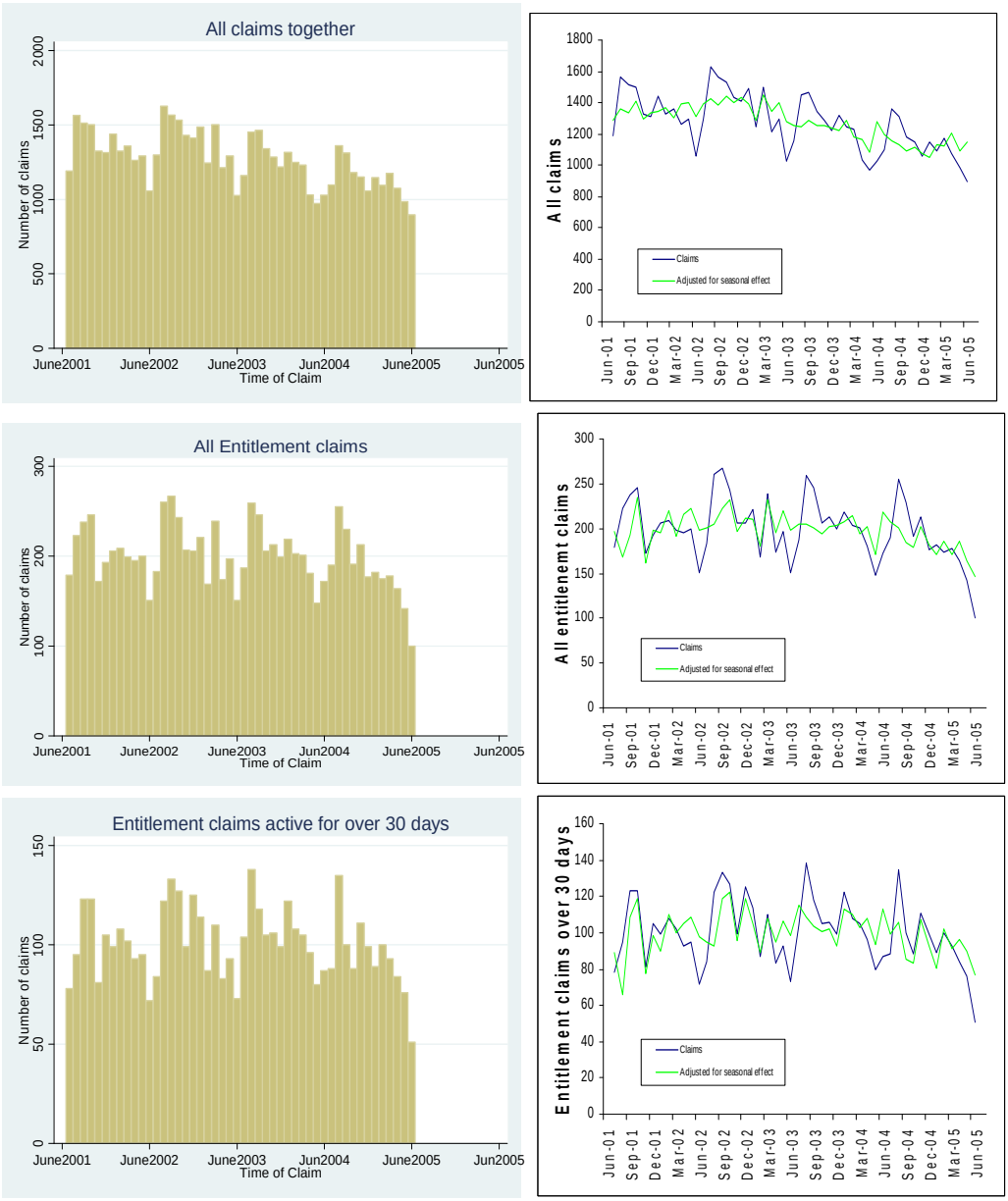
Table 4 (p31) shows a breakdown of the 61,056 claims by type of claim. The trend in the number of claims for the duration of the study is presented as a histogram and a line graph (Figure 10). This trend shows seasonal variation, and so the seasonally adjusted trend is also presented as a line graph. These are presented for

- All types of claims
- Entitlement claims, and
- Entitlement claims active for over 30 days. (Figure 10)

Assuming that a linear trend line is a good fit for the seasonally adjusted number of claims, there was a monthly reduction of 6.55 claims, 0.51 claims, and 0.11 claims from all types of claims, ECs and ECs active for over 30 days, respectively.

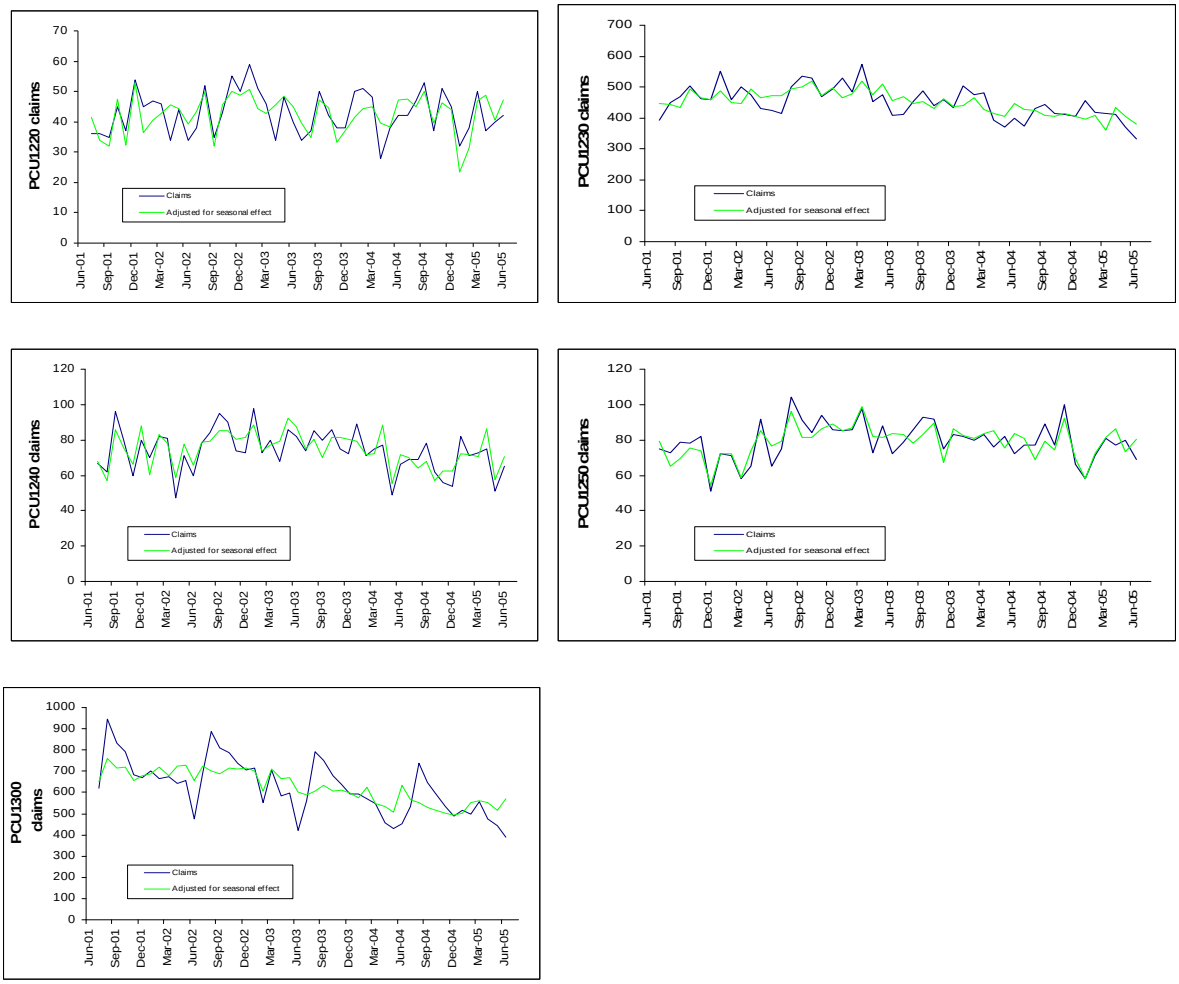
Figure 10: Crude and seasonally adjusted frequency of claims by month.

For (a) all claim types (n=61,056); (b) entitlement claims (n=9,557); (c) entitlement claims active for more than 30 days (n=4,806)



The trends in claims over time for each farm type are shown in Figure 11.

Figure 11: The trends in claims over time for each farm type.



Note: different scales on the Y axis are used in each of these figures.

The average change each month in the seasonally adjusted claims is:

PCU 1220: increase of 0.02 claims per month.

PCU 1230: decrease of 1.78 claims per month.

PCU 1240: decrease of 0.15 claims per month.

PCU 1250: increase of 0.09 claims per month.

PCU 1300: decrease of 4.74 claims per month.

These increases/decreases added to an overall decrease of 6.56 claims per month (cf page 44).

3.4. Modeling results

The modeling results upon which the presentation below is based are reproduced in Appendix 5.

3.4.1. Cox's regression

For each outcome and follow-up period, attendance at Awareness only (AO) or Awareness followed by Plans (AP) were associated with increased injury rates (Table 9). These associations could be due to confounding and so were explored further in the Cox's and logistic regressions that included the potential confounders captured by the ACC claims and levy data (Table 10 and Table 11).

Table 9: The crude rates of injury during follow-up for the data used in the Cox's regression analyses.

Outcome [a]	Follow-up (months)	Exposure [b]	No. of outcomes	Total at-risk	Person-months	Rate (per 1000 pm)	Crude RR[c]
ERC>0	12	AO	87	2,611	28,509	3.05	1.71
		AP	3	251	1,198	2.50	1.40
		None	267	14,310	149,856	1.78	
ERC>0	24	AO	142	2,611	47,762	2.97	1.73
		AP	3	251	1,204	2.49	1.45
		None	428	14,310	248,895	1.72	
ERC>21	12	AO	62	2,611	28,678	2.16	1.59
		AP	2	251	1,198	1.67	1.23
		None	181	14,310	150,390	1.20	
ERC>21	24	AO	104	2,611	48,274	2.15	1.82
		AP	2	251	1,204	1.66	1.41
		None	296	14,310	250,467	1.18	

[a] ERC>0=earnings-related compensation for one or more days. [b] AO=Awareness only; AP=Awareness followed by Plans; None=no exposure to FS during the period. [c] RR=rate ratio

Table 10: Rate ratio estimates for Awareness only and Awareness and Plans from Cox's regressions after adjusting for confounding.

	Follow-up	AO[a]		AP[b]	
Outcome	**(Months)**	**RR[c]**	**95% CIs[d]**	**RR**	**95% CIs**
ERC[e]>0	12	1.60	(1.25 - 2.06)	1.42	(0.44 - 4.66)
ERC[e]>0	24	1.63	(1.34 - 1.99)	1.44	(0.44 – 4.70)
ERC[e]>21	12	1.62	(1.20 - 2.19)	1.47	(0.35 - 6.27)
ERC[e]>21	24	1.70	(1.35 - 2.14)	1.46	(0.35 - 6.19)

[a] AO=Awareness only. [b] AP=Awareness and Plans. [c] RR=rate ratio. [d] CIs=confidence intervals. [e] ERC=earnings related compensation.

The results consistently show that attendance at Awareness was associated with increased rates (60 to 70% greater) of injury resulting in earnings-related compensation of 1 or more days duration, and of over 21 days duration, for both 12 or 24 months follow up. There was insufficient power to assess the effect of Plans (AP).

3.4.2. Logistic regression

The logistic regression results relating to the association between attendance at the FS Awareness Programme (AO) and injury risk are similar to those for the Cox's regression (Table 11).

Table 11: Odds ratio estimates for Awareness only from logistic regression models after adjusting confounding.

	Follow-up	AO[a]		AP[b]	
Outcome	**(Months)**	**OR[c]**	**95% CIs[d]**	**OR**	**95% CIs**
ERC[e]>0	12	1.65	(1.27 - 2.15)		Not estimable
ERC[e]>0	24	1.71	(1.32 - 2.21)		Not estimable
ERC[e]>21	12	1.65	(1.21 - 2.26)		Not estimable
ERC[e]>21	24	1.90	(1.40 - 2.57)		Not estimable

[a]=Awareness only. [b]=Awareness and Plans. [c]=odds ratio. [d]=confidence intervals. [e]=earnings related compensation.

Odds ratios for Plans (AP) could not be estimated in these logistic regressions models, because there were insufficient outcomes for participants who completed the Plans workshop in time to permit the full period of and 12 or 24 months follow-up.

3.4.3. Summary of the modeling results

Irrespective of the modeling approach used, the results were fairly consistent for AO, showing a statistically significant increased risk / rate of injury during follow-up. Estimates ranged from 60% to 70% increased rate; and 65% to 90% increased risk.

For AP, the analysis was only viable for the Cox regression. The results of the modeling show a consistent increased rate for AP across all models (42% to 47% estimated increased rate). However, these estimates had very low precision; the data was consistent with anything between a 65% decrease and a 527% increase in rates.

3.5. Investigation of bias

The results in section 3.4 show a statistically significant association between AO and injury resulting in earnings-related compensation of either greater than 0 or 21 days duration, during 12 and 24 months follow-up. This finding is unlikely to be due to chance alone.

These results for AO could be due to bias. They could be an artifact caused by:

- selection bias
- the influence of FS on entitlement claims-making behaviour.

Both of these explanations were investigated.

3.5.1. Selection bias

Rates of injury claims during the 12 months prior to the start of follow-up:

The 17,172 people in the dataset used for the modeling were classified according to the exposure type and the number of claims they made during the 12 months immediately prior to follow-up (Table 12).

Table 12: Risks, rates and RRs for each exposure group for the 12 months prior to follow--up.

		Exposure group		
	Risk / Rate per 1,000	**AO**	**AP**	**None**
ERC>21	Risk (CIs)	50 (42.1 – 59.3)	32 (13.9 – 61.8)	61
	Rate (CIs)	51 (42.6 – 60.4)	32 (13.8 – 62.8)	62
	RR (CIs)	*0.82 (0.68 – 0.97)*	*0.52 (0.25 – 1.03)*	*1*
ERC>0	Risk (CIs)	83 (72.8 – 94.4)	52 (27.9 – 86.9)	99
	Rate (CIs)	84 (73.5 – 96.2)	52 (27.6 – 88.6)	102
	RR (CIs)	*0.82 (0.72 – 0.95)*	*0.51 (0.29 – 0.88)*	*1*
Med fees only	Risk (CIs)	413 (394 – 432)	227 (177 – 284)	466
	Rate (CIs)	476 (450 – 503)	271 (210 – 343)	547
	RR (CIs)	*0.87 (0.82 – 0.92)*	*0.50 (0.39 – 0.63)*	*1*

In all instances, the rates (and risks) of claims in the twelve months prior to follow-up for those exposed to FS were less than for the controls (labeled “None” in the table). This suggests that

the results of the regression analyses were not due to high ACC claimers self-selecting for attendance at FS.

3.5.2. Claims-making behaviour

There is the strong possibility that claims-making behaviour was influenced by attendance at FS. The potential affect on claims-making behaviour (as opposed to actual injury incidence), resulting from attendance at one or more FarmSafe Programmes, was investigated.

The distribution of ACC diagnoses were compared for attenders at FS Awareness against non-attenders. FS is expected to influence the occurrence of injury, so the rate of injury was expected to decline amongst attenders. Even if this was the case, if attendance did not affect claims making behaviour, the severity threshold for making a claim would be independent of attendance. This being the case, if an injury with a particular diagnosis had occurred, we would expect the likelihood of a claim being made, given that injury diagnosis, to be similar for attenders and non-attenders. Turning this around, if the distribution of injury diagnosis amongst claimants was found to be dissimilar for attenders and non-attenders; this would suggest that claims-making behaviour was influenced by attendance. (Correspondingly, if claims-making behaviour, given an injury, did not change as a result of attendance at the FS Programmes, then we would expect that the proportion of farmers making a claim for a given injury diagnosis or severity of injury, to have been similar for FS attenders compared with the non-attenders.)

This was investigated in the following way. For the subset of claims used in the modeling, we compared (using tables and chi-squared tests) the distribution of diagnoses as recorded by ACC ("diagnose" and "injury site" – see "IPRU's understanding of ACC data") for the ERC>0 outcome (i.e. first EC claim with WCdays>0) during 12 months of follow-up for people exposed to FS Awareness versus the non-exposed group.

There was no evidence of a difference in the distribution of diagnosis of injury for FS AO attenders and non-attenders (Table 133). Consequently, we were able to discern no effect of FS Awareness on claims-making behaviour.

Table 13: Distribution of diagnosis of injury for FS AO attenders and non-attenders.

Diagnosis	Course: **AO** [n(%)]	Course: **none** [n (%)]	Total
Laceration	10 (12)	18 (7)	28
Soft tissue - Lower back	9 (10)	29 (11)	38
Soft tissue – knee	6 (7)	28 (10)	34
Soft tissue – ankle	5 (6)	18 (7)	23
Soft-tissue – shoulder	5 (6)	21 (8)	26
Soft-tissue - other	14 (16)	34 (13)	48
Fracture/disloc – chest	5 (6)	6 (2)	11
Fracture/disloc – hand/wrist	4 (5)	14 (5)	18
Fracture/disloc – other	13 (15)	53 (20)	66
Hernia	1 (1)	11 (5)	12
Other	4 (5)	14 (5)	18
Unknown	11 (13)	21 (9)	32
Total	87 (100)	267 (100)	354

Pearson chi2 (11) = 10.7249 Pr = 0.467

3.6. Incidental findings

The modeling results, above, were adjusted for the potential independent confounding effects of quarter of follow-up, gender, premium class unit (synonymous with industry class and type of farm), fund code (Employers, Self-employed), type of employer (self-employed without employees, self-employed with employees, shareholder employees), age group, liable earnings, occupation (livestock workers, mixed livestock workers, crop and livestock workers, other agricultural workers, other occupations), ethnicity (level 1), and the Skills course attended. The latter was used as a marker of hazard exposure.

The inclusion of these terms in the model has permitted a description of the associations between each of these factors and the injury claims outcomes. Table 14 shows the p-values for the potential confounding variables from the Cox regression models, That is, it shows whether there was a statistical association between the potential confounding variable and the time-off work outcomes. Similar results were found for each model, although some associations depended on the model chosen.

Table 14: p-values for the potential confounding variables from the Cox regression models.

	Model			
Variable	12m wc0	12m wc21	24m wc0	24m wc21
Quarter	0.21	0.54	0.37	0.72
Gender	0.16	0.05*	0.04*	0.02*
PCU	0.43	0.67	0.74	0.97
Fund code	0.05	0.42	0.02*	0.05
Age	0.47	0.44	0.29	0.20
Earnings	0.08	0.08	0.005**	0.02*
Occupation	0.26	0.74	0.06	0.28
Ethnicity	0.36	0.84	0.24	0.38
Skills programmes	0.04*	0.005**	0.08	0.01*
ACC_Suffix	0.59	0.22	0.48	0.87
Prior claims history	0.001***	0.0008***	0.002**	0.004**

12m_wc0 = 12 months follow-up, outcome of earnings-related entitlement claim
12m_wc21 = 12 months follow-up, outcome of earnings-related compensation paid over 21 days.
24m_wc0 = 24 months follow-up, outcome of earnings-related entitlement claim
24m_wc0 = 24 months follow-up, outcome of earnings-related compensation paid over 21 days.
* = p<0.05
** = p<0.01
*** = p<0.001

These models showed the following associations with the injury outcomes:

- With gender – showing fairly consistent associations

- Between employees compared with self-employed - showing fairly consistent associations
- An association with liable earnings (an indicator of size of organisation) - showing fairly consistent associations.
- An association with occupation, but in only one model.
- With attendance at Skills Programmes.
- Consistent associations with earnings-related entitlement claims in the previous 12 months.

Table 15 shows the p-values associated with each of the levels within each variable (e.g. it shows the quartiles which show a significant difference from the reference category – in this case chosen to be those with the lowest liable earnings in quartile 1.)

Given that the results are relatively consistent across model (with the exception of the results for occupation); we have presented more complete results from just one model in Table 16. This gives the estimates of RR associated with each of these potential confounders for the Cox regression model for earnings-related compensation claim as the outcome and 24 months follow-up. This model was chosen as it was the one with the largest number of outcomes, and the longest period of person-time follow-up. These models showed the following associations:

- Suggestion of a variation in rates over time.
- Male rates greater than female rates.
- No significant association with industry group.
- Reduced rate for employees compared with self-employed.
- Increased rate for people aged 50-59 compared with the reference group aged 20-29.
- An association with liable earnings (an indicator of size of organisation) with the farmers and farm workers on farms with the smallest and largest liable earnings showing the lowest rates.
- No apparent association with ethnic group.
- Inflated rates (though not statistically significant) for people attending the following Skills programmes:
    - ATV (indicator of ATV exposure)
    - Chainsaws (indicator of chainsaw exposure)
- No significant association with type of employer.
- A significantly increased rate for those with an earnings-related entitlement claim in the previous 12 months.

Table 15: p-values associated with each of the levels within each potential confounding variable.

		12m_wc0	12m_wc21	24m_wc0	24m_wc21
Quarter	**4**	No outcomes	No outcomes	0.65	0.38
	5	1.00	0.94	0.91	0.74
	6	0.08	0.09	0.30	0.24
	7	ref	ref	ref	Ref
	8	0.46	0.23	0.97	0.76
	9	0.90	0.69	0.45	0.88
	10	0.63	0.67	0.74	0.63
	11	0.25	0.58	0.18	0.38
	12	0.40	0.96	0.11	0.49
	13	0.88	0.87	0.80	0.74
	14	0.05	0.21	0.04*	0.14
	15	0.63	0.58	0.54	0.48
	16	0.30	0.32	0.24	0.25
Gender		0.16	0.05*	0.05*	0.02*
PCU	**1220**	ref	ref	ref	Ref
	1230	0.42	0.69	0.39	0.68
	1240	0.73	0.33	0.59	0.75
	1250	0.57	0.37	0.42	0.49
	1300	0.77	0.66	0.70	0.64
Fund	**Employees**	0.05	0.42	0.02*	0.05
	Self-employed	ref	ref	ref	Ref
Age	**10-19**	0.46	0.57	0.76	0.57
	20-29	ref	ref	ref	Ref
	30-39	0.44	0.32	0.67	0.76
	40-49	0.15	0.04*	0.35	0.08
	50-59	0.04*	0.05	0.04*	0.04*
	60-69	0.48	0.13	0.95	0.32
	70-79	0.62	0.55	0.26	0.06
	80-89	No outcomes	No outcomes	0.85	No outcomes
Earnings	**Quartile 1**	ref	ref	ref	Ref
	Quartile 2	0.07	0.08	0.01*	0.02*
	Quartile 3	0.02*	0.01*	0.005**	0.005**
	Quartile 4	0.50	0.38	0.85	0.29
Occupation					
Livestock workers		ref	ref	ref	Ref
Mixed livestock		0.62	0.32	0.58	0.36
Crop and livestock		0.12	0.84	0.13	0.22
Other agricultural workers		0.06	0.94	0.03*	0.57
Other		0.91	0.38	0.27	0.19

Ethnicity	**European**	ref	ref	ref	Ref
	Maori	0.43	0.74	0.53	0.55
	Other	0.79	0.90	0.14	0.10
	Unknown	0.12	0.41	0.22	0.78
Skills	**ATV**	0.33	0.18	0.26	0.12
	Chainsaw	0.08	0.05*	0.18	0.11
ACC_Suffix	**Self-employed**	colinearity	colinearity	colinearity	Colinearity
	Employers	ref	ref	ref	Ref
	Shareholder employees	0.59	0.22	0.48	0.87
Prior claim		0.001***	0.001***	0.002**	0.004**

* = p<0.05
** = p<0.01
*** = p<0.001

Table 16: Estimates of RR associated with each of these potential confounders for the Cox regression model for earnings-related compensation claim as the outcome and 24 months follow-up.

	RR	se	z	P-value	95% CI
Quarter 4	1.58	1.59	0.45	0.652	.22 - 11.34
5	1.03	.30	0.11	0.914	.59 - 1.81
6	1.28	.30	1.04	0.300	.80 - 2.03
7	1				
8	1.01	.12	0.04	0.968	.79 - 1.28
9	.90	.13	-0.75	0.454	.68 - 1.19
10	.92	.23	-0.34	0.736	.56 - 1.51
11	.71	.18	-1.33	0.185	.43 - 1.18
12	.75	.13	-1.61	0.108	.54 - 1.06
13	.95	.21	-0.25	0.801	.61 - 1.47
14	.22	.16	-2.11	0.035*	.05 - .90
15	.64	.46	-0.62	0.537	.15 - 2.65
16	. 42	.31	-1.18	0.237	.10 - 1.76
Male	1.27	.15	2.01	0.045*	1.01 - 1.60
PCU 1220	1				
1230	.81	.20	-0.85	0.393	.51 - 1.31
1240	.86	.25	-0.53	0.593	.49 - 1.51
1250	.78	.23	-0.81	0.417	.43 - 1.41
1300	.91	.22	-0.39	0.695	.57 - 1.45
Fund:					
Employees	.76	.09	-2.34	0.020*	.60 - .96
Self-employed	1				
Age 10-19	1.08	.29	0.30	0.765	.64 - 1.84
20-29	1				
30-39	1.07	.18	0.43	0.669	.78 - 1.48
40-49	1.17	.19	0.93	0.352	.84 - 1.61
50-59	1.41	.24	2.04	0.042*	1.01 - 1.97
60-69	1.01	.21	0.06	0.950	.67 - 1.52
70-79	1.39	.40	1.14	0.255	.79 - 2.43
80-89	.87	.63	-0.19	0.847	.21 - 3.61
Earnings					
Quartile 1	1				
2	1.37	.17	2.50	0.012*	1.07 - 1.75
3	1.42	.18	2.78	0.005**	1.11 - 1.82
4	1.03	.15	0.19	0.846	.77 - 1.37
Occupation					
Livestock workers	1				
Mixed livestock	1.15	.29	0.56	0.575	.70 - 1.88
Crop & livestock	1.25	.18	1.51	0.132	.94 - 1.67
Other agric	1.29	.15	2.14	0.033*	1.02 - 1.63
Other	.85	.12	-1.10	0.270	.65 - 1.13

Ethnicity						
European	1					
Maori	1.15	.25	0.63	0.531	.75	- 1.76
Other	1.36	.29	1.48	0.140	.90	- 2.05
Unknown	.73	.19	-1.22	0.221	.44	- 1.21
Skills workshops						
ATV	1.87	1.04	1.12	0.261	.63	- 5.56
Chainsaw	2.90	2.28	1.35	0.176	.62	- 13.52
ACC_Suffix						
Shareholder employees	1.29	.48	0.70	0.483	.63	- 2.66
Employers	1					
Prior claim	1.42	.16	3.07	0.002**	1.14	- 1.78

* = p<0.05
** = p<0.01
*** = p<0.001

4. Discussion

4.1. Discussion of results

4.1.1. Principal findings

The aim was to develop and pilot a feasible method to investigate whether exposure to the **Awareness and Plans** FS Programmes are associated with a reduction in injury outcomes amongst sheep, beef and dairy farmers and farm workers.

This work was based on ACC levy and claims data, and Telford FS enrolment data. An important "finding" was that there was no up-to-date documentation made available to the team regarding the ACC data. Significant time and effort by the IPRU team was spent understanding the ACC data and creating our own documentation ("IPRU's understanding of ACC data" – in preparation).

In regard to the aim, the principal findings were:

- The original proposed method of evaluation was not feasible due to missing ACC employer identification numbers in the Telford enrolment data for a large proportion of the FS attendees.
- We developed a feasible and optimal method of evaluation based on these data, taking into account their limitations.

It should be noted that the method we developed was aimed at measuring **the effect on the individuals who attended FS**. This design cannot evaluate changes to the general safety culture amongst all sheep, beef and dairy farmers and farm workers resulting from a proportion of that population attending FS. The latter is an affect that has been hypothesised by the FS Consortium. (Personal correspondence, 25 January 2007)

In regard to the exploratory analysis, as well as the application of the evaluation method, we found the following:

- Over the period of study (July 2001 to June 2005)
    - There was a downward trend in levy invoices for S/B/D farms
    - There was a downward trend in claims for S/B/D farms
- Attendance at the Awareness Programme was associated with an increased rate of earnings-related compensation claims during the 12 and 24 months follow-up post-attendance. (It should be noted that an effect on ACC claims rates is not the same thing as an effect on injury rates in that a person can be injured and not make a claim.)

- No selection bias nor changes to claims-making behaviour could be found in our relatively limited investigations.

We hypothesise that attendance at FS is increasing the likelihood of the farmer or farm worker making a claim in the event of an injury. This is an important hypothesis to test.

From the process and impact evaluation carried out by Kate Morgaine and colleagues[j], preliminary indications are that attending a FS Awareness Workshop improves both the attitude to farm safety of those who attend and the environmental safety practices such as ensuring non-slip flooring in the dairy shed, escape routes in the yards, no-go areas on the farm for ATVs, or conducting farm safety checks. The safety climate measure of both groups was reasonable and similar at the baseline assessment but following attendance at a FarmSafe Awareness Workshop the average score increased by 2.2 points. This was a statistically significant improvement ($p=0.035$). There was little change and little difference between the two groups with regard to their personal safety practice, however there was a substantial and significant difference between the groups in the safety environment measurement score used – see footnote. Those who attended the FarmSafe Awareness Workshop increased their average score by 2.6 out of a possible 32 points ($p<0.0001$). (Kate Morgaine, thesis in preparation) These findings run counter to the pilot outcome evaluation results presented here. Their findings need to be subjected to formal external review and, until that time, must be considered with caution.

4.1.2. Strengths and weaknesses of the study

A strength of our study is our use of linkage to develop an optimal method of evaluation. Although there seems to be uncorrected bias in the comparisons we made, if this bias can be identified and corrected, the method should provide a relatively inexpensive and valid approach to post-hoc evaluation.

The design used for outcome evaluation can be viewed as one:

- based on a restricted target population - i.e. not all sheep, beef and dairy farmers / workers; but restricted to those who have made a claim to the ACC (directly or indirectly);

[j] A sample of sheep, beef and dairy farmers and farm workers who attended a FarmSafe Awareness Workshop completed a survey before and after attending the workshop. This was compared with a randomly selected sample of sheep, beef and dairy farmers and farm workers who did not attend a FarmSafe Awareness Workshop. This group completed the same surveys approximately six months apart. The surveys measured attitudes to workplace safety in general and perceptions of safety on the farm (the safety climate measure – SCM), personal safety practices eg. using ear protection of the respondents (safety practice measure – SPM), and environmental safety practices - eg. rollover protection on tractors - on the farm (safety environment measure – SEM).

- with a more limited outcome than previously proposed – i.e. we did not use all claims (including medical fee only) as an outcome. (A more limited set of outcomes were used due to the amount of resource expended to understand the data, develop and apply the methods.)

External validity:

Inference from an analysis of these data under this changed design cannot necessarily be made to the original population. Those compensated by the ACC are probably a different population to those who are not. In that sense, external validity is compromised. However, the new target population is also a population that is of interest – perhaps of more interest. They are the population who are getting injured and making claims and so should be the target of our interest and the FS intervention.

Internal validity:

This deals with the issue of whether inference from the chosen method of outcome evaluation is valid (i.e. whether inference can be made to the study population) or whether estimates (e.g. of RRs) and hypothesis tests are biased.

Possibilities for the 'Awareness only' results are that they are real (FS Awareness does result in an increased rate of injury after attendance) or they are an artifact caused by:

a) selection bias
b) the influence of FS on entitlement claims-making behaviour
c) confounding
d) other sources of bias.

These explanations were investigated and / or discussed.

Selection bias

Selection bias was regarded by a number of people as the largest threat to the validity of the comparison (FS consortium, 6 October 2006, Lesley Day 9 October 2006).

The occurrence of an ACC claim of any sort could be affected by attendance at any FS Programme. Consequently, if the study population had been defined as including people from the target population who had any type of claim at any time (before or after attendance at any FS course), then this could result in selection bias. However, in the method developed during

this project, in order to be selected into the cohort, the approach required a claim of any sort **prior** to attendance at FS. This will exclude the above source of selection bias.

Self-selection of workers into the FS programme could have resulted in some selection bias. In theory, those who self-select could differ from those who do not. For example:
(1) If those who self-select are already more safety conscious, even with no effect of FS, a reduced risk would be estimated for workers who attended FS compared with controls.
(2) If those who self-selected did so because of their long-term history of increased injury rates, then if FS had no effect, an increased risk would be estimated for workers who attended FS compared with controls.

In regard to the first of these, the a priori opinion was that those who were most likely to self-selected for FS would be more committed to making safety-related changes than those who did not attend the courses. It was the opinion of selected members of the FS consortium that that was the case, at least in the first year. In which case, this evaluation would over-estimate the positive effect of FS (FS consortium, personal correspondence, 6 October 2006; Lesley Day, personal correspondence, 9 October 2006, Gordon Smith, personal correspondence, 10 October 2006). This a priori perception runs counter, however, to the results that we found in this study.

Possibility number (2) (above) was also investigated in this current study and our results do not support this, either. Morgaine and colleagues also considered the group who attended and had not attended FS Awareness. In their study, those who self-selected for the Awareness Programme had similar personal and farm characteristics to those who did not. Prior to attendance, they also had similar safety climate scores (attitudes to and perceptions of safety) as well as the same scores for their personal safety practice and safety environment of the farm. Furthermore, prior to attendance at FS Awareness, there was no discernable difference in injury experience between those who attended and those who did not. (Kate Morgaine, thesis in preparation) Consequently, neither our work nor that of Morgaine and colleagues suggest that people who self-select for Awareness are substantially different, in these important ways, to those who do not.

We used 5:1 matching of the non-exposed to the exposed (to FS). Those people who attended FS were matched to those who were not on the date of the injury that resulted in a claim that occurred before and closest to attendance at FS (index injury date). (This was done principally to define, as far as possible, a comparable cohort of non-exposed (i.e. control) people to the exposed.) The severity of the injury was not considered in the matching. A better match may have been achieved if we had had some measure of severity and matched people with like injuries prior to attendance. Preliminary results from an Australian study suggest that those who have a history of hospitalised injury (in the previous 3 years prior to the study) were

associated with a higher rate of injury subsequently (Lesley Day, personal correspondence, 9 October 2006). However, in our study, most index injuries were “medical fees only” injuries and so it is unlikely that selection bias would be reduced substantially if this more sophisticated strategy had been adopted - since these injuries are in the main likely to be minor and thus there would be no basis to discriminate on severity.

Claims-making behaviour

The result for Awareness could have been an artifact caused by the influence of FS on entitlement claims-making behaviour. This was felt to be a primary driver by one ACC key informant (Peter Jones, personal correspondence, 4 October 2006) as well as some members of the FS Consortium. We could only investigate this in a limited way; those investigations showed no evidence of an influence of attendance on entitlement claims-making behaviour. Nevertheless, we hypothesise that this is the most likely explanation for the increased rates of earnings-related compensated claims in the FS Awareness group, compared to the group who did not attend FS.

Misclassification bias

The linkage is not likely to be perfect. Consequently, some of those designated as NE may have really attended a FS programme. This misclassification will bias the result towards the null and so do not help to explain the result (increased rates of injury on follow-up in the AO group compared with the control)

Choice of outcome

The choice of outcome was traumatic injury only and excluded “gradual process”. The selected members of the FS consortium with whom this was discussed felt that the exclusion of gradual process claims from the outcome was appropriate, given the content of the FS workshops (personal correspondence, 6 October 2006).

Skills workshop attendance as a confounder

Attendances at the Skills workshops have been taken as a marker of exposure to hazards. This was discussed with selected members of the FS consortium who confirmed that the Skills workshops were aimed at current practitioners. For example, attendance at the ATV workshop is a marker of past and future use of ATVs on the farm (personal correspondence, 6 October 2006). Consequently, the strategy that we have adopted seems appropriate.

Uncorrected confounding.

Inevitably, not all potential confounding variables will be captured by the data sources used in this study. Eg. A potential confounding factor for this analysis was attendance by the study subjects at other farm safety training courses. There were no significant players when FS started, but there are now. Nevertheless, opinion was that the influence of any courses probably was not significant during the course of the study (i.e. mid-2001 to mid-2005). (Peter Jones, ACC, personal correspondence, 4 October 2006)

Preliminary evidence from the Australian Farm Injury Risk among Men (FIRM) case-control study found that any sort of agricultural training – not just safety training – is associated with a reduced risk of injury (Lesley Day, Monash, personal correspondence, 9 October 2006). Consequently, this general training represents a potential confounder that we were unable to adjust for in the analysis. We would only be able to do so in a study that involved primary data collection. This would only explain the result if choosing to do FS was associated with not having done agricultural training. This is plausible since those without any specific training may be more aware that they are untrained and therefore may be more likely to attend FS. This could be explored, if funded, by following up with a sample of FS attenders and non-attenders to ascertain the percentages who had previously undertaken agricultural training.

Duration and extent of exposure

Within the timeframe for this pilot evaluation, we were able to investigate the impact of FS attendance on the risk of injury for the individuals who attended (with the mechanism for change being behaviour change, and through modifications they made to the environment as a result of attendance). Members of the FS Consortium indicate that the goal of FS is to change the general safety culture for all Sheep, Beef and Dairy farmers and farm workers. This will require repeated exposure over a sustained period of time, and would require a substantially larger proportion of farmers and farm workers to be exposed than was current at the time of this pilot evaluation. That being the case, this enhanced effect cannot be expected to be detected by an evaluation carried out so early in the lifetime of FS.

Precision

This current pilot study has sufficient power and precision to investigate the association between attendance at the Awareness workshops (AO) and the subsequent rates of injury. The data available at this time does not provide sufficient precision for an investigation of effect of attendance at Plans on the subsequent injury rates, using this method. The method we have proposed is a feasible method once more people have attended the Plans workshops and

sufficient follow-up time has passed so that the number of earnings-related claims provides enough power to detect an effect.

4.1.3. Strengths and weaknesses in relation to other studies

No outcome evaluations of these FS programmes have previously been carried out. An imposed limitation of this pilot outcome evaluation of Awareness was due to when the evaluation took place – namely after the FS Awareness programme had been well established. Consequently, it took place after a large number of farmers had already been through the programme. This is fine for a retrospective analysis, but not for a methodologically stronger prospective evaluation. Our evaluation was also limited by the budgetary restrictions placed on the study.

The most sound evaluation of an intervention aimed at changing the safety culture of farmers was the West Jutland (Denmark) Study. [16] This was an evaluation of an intervention that comprised a safety inspection, a one day safety course and recommendations for safety improvements on the farm. Unlike other evaluations (including the current one), the West Jutland Study employed a randomised controlled trial (RCT) design, with ongoing assessment of injury occurrence, recognised as the most valid design for evaluation (where it is feasible) and providing the strongest evidence. One advantage of an RCT design is that it controls selection bias – i.e. the random allocation of farms to an intervention or a control group results in groups being compared that are similar in all respects other than their exposure to the intervention. Also, the use of prospective collection of injury data means that an "objective" definition of injury can be used – eg. independent of whether the injury results in a claim to the ACC or an admission to hospital – which reduces the chances of information bias.

Our study, though, was an observational study in which the farmers / workers choose whether or not they attended the FS programme (i.e. they self-selected). Those who attended were likely to be different in important ways to those that did not, resulting in selection bias (see the previous section). The interpretation of results from non-RCT controlled studies are, as a consequence of potential and likely selection bias, much more difficult to interpret than RCTs. Additionally, the use of routinely collected (in this case, ACC claims) data, as a source of data from which the injury outcomes were derived, opened up the strong possibility of information bias (caused if FS promotes ACC claims following injury in the period subsequent to attendance). Prospectively capturing injury data, with a definition of injury based on pathology and or severity (rather than claims or use of health services) would help circumvent this problem.

The use of a non-RCT design for the current study was an inevitable consequence of the timing and limited funds available for this evaluation, but it is a significant limitation of this study. Outcome evaluation is more meaningful and interpretable if undertaken in a RCT design, with prospective collection of well-defined injury outcomes.

4.1.4. What new knowledge this study brings

The most important new knowledge that this study brings is the method that we developed for the outcome evaluation. The method is based on the linkage and analysis of these ACC and Telford data and takes account of the limitations of those data. We produced a method of outcome evaluation that we and others (Lesley Day, Gordon Smith personal correspondence, 9&10 October 2006) think is optimal, in the sense that it was the method that minimised bias (particularly selection bias) given the limitations described in the previous sections.

We also found the following:

- Attendance at the Awareness programme was associated with an increased rate of earnings-related compensation claims during the 12 and 24 months follow-up post-attendance.
- This does not appear to be due to farmers / workers who had a higher prior injury claims rate self-selecting for the Awareness programme.
- The distribution of injury diagnoses amongst attenders and non-attenders was similar, suggesting similar claims making behaviour. (Nevertheless, we hypothesise that changes to claims-making behaviour is likely to be a major contributor to the increased rates amongst FS attenders.)

These findings are preliminary, since further investigation of other potential sources of bias are necessary before inference can be made regarding the effect of the FS Awareness programme on injury rates..

4.2. Recommendations / Implications for the ACC

Evaluation of new programmes

All new injury prevention programmes which involve significant investment should be evaluated, unless implementing a known and effective intervention. As an "unproven" injury prevention programme is developed, evaluation should be built in as an integral part of the process. Consequently, it is recommended that:

Recommendation 1: ACC, in developing any new injury prevention programme, build evaluation into the programme design.

Ideally, the design used for an outcome evaluation of such a programme would be a randomised controlled trial – e.g. random allocation of people to the programme, with wait-list controls – unless there are methodological reasons why this is not a feasible method.

Improve documentation of ACC databases

No up-to-date or adequate documentation of the ACC claims and levy data were provided by ACC to aid our understanding of these data, despite several requests. We were informed that such documentation does not exist for the data that were supplied to us (i.e. data for the period July 2001 to June 2005). This is a major problem for users of these data who are external to the ACC (and it is also likely to be a problem for new ACC employees who wish to use these data). As part of this project, we had to spend considerable time and effort developing an understanding of the ACC data, and creating our own user guide.

It is our view that these ACC data are a national resource. Injury prevention and control, and the research that supports it, are not only the business of the ACC, but also the business of many other organisations and agencies in New Zealand, including groups like ourselves in academic institutions. Lack of documentation limits understanding of the ACC data, and so reduces opportunities to use these data in creative and effective ways for injury prevention research. Lack of documentation also has a financial cost with all organisations and agencies using the data having to invest substantial time to understand the data and with ACC staff having to respond to numerous data queries.

Recommendation 2: We recommend that the ACC should improve the documentation of their databases, including the production of data dictionaries and user guides for their current and past claims and levy data.

Investigation of bias in the outcome evaluation of the Awareness programme

The results of this limited pilot have found an increased rate of earnings-related claims in the FS Awareness group compared with matched unexposed controls during 12 or 24 month follow-up post attendance. This result is unlikely to be due to chance – i.e. it is unlikely to be due to lack of statistical power. It could, however, be due to bias. The following is recommended:

Recommendation 3: ACC should commission work to investigate the finding that Awareness is associated with higher rates of claims following injury to determine whether this is a real result or an artifact due to uncorrected bias.

The sorts of methods used could include:

- A replication of the modeling with “all claims” as the outcome.
- For this and the other outcomes, investigate what changes to the rates have occurred from before to after FS, contrasted with similar for the controls.
- Linkage of FS enrolments to hospital data and compare rates of hospitalisation (>0 days stay, and for serious non-fatal injury discharges) for the FS group contrasted with similar for the non-FS group, both before and after attendance.
- A survey of non-attenders and attenders to answer some of the following questions:
    - Why farmers they did or did not take course,
    - Prior injury,
    - Exposure history,
    - Attitudes to making an ACC claim and their threshold for making such a claim,
    - Risk taking behavior,
    - Other relevant characteristics.
    - Attendance at other agricultural courses.

Process, impact and outcome evaluation of the Plans programme

Work to date has focused on:

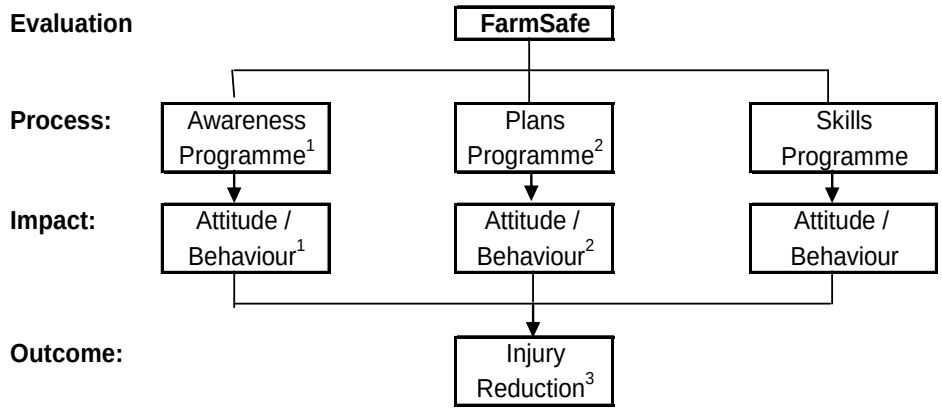
(a) the process and impact evaluation of the 'Awareness' programme; this work has been carried out by Kate Morgaine, IPRU; and

(b) the outcome evaluation of the Awareness and Plans programmes

(see Figure 12).

There is a gap in the evaluation of FS – namely in the process, impact and outcome evaluation of the Plans programme. Systematic evaluation would be valuable for future community-based preventative initiatives and would enhance the ongoing and future implementation of the FS Programme. Given the uncertainty regarding the effectiveness of FS, an RCT is the method of choice, if feasible.

Figure 12*:* Past ongoing and proposed evaluations of the FarmSafe™ Programmes.



1. Process and impact evaluation of the 'Awareness' Programme – Kate Morgaine, IPRU, University of Otago.
2. Process and impact evaluation of the 'Plans' Programme – unfunded proposal.
3. Pilot outcome evaluation of the effectiveness of FarmSafe programmes – this current Pilot work (Colin Cryer, IPRU).

The goals of the FS programmes are to change the safety culture of farmers and to reduce injury. In regard to Plans, the effect on injury rates is uncertain. We recommend investigating whether attendance at FS Plans results in a reduction in injury for farmers and their farm workers. If FS Plans is found to be effective in reducing the incidence of injury on farms, the

question will be: which elements of the FS Plans programmes were most effective, and which ineffective? If no effect of Plans on injury reduction are found, the question will be: is this result due to the design, content and acceptability of the FS programmes, to the methods used to implement the Plans programme and the uptake of the programmes, or to a lack of impact of the programme on the safety culture; to attitudes and safety behaviours of farmers who attended the programmes? Work needs to be put in place to investigate these questions - to complement the work on FS Awareness.

There are likely to be a number of methodological problems to solve before a full evaluation is launched, and consequently, we recommend that a first stage should be a pilot / developmental phase.

Recommendation 4: We recommend that ACC commission developmental work aimed at a process, impact and outcome evaluation of the Plans programme to determine the success of the programme in changing the safety culture of farmers, the farm environment, and in reducing rates of injury..

Final remarks

FS is an expensive flagship intervention. Given the uncertainty regarding its effectiveness, this is all the more reason to invest more time to find out why we obtained the results we have.

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6. Appendix 1: Data requests

6.1. ACC data

Name: Colin Cryer
Position: Research Associate Professor
Address: Injury Prevention Research Unit (IPRU), Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, P O Box 913, Dunedin.
Date: 20 December 2005

This is a request to the ACC for claims data and levy data.

Period of interest: Date of injury in the period 1 July 2001 to 30 June 2005

Population:

- Sheep, beef and dairy farmers with the following industry codes: 01220, 01230, 01240, 01250, 01300, 01590
- For claims, work-related cases only (i.e. those paid from the Employers, Self-Employed, or Residual Account (for the latter, with the 'at work' field set to 'Yes')

Datasets required:

- ACC levy data for all sheep, beef and dairy farmers with the relevant industry codes.
- All ACC work-related claims data for sheep, beef and dairy farmers and farm workers.

PTO

Data required:

Levy data

- Employer ID
- Employer ACC Number
- Employer ACC suffix
- Levy year
- Liable Earnings
- Industry code

Claims data

- Employer ID
- Employer ACC number
- Employer ACC suffix
- Case ID
- Event ID
- Person/Claimant ID
- NHI number
- Name
- Address
- Date of birth
- Sex
- Ethnicity
- Fund code
- Occupation code and description
- Industry code
- Accident Date
- Lodgement Date
- Claim type – Med fee only, or entitlement, or others
- Circumstances of injury codes and description (Activity prior to the injury, Cause , Contact, External agency, Scene, Location, whether the claims is Serious Injury)
- Number of days claimant received weekly compensation (WCdays)
- Nature of injury codes and descriptions (Diagnosis, read, ICD9, ICD10)
- Free text descriptions of circumstances or nature of injury – where they exist.
- Cost of claim in the period 1-Jul-01 to 30-Jun-02
- Cost of claim in the period 1-Jul-02 to 30-Jun-03
- Cost of claim in the period 1-Jul-03 to 30-Jun-04
- Cost of claim in the period 1-Jul-04 to 30-Jun-05

6.2. FarmSafe™ enrolment data

28 September 2005

Jonathan Walmisley
Chief Executive Officer
Telford Rural Polytechnic
Freepost 73901
P O Box 6, Balclutha
South Otago

Dear Jonathan

Re: Pilot injury outcome evaluation of the effectiveness of the FarmSafe™ Programmes for sheep, beef and dairy farmers.

Following on from our telephone conversation last week, I applied to, and have agreed funding with, the ACC for the Injury Prevention Research Unit (IPRU, University of Otago) to carry out a pilot outcome evaluation of the FarmSafe Programmes. This work complements the work that Kate Morgaine (IPRU) is currently carrying out. For your information, the proposal for this work is included.

When I called, you put me in contact with Julie Dalziel, and I met with Julie on Monday 26 September to discuss the project with her.

The project relies on, for sheep, beef and dairy farmers and farm workers, linking ACC levy data and claims data to FarmSafe enrolment data, at the farm level. The original plan was to use the enrolment data as supplied by Julie and her predecessor to ACC. My discussion with Julie identified that this would be less desirable than linking to the full enrolment data sets that Telford Rural Polytechnic hold [see table following].

I am writing to you to ask your permission for Julie to supply to IPRU with these enrolment data for the Awareness, Plans and Skills Programmes, please. In order to carry out the linkage, we do need identifying data (i.e. name, address, date of birth). Following linkage, however, these personal identifiers will be stripped from the data set, and destroyed, so that the data that we work on is anonymised. Any data that you supply will be held on secure computers and will be confidential to the staff of IPRU who are engaged on this project.

I would be very grateful if you were able to help us in this way. I am happy to provide any further information that you require when considering this request. Also, we would be more than happy to feedback results from our statistical analyses as they emerge.

Yours sincerely

Variable	Label
acc	ACC number
Course_attend_date	Date of the start of the course attended
Course_attended	Course attended (Awareness, Plans, Skills-type)
Dob	Date of birth
ethnicity	Ethnicity code
Given_names	Given names
Nzqa_id	NZQA ID
occupation	Occupation
Sex	Sex
Surname	Surname
Title	Title

7. Appendix 2: Record Linkage

Biostatistical and data management team, IPRU.

7.1. Preparation of Datasets for Linkage

7.1.1. Data Sources

IPRU received 3 SAS datasets from ACC: claims data, levy data and multiple injury data. The claims dataset contains all work-related claims for sheep, beef and diary farmers (specified by industry codes) where the date of injury was between 1 July 2001 and 30 July 2005. Each record in the ACC claims data set represents one claim for a claimant, but a claimant may have more than one claim (more than a record).

One Excel data set was obtained from Telford, which contains enrolment data for participants enrolled in a FarmSafe course. This data set was imported into SAS. Participants of a FarmSafe course complete enrolment at the course venue, therefore each record also represents course attendance. There are several FarmSafe courses and one participant may enroll in one or more courses and may also enroll in the same course more than once (on different dates). Communication between Kate Morgaine and FarmSafe confirmed multiple enrolment in the same course which was usually because the participant wanted a refresher. However there may be other reasons such as finishing off credits for a course. Multiple enrolments in the same course is discouraged by FarmSafe.

7.1.2. Creating Data Sets for Linkage

The purpose of the record linkage between FarmSafe and ACC is to find (match) people that attended at least one FarmSafe course and had at least one successful ACC claim. Therefore the record linkage was about linking people not events and as a result only those attributes that are related to identifying a person were used in the linkage. Attributes specific to a FarmSafe course or an ACC claim were not used in the linkage. For both the ACC and FarmSafe data sets, a set of person attributes were extracted such that the resulting data sets contained one row per person. There were 65,879 ACC claims associated with 43,124 claimants and 19,753 FarmSafe course attendances by 16,059 people, see.

Attributes associated with the persons' name were stripped of all non-alphabetic characters, including white space, and converted to uppercase. For example, the surname "O' Conner" was transformed to "OCONNER". All other attributes were checked for unusual values and were set to missing if the values were implausible.

The Soundex of given names and surname were computed and the first characters of the given names were extracted as separate variables to aid with blocking strategies in the record linkage process. Table 17 lists all attributes used in the record linkage.

Table 17*:* List of attributes used in the record linkage.

FarmSafe data set	ACC data set
First given name	First given name
Second given name	Second given name
First given initial	First given initial
Second given initial	Second given initial
*Soundex of surname	*Soundex of surname
*Soundex of first given name	*Soundex of first given name
Sex	Sex
Date of birth	Date of birth
Year of birth	Year of birth
Month of birth	Month of birth
Day of birth	Day of birth

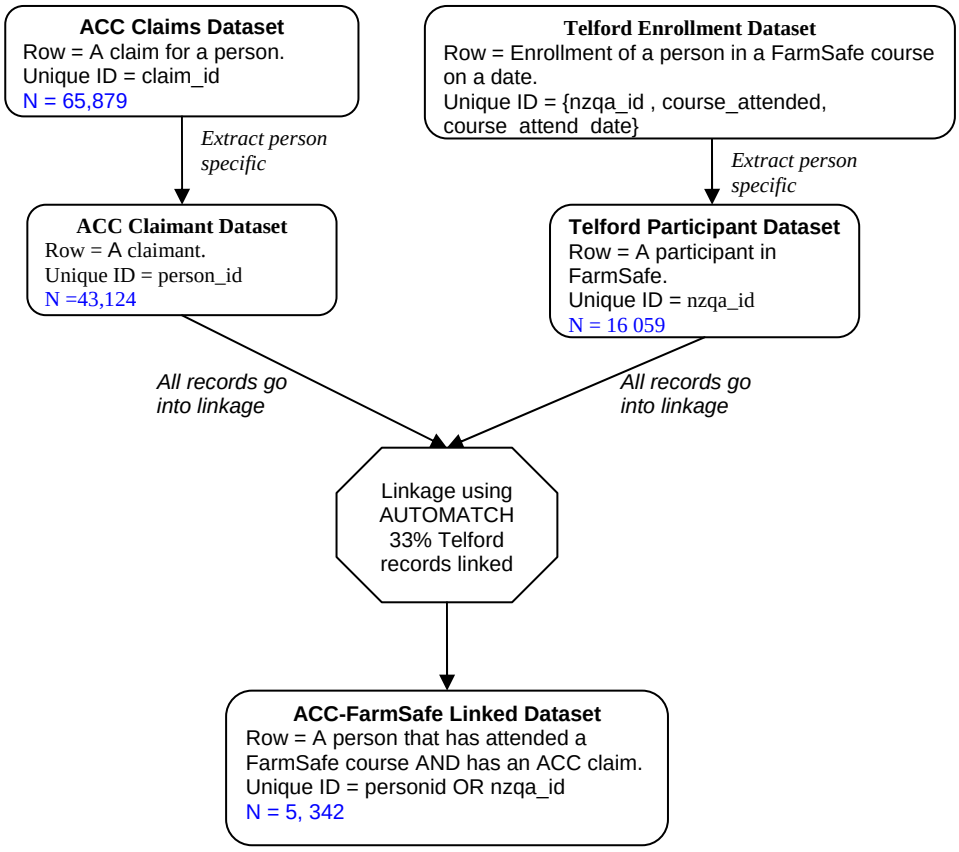
*Soundex is a phonetic algorithm that is used to match words that sound the same, despite having different spelling.

7.2. Record Linkage Methodology

The software used for record linkage was AUTOMATCH. The record linkage process involves selecting a matching and blocking strategy at each pass. AUTOMATCH allows up to 8 passes. Blocking variables reduce the number of record pairs that are examined at each pass. For each pass matching variables are compared within each of the datasets and an overall score is computed that describes the similarity of record-pairs. Scores that are above a user defined maximum threshold are classified as matches, scores below the user defined minimum threshold are classified as non-matches and scores in between the two thresholds are classified as undecided cases. Undecided cases are usually subject to clerical/manual review – however, given the large number of records that may be classified as undecided, the minimum and maximum thresholds were always set as equal at each pass to eliminate manual review. After each pass, the record-pairs were sorted in deceasing score order and a manual scan was conducted to decide on an appropriate cut-off threshold. Table 18 lists the blocking and matching variables selected at each pass.

Table 18*:* Blocking and matching variables used at each pass.		
Pass Number	Blocking variables	Marching variables
1	Surname First given name Second given name Sex Date of birth	First given name
2	Surname First given name Sex Date of birth	Second given name
3	Soundex of first given name Soundex of surname Date of birth	Surname First given name Second given name Sex
4	Soundex of surname First given initial Date of birth	Surname First given name Second given name
5	First given name Second given initial Surname Sex	Second given name Year of birth Month of birth Day of birth
6	Soundex of first given name Second given initial	Surname First given name Year of birth Month of birth Day of birth
7	First given initial Surname	First given name Second given name Year of birth Month of birth Day of birth
8	Soundex of surname First given initial	First given name Second given name Surname Year of birth Month of birth Day of birth

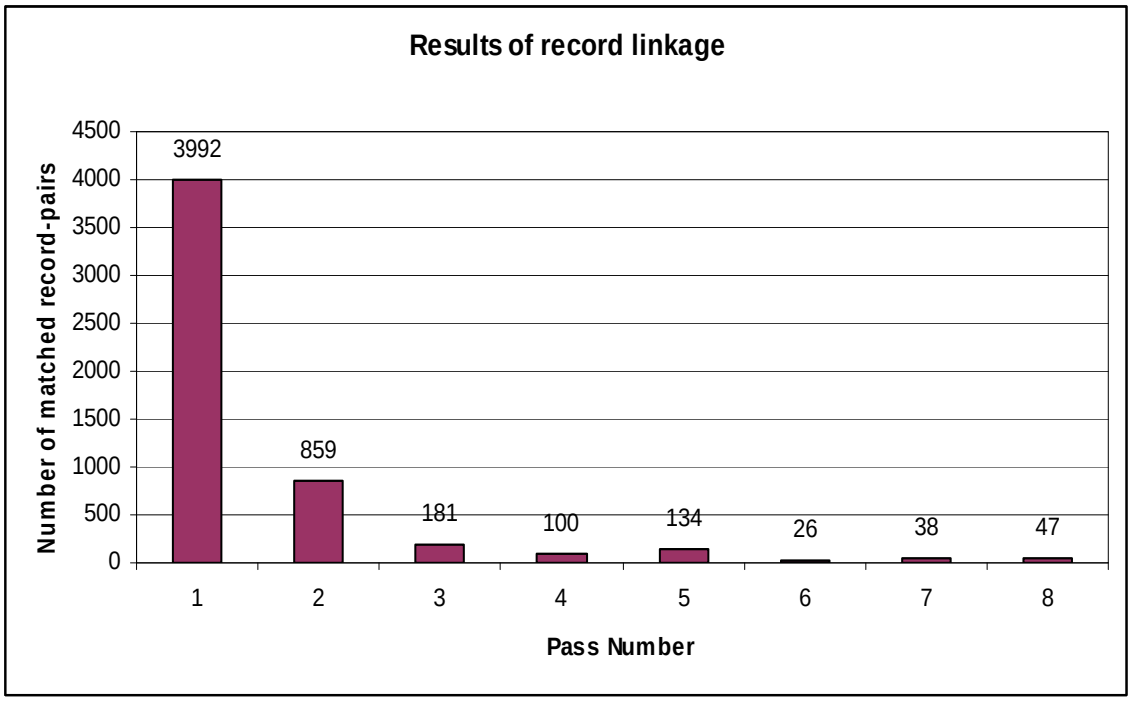
Figure 13: Flowchart describing the record linkage process.



7.3. *Linkage Result*

5,342 of the 16,059 FarmSafe participants were found to exist in the ACC claims data set, which resulted in a linkage rate of 33%. Figure14 displays the number of matched record-pairs at each pass of the record linkage process. 74% of the matched record-pairs were matched on the first pass indicating that most of the matched record-pairs were exact matches (no spelling mistakes or discrepancy between any of the matching variables).

Figure 14*:* Bar chart of record linkage results



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

APPENDIX A: AUTOMATCH MATCHING CODE

```
; FARMSAFE TELFORD / ACC DATA LINKAGE 2006
;   Matching Telford Farmsafe course enrolment dataset with
;   ACC injury claims data
;


PROGRAM MATCH
DICTA C:\farmlink\telford
DICTB C:\farmlink\acc

; ============================================================================
;  PASS 1
;   Get the obvious/ easy matches i.e. where all the main fields match
;             Telford left column, acc right column

BLOCK1  CHAR     SURNAME          SURNAME
BLOCK1  CHAR     SEX       SEX
BLOCK1  CHAR     BDATE     BDATE
BLOCK1  CHAR     NAME1     NAME1
BLOCK1  CHAR     NAME2     NAME2

MATCH1 CHAR      NAME1     NAME1 0.99 0.01

CUTOFF1 -50 -50 200


; ============================================================================
; PASS 2
;   Block on Surname and first names (and sex and b/date), but match on name2 to
;             find matches that are good but with variation in name 2

BLOCK2 CHAR     SURNAMESURNAME
BLOCK2 CHAR      NAME1    NAME1
BLOCK2 CHAR     BDATE     BDATE
BLOCK2 CHAR     SEX       SEX


MATCH2 CHAR      NAME2     NAME2    0.99 0.01

CUTOFF2 -50 -50 200

; ============================================================================
; PASS 3
;   Now accept some spelling mistakes in the first name and surnames. Block on the SOUNDEX value
;             of the names. Allow for errors in coding gender.

BLOCK3 CHAR      F1SDX     F1SDX
BLOCK3 CHAR      SNSDX     SNSDX
BLOCK3 CHAR      BDATE     BDATE


MATCH3 CHAR      NAME1     NAME1    0.9 0.01
MATCH3 CHAR      NAME2     NAME2    0.9 0.01
MATCH3 CHAR      SURNAME SURNAME 0.9 0.01
MATCH3 CHAR      SEX       SEX       0.5 0.1

CUTOFF3 -50 -50 200

; ============================================================================
; PASS 4
;   Block on initials rather than full first and middle names to allow
;             for spelling errors not picked up by soundex

BLOCK4 CHAR      F1INIT    F1INIT
BLOCK4 CHAR      SNSDX     SNSDX
BLOCK4 CHAR     BDATE     BDATE


MATCH4 UNCERT  NAME1     NAME1    0.999 0.001 700
MATCH4 UNCERT  SURNAME SURNAME 0.9 0.01 700
MATCH4 UNCERT  NAME2     NAME2    0.5 0.2 700
```

```
CUTOFF4 2.53 2.53 200


; ========================================================================
;  PASS 5
;   Allow for some latitude in the birthdates

BLOCK5 CHAR      NAME1    NAME1
BLOCK5 CHAR      F2INIT     F2INIT
BLOCK5 CHAR      SURNAME            SURNAME
BLOCK5 CHAR      SEX        SEX

MATCH5 CHAR      NAME2    NAME2    0.5 0.01
MATCH5 NUMERIC   BYEAR  BYEAR      0.999 0.001
MATCH5 NUMERIC   BMONTH BMONTH     0.99 0.05
MATCH5 NUMERIC   BDAY   BDAY       0.99  0.05


CUTOFF5 -6.04 -6.04 200



; ========================================================================
;  PASS 6
;   Allow for some mistakes in the surname that soundex doesn't pick up as
;             well as variance in date

BLOCK6 CHAR      F1SDX    F1SDX
BLOCK6 CHAR      F2INIT     F2INIT



MATCH6 UNCERT  NAME1    NAME1    0.7 0.001 800
MATCH6 UNCERT  SURNAME SURNAME 0.9999 0.001 700

MATCH6 NUMERIC   BYEAR  BYEAR      0.999 0.001
MATCH6 NUMERIC   BMONTH BMONTH     0.99 0.05
MATCH6 NUMERIC   BDAY   BDAY       0.99  0.05


CUTOFF6 15.43 15.43 200

; ========================================================================
;  PASS 7
;   Try and capture those last few first name differences spotted in the
;             previous pass

BLOCK7 CHAR      F1INIT     F1INIT
BLOCK7 CHAR      SURNAME            SURNAME

MATCH7 UNCERT  NAME1    NAME1    0.999 0.001 700
MATCH7 CHAR      NAME2    NAME2    0.8 0.01

MATCH7 NUMERIC   BYEAR  BYEAR      0.99 0.05
MATCH7 NUMERIC   BMONTH BMONTH     0.99 0.05
MATCH7 NUMERIC   BDAY   BDAY       0.99  0.05

CUTOFF7              8.12 8.12 200

; ========================================================================
;  PASS 8
;   Final pass: initially loosen up all criteria to see what is still not
;             being picked up and try and extract them accordingly. . .
;
;             The only pattern i could see was in reamaingin matches where day and month had been
;             potentially transposed. attempting match nest based on those

;This is the original final pass to try and spot a pattern in remaining cases
;BLOCK8 CHAR      SNSDX    SNSDX
;BLOCK8 CHAR      F1INIT     F1INIT

;MATCH8 CHAR      NAME1    NAME1    0.999 0.001
;MATCH8 CHAR      NAME2    NAME2    0.8 0.01
;MATCH8 CHAR      SURNAME SURNAME 0.9999 0.001
```

```
;MATCH8 NUMERIC   BYEAR  BYEAR      0.99 0.05
;MATCH8 NUMERIC   BMONTH BMONTH     0.99 0.05
;MATCH8 NUMERIC   BDAY   BDAY       0.99  0.05

;CUTOFF8 -50 -50 200

BLOCK8 CHAR      SNSDX    SNSDX
BLOCK8 CHAR      F1INIT   F1INIT

MATCH8 CHAR      NAME1    NAME1    0.9 0.001
MATCH8 CHAR      NAME2    NAME2    0.8 0.01
MATCH8 CHAR      SURNAME SURNAME 0.9999 0.001
MATCH8 NUMERIC   BYEAR  BYEAR      0.99 0.05
MATCH8 NUMERIC   BMONTH BDAY     0.99 0.05
MATCH8 NUMERIC   BDAY   BMONTH      0.99  0.05

CUTOFF8 23.04 23.04 200
```

8. Appendix 3: Method of analysis as described in the original proposal.

Aim:

To investigate whether exposure to the **Awareness and Plans** FS programmes are associated with a reduction in injury outcomes.

Injury outcomes

The injury outcomes that will be considered in this work are:

(a) ACC claims rates (treatment only and entitlement claims combined);

(b) Serious injury rates; and

(c) ACC claims costs.

Serious injury will be defined as any injury resulting in an employment-related entitlement claim for absence from work for over 7 days, paid by the ACC. As well, other severity thresholds will be considered for the definition of 'serious injury' including over 14 and over 28 days absence from work. Consistency of the effect estimates for each of the serious injury case definitions will be investigated and described.

Experimental unit

Data will be captured at the farm level in two ways:

Data solely relating to the farm owner, manager or share-holder employee

Claims and cost data on all persons working on the farm.

Outcome data

The proposed source of outcome data will be the ACC claims database. Data for the period 1 July 2001 to 30 June 2005 will be obtained for the pilot work. For future evaluation work, further years data would be incorporated as they become available. It is anticipated that follow-up will be required at least through to June 2008 and ideally would continue through to 2009. (We might expect that the Awareness programme will be completed by 2008, and the Plans programme by 2009.) This pilot work, and this proposal, is based only on the period 1 July 2001 to 30 June 2005.

Data will be restricted to claims managed in the employers account, and the self-employed account. This includes treatment only as well as entitlement claims.

Members of the target population will be identified from ACC Levy data.

Key fields include the following: ACC number, name, age, sex, ethnicity, occupation, levy (surrogate for cumulative hours worked), place of work (ie. farm), injury date, claim type (treatment / entitlement), nature of injury, circumstances of injury (ie. activity, cause, contact, agency, and place of occurrence), and free text description of circumstance.

Exposure data

The proposed source of exposure data is the enrolment database managed by Telford Rural Polytechnic. These data are held by ACC. Information on attendances at each of the three FarmSafe programmes (Awareness, Plans, Skills) will be relevant to this work.

There is a question regarding whether exposure to the programmes on 'Awareness' or 'Plans' impacts only the individual who attends the course, or all workers on the farm from which they came. The session on Plans is aimed at the principal person on each farm – the farm owner, farm manager, tenant farmer, etc. – rather than farm workers. Nevertheless, a significant outcome from the 'Plans' phase, is a safety plan for the farm, which should affect the subsequent safety of the person who attends the course as well as other workers on the farm. The effect on the employer's injury incidence and cost, as well as on those of all workers on the farm, will be investigated.

Fields from the Telford Rural Polytechnic database that we propose to use in our work include: ACC number, name, age, sex, ethnicity, course, date attended, credits awarded, and national student number.

Denominator data

The proposed source of denominator data is the ACC levy data.

Linkage of outcome data to exposure data

ACC has databases of levy payers, claims, and also the FS enrolment data. Individuals on these databases are identified by their ACC number. The proposed work is based on the premise that ACC will supply databases of ACC levy payers, ACC claims and FS enrolment data, for all sheep, beef and dairy farmer and farm worker levy payers for the period 1 July 2001 to 30 June 2005. IPRU will link these data and produce diagnostic information regarding the linkage performance, including:

- The number of unlinked claims and enrolment records (and details of those orphaned records)
- For a sample of cases, detailed checks to ensure that names match up and that the right family member has been linked

- Computer checks of matches and mismatches in the demographic data fields (eg. age, sex, etc.)

Statistical analysis

An initial exploratory data analysis will be carried out – using descriptive statistics, graphical methods, and simple inferential statistics. This will include a comparison of claims experience – prior to attendance at FS - of those who are early adopters against the rest, to check whether there is any bias associated with early self-selection for the FS programme. If it exists, this will have implications for the statistical modeling used to describe the effects of the programmes.

Multivariable (Poisson or negative binomial) regression modeling will be used to investigate the effects of exposure to each of the FS programmes on the injury and cost outcomes, adjusting for baseline characteristics of farms and individuals. Different models for the effect of exposure to FS will be considered. Initially the simplest model investigated will be a step function for the effect of exposure. That is, it will initially be assumed that once a person has attended a FarmSafe module, its effect will be immediate and will be sustained at the same level for the whole period of follow-up. More complex 'decay of effect' models will be considered subsequently. If necessary, possible drifts in claims rates and costs will be ameliorated by using the claims and cost experience of other rural occupations as a nuisance variable in the analysis.

Investigation of the effect of attendance on claims lodging behaviour

The potential affect on claims lodging behaviour (as opposed to actual injury incidence) resulting from attendance at one or more FarmSafe Programmes will also be investigated. If claims behaviour, given an injury, does not change as a result of attendance at the FarmSafe Programmes, then you would expect the proportion of farmers making a claim for a given injury diagnosis or severity of injury, to be similar for FS attenders compared with the non-attenders. This will be investigated in two ways.

Firstly, the distribution of ACC diagnoses will be compared for attenders of FS against non-attenders. FS is expected to influence the occurrence of injury, so the rate of injury is expected to decline amongst attenders. However, even if this is the case, if attendance does not affect claims making behaviour, the severity threshold for making a claim will be independent of attendance. This being the case, given an injury has occurred, we would expect the likelihood of a claim being made, given an injury, to be similar for attenders and non-attenders. Turning this around, if the distribution of injury resulting in a claim is found to be similar for attenders and non-attenders, this would suggest claims making behaviour is independent of attendance.

Secondly, it will be investigated in a subset of farmers where injury requires hospital inpatient treatment. To enable this, the data supplied by ACC will be linked to NZHIS hospitalisation data by IPRU. For the linked cases, the diagnosis of injury will be tabulated and relatively homogenous and frequently occurring diagnostic groups identified. For these groups, claims rates for attenders and non-attenders will be compared. Furthermore, IPRU will derive the ICD-based Injury Severity Score (ICISS) for each case from the hospitalisations diagnostic data. For groups of farmers with injuries of like severity, claims rates for attenders and non-attenders will be compared. In both instances, if claims rates are similar for attenders and non-attenders, this would suggest that claims rates given a type or severity of injury are unaffected by attendance at a FarmSafe Programme.

Investigation of contaminating factors

There is a concern that the evaluation of the FS programmes could be contaminated by farmers and farm workers attending other safety programmes. The potential for this problem will be investigated through interviews with key informants to identify safety programmes provided to sheep, beef and dairy farmers in New Zealand, and to seek estimates of potential coverage. This will inform the interpretation of the results of the analysis, as well as recommendations for future evaluations.

9. Appendix 4: The method of classification of ACC claims into gradual process and injury claims.

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

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

The SAS code supplied by ACC is reproduced below.

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

```
('070'   le ICD9Code le '070.99') or /*Viral Hepatitis*/
('100'   le ICD9Code le '100.99') or /*Leptospirosis*/
('140'   le ICD9Code le '208.99') or /*Malignant cancer*/
('162'   le ICD9Code le '163.99') or /*Lung Cancer/Meso*/
('173'   le ICD9Code le '173.99') or /*Epithelial skin ca*/
('230'   le ICD9Code le '234.99') or /*Carcinoma in situ*/
('331'   le ICD9Code le '332.99') or /*Cerebral
degeneration/Alzheimers/Parkinsons*/
('337.2' le ICD9Code le '337.29') or /*Regional pain syndrome,
autonomic nerv sys*/
('348.3' le ICD9Code le '348.39') or /*Toxic encephalopathy*/
('350'   le ICD9Code le '353.99') or /*Cranial nerve, nerve root
and plexus disorders*/
('354'   le ICD9Code le '355.99') or /*Upper/lower limb
mononeuropathies, incl. Carpal TS*/
('356'   le ICD9Code le '357.99') or /*Peripheral/Toxic
neuropathies*/
('388.1' le ICD9Code le '388.19') or ('389'    le ICD9Code le
'389.99') or /*Hearing Loss*/
('410'   le ICD9Code le '414.99') or /*Ischaemic Heart Disease*/
('443.0' le ICD9Code le '443.09') or /*Raynaud's Phenomenon*/
('481'   le ICD9Code le '482.99') or /*Pneumococcal/other
bacterial pneumonia, incl. Legionnaires*/
('490'   le ICD9Code le '496.99') or /*CORD etc.*/
('495'   le ICD9Code le '495.99') or /*Allergic Alveolitis from
external agents*/
('500'   le ICD9Code le '500.99') or /*Pneumoconiosis from coal*/
('501'   le ICD9Code le '502.99') or /*Pn Asbestos/Silicosis*/
('503'   le ICD9Code le '503.99') or /*Pn Siderosis/other
inorganic*/
('504'   le ICD9Code le '505.99') or /*Pn from organic/other*/
('506'   le ICD9Code le '508.99') or /*Respiratory conditions
from other external agents*/
('570'   le ICD9Code le '573.99') or /*Hepatic disease*/
('571.4' le ICD9Code le '571.49') or ('573.1' le ICD9Code le
'573.39') or /*Chronic Hepatitis*/
('580'   le ICD9Code le '593.99') or /*Renal disease*/
('585'   le ICD9Code le '585.99') or /*Chronic Renal failure*/
('692'   le ICD9Code le '692.99') or /*Contact Dermatitis*/
(ICD9Code eq '709.01')          or /*Vitiligo/Leucoderma*/
```

('710.1' le ICD9Code le '710.19') or /*Scleroderma*/
('719.4' le ICD9Code le '719.49') or /*Arthralgia*/
('720' le ICD9Code le '721.99') or /*Spondylopathy/Spondylitis*/
('722.4' le ICD9Code le '722.79') or /*Intervertebral disc degen/myelopathy*/
('723.1' le ICD9Code le '723.69') or /*Cervical Neuropathy/Neuritis, incl. neck pain*/
('724.1' le ICD9Code le '724.59') or /*Thor, Lumb, Sacc Neuropathy/Neuritis, incl. back pain*/
('725' le ICD9Code le '727.49') or /*Disorders of muscle, synovium, tendon and bursa*/
('727.8' le ICD9Code le '727.89') or /*Transient synovitis*/
('728.6' le ICD9Code le '728.79') or /*Palmar/Plantar fasciitis*/
('729.0' le ICD9Code le '729.19') or /*Rheumatism/Fibromyalgia NOS, pain synd soft tiss*/
('729.2' le ICD9Code le '729.29') or /*Neuropathy/Radiculopathy NOS*/
('980' le ICD9Code le '980.99') or /*Alcohol products*/
('981' le ICD9Code le '981.99') or /*Petroleum products*/
('982' le ICD9Code le '982.99') or /*Non-Petroleum solvent*/
('983' le ICD9Code le '983.99') or /*Corrosives, incl. Phosphorus*/
('984' le ICD9Code le '984.99') or ('E86.15' le ICD9Code le 'E86.15') or /*Lead*/
('985' le ICD9Code le '985.99') or /*Other toxic metals*/
('985.0' le ICD9Code le '985.09') or /*Mercury*/
('985.1' le ICD9Code le '985.19') or /*Arsenic*/
('985.2' le ICD9Code le '985.29') or /*Manganese*/
('985.3' le ICD9Code le '985.39') or /*Beryllium*/
('985.4' le ICD9Code le '985.49') or /*Antimony*/
('985.5' le ICD9Code le '985.59') or /*Cadmium*/
('985.6' le ICD9Code le '985.69') or /*Chromium*/
('985.8' le ICD9Code le '985.99') or /*Other metals*/
('986' le ICD9Code le '986.99') or /*Carbon Monoxide*/
('987' le ICD9Code le '987.99') or /*Other gases/vapours*/
('989' le ICD9Code le '989.49') or /*Other chemicals (not food or animals)*/
('989.6' le ICD9Code le '989.69') or /*Other chemicals (not food or animals)*/

```
      ('989.8' le ICD9Code le '989.99') or /*Other chemicals (not food
       or animals)*/
      ('990'   le ICD9Code le '990.99') or ('E92.63' le ICD9Code le
'E92.69')) /*Radiation*/
  THEN DO ;
    GradProc_Diag = 'Y' ;
    GradProc_Diag_ICD = 'Y' ;
  END ;
  ELSE IF
      ('A788.' le ReadCode le 'A789z') or (ReadCode eq 'ZV01A') or
/*HIV/AIDS*/
      ('A3A4.' le ReadCode le 'A3A4z') or (ReadCode eq 'H22y2') or
/*Legionella*/
      ('A70..' le ReadCode le 'A70zz') or /*Viral Hepatitis*/
      ('B226.' le ReadCode le 'B226z') or (ReadCode eq 'B81y0') or
/*Lung Cancer/Meso*/
      ('14O3.' le ReadCode le '14O3z') or /*Pn Asbestos/Silicosis*/
      (ReadCode eq 'H432.')            or /*Pn Siderosis/other
inorganic*/
      ('U1AA.' le ReadCode le 'U1AAz') or (ReadCode eq 'SM9C.') or
/*Non-Petroleum solvent*/
      (ReadCode eq 'SM58.')            or /*Corrosives, incl.
Phosphorus*/
      (ReadCode eq 'F29y3')            or /*Toxic encephalopathy*/
      ('M295.' le ReadCode le 'M295z')    /*Vitiligo/Leucoderma*/
  THEN DO ;
    GradProc_Diag = 'Y' ;
    GradProc_Diag_ICD = 'Y' ;
  END ;
  ELSE GradProc_Diag_ICD = 'N' ;
  IF GradProc_Diag ne 'Y' THEN GradProc_Diag = 'N' ;
  IF ICD9Code ne " " or ReadCode ne " " THEN Has_Code = 'Y' ;
                                ELSE Has_Code = 'N' ;
  IF (NOT P) and First.Case_ID THEN Primary_ = 'Y' ;
  ELSE IF P and Primary_ eq 'Y' and (NOT First.Case_ID) THEN DO ;
    OUTPUT ChkP ;
    Primary_ = 'N' ;
  END ;
  IF Diagnosis in ('11','60') and GradProc_Diag_ICD eq 'N' THEN
  GradProc_Diag = 'N' ; *ignore nulls/other icd ;
```

```
ELSE IF Diagnosis in ('20','21','22','23','24','31','61','93') and
GradProc_Diag_ICD eq 'N' and Has_Code eq 'Y' THEN
GradProc_Diag = 'N' ; *keep nulls, ignore other icd ;
*keep all for '25','26','90','91','92','94' ;
OUTPUT Inj1 ;
RENAME Primary_ = Primary ;
RUN;
```

10. Appendix 5: Output from the statistical modeling

Categories

Models

4 models

12m_wc0 : is 12 months, Outcome is EC claim with WC>0.
12m_wc21 : is 12 months, Outcome is EC claim with WC>21.
24m_wc0 : is 24 months, Outcome is EC claim with WC>0.
24m_wc21 : is 24 months, Outcome is EC claim with WC>21.

Exposures

Exposed

0=unexposed
1=exposed to either AO or AP.

Course_type

None = control
AO = awareness only
AP = awareness and plans

_period

12 or 24

Outcome

0 or 1

Outcome_type

wc0 =EC claim with WC>=0
wc21=EC claim with WC>=21

Quarter

The quarter as at the beginning of follow-up period. There were no observations from the first 3 quarters, therefore the analysis includes 13 quarters from 4 to 16. These were treated as a categorical variable. Some early and late quarters had no outcome under some models (or had only a few outcomes). Therefore quarter 7 is used as the reference group. Some quarters were excluded from some models because no outcome occurred.

Male

0 =female (reference group)
1=male

Premium class (5 categorical groups)

PCU1220 (reference group)
PCU1230
PCU1240
PCU1250
PCU1300

Fund_code

0 = find code 10 (reference group)
1=fund code 6

Age Group

Age as at the beginning of period (in some previous analysis age may have taken as at the beginning of the project). 10 age Groups, starting from age zero (i.e., 0-10, 10-20, …90-100). Age20-30 is the reference group because that age Group had a reasonable number of outcomes under all models. Some age groups were excluded from some models because no outcomes occurred.

Average liable earnings

Four groups correspond to 4 quarters. (First quarter is the reference group).

Occupation (5 groups)

Livestock workers (reference group)
Mixed livestock workers
Crop livestock workers
Other agricultural workers
Other workers.

Ethnicity (4 groups)

European (reference group)
Maori
Unknown
Other

Skills courses

Attendance in each of the five skills courses as separate covariates, each coded as 0 and 1. Some courses were excluded from some models because no outcomes were observed.

Prior claims history.

Numeric variable stating number of claims during 12 month period immediately prior to the followup period. Here the “claims” are the wc0 type claims for two models with wc0 type outcomes, and wc21 type claims for other two models with wc21 type outcomes.

ACC suffix (3 categories)

D
E (reference group)
S
(acc suffix_s was automatically excluded from Cox regression due to co linearity).

Results

(1) Model 12m_wc0 (12 months , outcome is EC claims with WC>0)

Cox regression:

Quarter7 is the reference group. Quarter4 is excluded due to no outcomes.
Age20_30 is the reference group. Age0-10, 80_90, 90_100 are excluded due to no outcomes.
No outcomes among people who attended agrichemicals and tractors courses. No one in the dataset has attended the motorbikes Skills course. Therefore those three courses were excluded.
Acc suffix_E is the reference group.

. bysort model: tab course outcome

```
-> model = 12m_wc0
```

course	outcome 0	outcome 1	Total	person months	outcome Rate Crude (per 1000)	HR	mean followup duration(days)
AO	2,524	87	2,611	28509.3	3.05	1.71	321.2
AP	248	3	251	1197.8	2.50	1.40	144.7
none	14,043	267	14,310	149856.4	1.78	1.00	317.7
Total	16,815	357	17,172	179563.4	1.99		317.2

In this table:

"person months" is the analysis time in the language of survival analysis. Outcome rate is calculated taking person months as the denominator.
Crude HR is calculated from outcome Rates, therefore unadjusted for covariates.
Follow-up ends when period of 12 months is completed, or end of the project period is reached, or outcome is observed (which ever comes first). Therefore smaller mean follow-up duration is an indication of outcomes occurring sooner.

. stset _end_date_wc0 if model=="12m_wc0",id(personid) time0(followup_start_date) origin(time followup_start_date) scale(30.3333) failure(outcome==1)

```
                id:  personid
     failure event:  outcome == 1
obs. time interval:  (followup_start_date, followup_end_date_wc0]
 exit on or before:  failure
    t for analysis:  (time-origin)/30.3333
            origin:  time followup_start_date
            if exp:  model=="12m_wc0"

--------------------------------------------------------------------------------
    68688  total obs.
    51516  ignored at outset due to -if <exp>-
--------------------------------------------------------------------------------
    17172  obs. remaining, representing
    17172  subjects
      357  failures in single failure-per-subject data
 179563.4  total analysis time at risk, at risk from t =         0
                             earliest observed entry t =         0
                                  last observed exit t =  12.03298
```

```
. stcox ao ap quarter5 quarter6 quarter8 quarter9 quarter10 quarter11 quarter12
quarter13 quarter14 quarter15 quarter16 male pcu1230 pcu1240 pcu1250 pcu1300
fund_code age10_20 age30_40 age40_50 age50_60 age60_70 age70_80 earn25_50p
```

```
earn50_75p earn75_100p occu_mixedlivestock occu_croplivestock occu_otheragri
occu_other ethnic_maori ethnic_other ethnic_unknown skill_atv skill_chainsaws
accsuffix_d accsuffix_s prior_claim_ent

          failure _d:  outcome == 1
    analysis time _t:  (followup_end_date_wc0-origin)/30.3333
              origin:  time followup_start_date
                  id:  personid

note: accsuffix_s dropped due to colinearity

Cox regression -- Breslow method for ties

No. of subjects =        16856                     Number of obs   =     16856
No. of failures =          356
Time at risk    =  176215.3145
                                                   LR chi2(39)     =     86.72
Log likelihood  =   -3372.7355                     Prob > chi2     =    0.0000

------------------------------------------------------------------------------
          _t | Haz. Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          ao |   1.604329   .2043993     3.71   0.000     1.249816    2.059399
          ap |   1.424259   .8606214     0.59   0.558     .4357552    4.655167
    quarter5 |   .9998783   .4060304    -0.00   1.000     .4511192    2.216169
    quarter6 |   1.682894   .4987619     1.76   0.079      .941423    3.008352
    quarter8 |   1.134771   .1947875     0.74   0.461     .8105806     1.58862
    quarter9 |   .9761507   .1915056    -0.12   0.902     .6645449    1.433869
   quarter10 |   1.158045   .3528323     0.48   0.630     .6373562    2.104112
   quarter11 |   .6877454   .2227521    -1.16   0.248     .3645307    1.297541
   quarter12 |   .8420913   .1711211    -0.85   0.398     .5654403    1.254098
   quarter13 |   1.038993   .2519781     0.16   0.875     .6459193    1.671273
   quarter14 |   .2433272   .1760511    -1.95   0.051     .0589295    1.004728
   quarter15 |   .7043011   .5155574    -0.48   0.632     .1677521    2.956983
   quarter16 |   .4693791    .345598    -1.03   0.304     .1108651    1.987251
        male |   1.227903   .1807823     1.39   0.163     .9201172    1.638647
     pcu1230 |   .7814179   .2385443    -0.81   0.419     .4295721    1.421447
     pcu1240 |   1.126595   .3929368     0.34   0.733     .5687006    2.231784
     pcu1250 |   .8048367    .304236    -0.57   0.566     .3836591     1.68838
     pcu1300 |   .9149352   .2749158    -0.30   0.767     .5077208    1.648753
   fund_code |   .7463111    .111966    -1.95   0.051     .5561828    1.001434
    age10_20 |   1.276301   .4262922     0.73   0.465     .6632031    2.456176
    age30_40 |   1.176051   .2482872     0.77   0.442     .7775367    1.778817
    age40_50 |   1.347898   .2805826     1.43   0.152     .8963307    2.026963
    age50_60 |   1.555352   .3359754     2.04   0.041     1.018494    2.375192
    age60_70 |   1.202272   .3104726     0.71   0.476     .7247533    1.994415
    age70_80 |   1.215318   .4755276     0.50   0.618     .5644604    2.616656
  earn25_50p |     1.3344   .2139309     1.80   0.072      .974589    1.827051
  earn50_75p |   1.462635   .2348087     2.37   0.018      1.06779    2.003486
 earn75_100p |   1.130709    .208189     0.67   0.505     .7881798    1.622095
occu_mixed~k |   1.167811   .3632072     0.50   0.618     .6347986    2.148371
occu_cropl~k |   1.332034   .2480469     1.54   0.124     .9247143    1.918771
occu_other~i |   1.327637   .2025779     1.86   0.063     .9844607    1.790442
  occu_other |   1.019841   .1750135     0.11   0.909     .7285496    1.427599
ethnic_maori |   1.232469   .3244007     0.79   0.427     .7357489    2.064536
ethnic_other |   1.079879   .3183683     0.26   0.794     .6059335    1.924531
ethnic_unk~n |   .5719517   .2049829    -1.56   0.119     .2833319    1.154578
   skill_atv |   1.876514   1.212024     0.97   0.330     .5291373    6.654806
skill_chai~s |   3.909727   3.092981     1.72   0.085     .8293954    18.43025
 accsuffix_d |   .7258888   .4292535    -0.54   0.588     .2277786    2.313275
prior_clai~t |   1.582961   .2214328     3.28   0.001     1.203371    2.082288
------------------------------------------------------------------------------
```

Logistic regression:

. tab course outcome if followup_period ==12 & quarter<=12 & model=="12m_wc0"

```
           |        outcome
    course |         0          1 |     Total
-----------+----------------------+----------
        AO |     2,126         83 |     2,209
        AP |        14          0 |        14
      none |    10,875        240 |    11,115
-----------+----------------------+----------
     Total |    13,015        323 |    13,338
```

. logistic outcome ao ap quarter4 quarter5 quarter6 quarter8 quarter9 quarter10 quarter11 quarter12 quarter13 quarter14 quarter15 quarter16 male pcu1230 pcu1240 pcu1250 pcu1300 fund_code age0_10 age10_20 age30_40 age40_50 age50_60 age60_70 age70_80 age80_90 age90_100 earn25_50p earn50_75p earn75_100p occu_mixedlivestock occu_croplivestock occu_otheragri occu_other ethnic_maori ethnic_other ethnic_unknown skill_atv skill_agrichemicals skill_chainsaws skill_tractors accsuffix_d accsuffix_s prior_claim_ent if followup_period ==12 & quarter<=12 & model=="12m_wc0",or

note: ap != 0 predicts failure perfectly
    ap dropped and 14 obs not used

note: quarter4 != 0 predicts failure perfectly
    quarter4 dropped and 12 obs not used

note: age0_10 != 0 predicts failure perfectly
    age0_10 dropped and 1 obs not used

note: age80_90 != 0 predicts failure perfectly
    age80_90 dropped and 69 obs not used

note: age90_100 != 0 predicts failure perfectly
    age90_100 dropped and 4 obs not used

note: skill_agrichemicals != 0 predicts failure perfectly
    skill_agrichemicals dropped and 4 obs not used

note: skill_tractors != 0 predicts failure perfectly
    skill_tractors dropped and 9 obs not used

note: quarter13 dropped due to colinearity
note: quarter14 dropped due to colinearity
note: quarter15 dropped due to colinearity
note: quarter16 dropped due to colinearity
note: accsuffix_s dropped due to colinearity

Logistic regression Number of obs = 12972
  LR chi2(34) = 68.86
  Prob > chi2 = 0.0004
Log likelihood = -1473.6489 Pseudo R2 = 0.0228

outcome	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
ao	1.651273	.2213484	3.74	0.000	1.269748	2.147435
quarter5	.9959439	.4120358	-0.01	0.992	.442671	2.240726
quarter6	1.702549	.5165165	1.75	0.079	.9394281	3.085572
quarter8	1.137274	.1984191	0.74	0.461	.8078986	1.600934
quarter9	.9765605	.1945902	-0.12	0.905	.6608275	1.443146
quarter10	1.194232	.3696514	0.57	0.566	.6510525	2.190593

```
   quarter11 |   .6817575   .2237482    -1.17   0.243     .3583202    1.297145
   quarter12 |   .8523993   .1757164    -0.77   0.439     .5690803     1.27677
        male |   1.321982   .2120179     1.74   0.082     .9654078    1.810257
      pcu1230 |   1.066658   .3976852     0.17   0.863     .5136519    2.215038
      pcu1240 |   1.411581   .5924972     0.82   0.412     .6200434    3.213581
      pcu1250 |   1.140359   .5013461     0.30   0.765     .4817482    2.699373
      pcu1300 |   1.216409   .4485136     0.53   0.595     .5905069    2.505729
   fund_code |    .744009   .1190498    -1.85   0.065     .5437213    1.018076
    age10_20 |   1.274458   .4367303     0.71   0.479     .6510827    2.494679
    age30_40 |    1.13897   .2560443     0.58   0.563     .7330935     1.76956
    age40_50 |   1.320859   .2936237     1.25   0.211     .8543515    2.042098
    age50_60 |   1.484128   .3444938     1.70   0.089     .9416544    2.339112
    age60_70 |   1.148975   .3192392     0.50   0.617     .6665104     1.98068
    age70_80 |    1.20154   .5057106     0.44   0.663     .5265985    2.741552
  earn25_50p |   1.402009   .2429424     1.95   0.051     .9982821    1.969012
  earn50_75p |   1.508629   .2634673     2.35   0.019     1.071343    2.124401
 earn75_100p |   1.287273   .2511547     1.29   0.196     .8782058    1.886884
occu_mixed~k |   1.070397   .3732396     0.20   0.845     .5404271    2.120082
occu_cropl~k |   1.299353   .2622404     1.30   0.194     .8748517    1.929834
occu_other~i |   1.351051   .2193793     1.85   0.064     .9827805    1.857322
  occu_other |   1.125673   .1985439     0.67   0.502     .7966707    1.590543
ethnic_maori |   1.104108   .3153767     0.35   0.729     .6307758    1.932628
ethnic_other |   .8685429   .2986346    -0.41   0.682     .4427099    1.703975
ethnic_unk~n |   .6289704   .2280122    -1.28   0.201     .3090691    1.279985
   skill_atv |   2.661758   1.869599     1.39   0.163     .6718785    10.54499
skill_chai~s |   3.668031   3.263046     1.46   0.144      .641523    20.97267
 accsuffix_d |   .7949546   .4762055    -0.38   0.702     .2457214    2.571827
prior_clai~t |   1.555564   .2329816     2.95   0.003     1.159847    2.086291
------------------------------------------------------------------------------
```

(2) Model 12m_wc21 (12 months followup, outcome is EC claims with WC>21)

Cox regression:

Quarter7 is the reference group. Quarter4 is excluded due to no outcomes.
Age20_30 is the reference group. Age0-10, 80_90, 90_100 are excluded due to no outcomes.
No outcomes among people attended agrichemicals and tractors courses. No one in the dataset has attended the motorbikes Skills course. Therefore those three courses excluded.
Accsuffix_E is the reference group.

. bysort model: tab course outcome

```
-> model = 12m_wc21
```

course	outcome 0	outcome 1	Total	person months	outcomeRate (per 1000)	Crude HR	mean followup duration(days)
AO	2,549	62	2,611	28677.9	2.16	1.59	333.2
AP	249	2	251	1197.9	1.67	1.23	144.8
none	14,129	181	14,310	150389.9	1.20	1.00	318.8
Total	16,927	245	17,172	180265.6	1.36		318.4

```
. stset followup_end_date_wc21 if model=="12m_wc21",id(personid)
time0(followup_start_date) origin(time followup_start_date) scale(30.3333)
failure(outcome==1)

                id:  personid
     failure event:  outcome == 1
obs. time interval:  (followup_start_date, followup_end_date_wc21]
 exit on or before:  failure
    t for analysis:  (time-origin)/30.3333
            origin:  time followup_start_date
            if exp:  model=="12m_wc21"
```

```
------------------------------------------------------------------------------
    68688  total obs.
    51516  ignored at outset due to -if <exp>-
------------------------------------------------------------------------------
    17172  obs. remaining, representing
    17172  subjects
      245  failures in single failure-per-subject data
 180265.6  total analysis time at risk, at risk from t =         0
                             earliest observed entry t =         0
                                  last observed exit t =  12.03298

. stcox ao ap quarter5 quarter6 quarter8 quarter9 quarter10 quarter11 quarter12
quarter13 quarter14 quarter15 quarter16 male pcu1230 pcu1240 pcu1250 pcu1300
fund_code age10_20 age30_40 age40_50 age50_60 age60_70 age70_80 earn25_50p
earn50_75p earn75_100p occu_mixedlivestock occu_croplivestock occu_otheragri
occu_other ethnic_maori ethnic_other ethnic_unknown skill_atv skill_chainsaws
accsuffix_d accsuffix_s prior_claim_ent21

         failure _d:  outcome == 1
   analysis time _t:  (followup_end_date_wc21-origin)/30.3333
             origin:  time followup_start_date
                 id:  personid

note: accsuffix_s dropped due to colinearity

Cox regression -- Breslow method for ties

No. of subjects =        16856                     Number of obs   =     16856
No. of failures =          245
Time at risk    =  176909.1724
                                                   LR chi2(39)     =     72.46
Log likelihood  =    -2315.769                     Prob > chi2     =    0.0009

------------------------------------------------------------------------------
          _t | Haz. Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          ao |    1.62136   .2476586     3.16   0.002     1.201878    2.187249
          ap |   1.474811   1.089414     0.53   0.599     .3467133     6.27339
    quarter5 |   .9589974   .5134373    -0.08   0.938     .3358095    2.738684
    quarter6 |   1.860329   .6834932     1.69   0.091     .9054293    3.822302
    quarter8 |   1.294939   .2800139     1.20   0.232     .8475938    1.978384
    quarter9 |   1.102637   .2688806     0.40   0.689     .6836995     1.77828
   quarter10 |   1.177282   .4507497     0.43   0.670     .5558763    2.493347
   quarter11 |   .8074292   .3103345    -0.56   0.578     .3801422    1.714995
   quarter12 |   1.011795   .2508527     0.05   0.962       .62238    1.644863
   quarter13 |   1.044636   .3193871     0.14   0.886     .5737445    1.902004
   quarter14 |    .396367   .2908771    -1.26   0.207     .0940668    1.670162
   quarter15 |   .5688802   .5846063    -0.55   0.583     .0759082    4.263369
   quarter16 |   .3562401   .3678917    -1.00   0.318     .0470653    2.696403
        male |   1.454508   .2747823     1.98   0.047     1.004406    2.106314
     pcu1230 |   1.185854   .5027681     0.40   0.688     .5165903    2.722177
     pcu1240 |   1.584535    .744125     0.98   0.327      .631194     3.97778
     pcu1250 |   1.545985   .7491763     0.90   0.369     .5980228    3.996622
     pcu1300 |   1.202551   .5064381     0.44   0.661      .526783     2.74521
   fund_code |   .8652492   .1543444    -0.81   0.417     .6099617    1.227382
    age10_20 |   1.284163   .5598914     0.57   0.566      .546385    3.018156
    age30_40 |   1.308989   .3504773     1.01   0.315     .7745151    2.212292
    age40_50 |   1.728697   .4507813     2.10   0.036     1.036947    2.881916
    age50_60 |   1.701171   .4656117     1.94   0.052     .9948865    2.908857
    age60_70 |   1.607756   .5021601     1.52   0.128     .8716847    2.965385
    age70_80 |   1.339175   .6477706     0.60   0.546     .5189241    3.455978
  earn25_50p |   1.405264   .2739164     1.75   0.081     .9590475    2.059091
  earn50_75p |   1.624618   .3154423     2.50   0.012     1.110398    2.376971
 earn75_100p |   1.218572    .273827     0.88   0.379     .7844702    1.892892
occu_mixed~k |   1.384813     .45502     0.99   0.322      .727285    2.636804
occu_cropl~k |   1.048565   .2506408     0.20   0.843     .6563429    1.675174
occu_other~i |   .9852676   .1933476    -0.08   0.940     .6706804    1.447414
```

```
  occu_other |    .830019   .1774663    -0.87   0.384     .5458745     1.26207
ethnic_maori |   1.116258   .3701722     0.33   0.740     .5827603    2.138154
ethnic_other |   1.047761   .3781896     0.13   0.897     .5164408    2.125708
ethnic_unk~n |   .7271263   .2796506    -0.83   0.407     .3421687    1.545181
   skill_atv |   2.488073   1.692506     1.34   0.180     .6558963    9.438242
skill_chai~s |   5.145215   4.289364     1.96   0.049     1.004131    26.36434
 accsuffix_d |   .2900933   .2935344    -1.22   0.221     .0399245    2.107833
prior_cla~21 |   1.932944   .3804943     3.35   0.001     1.314204    2.842993
------------------------------------------------------------------------------
```

Logistic regression:

. tab course outcome if followup_period ==12 & quarter<=12 & model=="12m_wc21"

```
           |        outcome
    course |         0          1 |     Total
-----------+----------------------+----------
        AO |     2,150         59 |     2,209
        AP |        14          0 |        14
      none |    10,951        164 |    11,115
-----------+----------------------+----------
     Total |    13,115        223 |    13,338
```

```
. logistic outcome ao ap quarter4 quarter5 quarter6 quarter8 quarter9 quarter10
quarter11 quarter12 quarter13 quarter14 quarter15 quarter16 male pcu1230 pcu1240
pcu1250 pcu1300 fund_code age0_10 age10_20 age30_40 age40_50 age50_60 age60_70
age70_80 age80_90 age90_100 earn25_50p earn50_75p earn75_100p
occu_mixedlivestock occu_croplivestock occu_otheragri occu_other ethnic_maori
ethnic_other ethnic_unknown skill_atv skill_agrichemicals skill_chainsaws
skill_tractors accsuffix_d accsuffix_s prior_claim_ent if followup_period ==12 &
quarter<=12 & model=="12m_wc21",or

note: ap != 0 predicts failure perfectly
      ap dropped and 14 obs not used

note: quarter4 != 0 predicts failure perfectly
      quarter4 dropped and 12 obs not used

note: age0_10 != 0 predicts failure perfectly
      age0_10 dropped and 1 obs not used

note: age80_90 != 0 predicts failure perfectly
      age80_90 dropped and 69 obs not used

note: age90_100 != 0 predicts failure perfectly
      age90_100 dropped and 4 obs not used

note: skill_agrichemicals != 0 predicts failure perfectly
      skill_agrichemicals dropped and 4 obs not used

note: skill_tractors != 0 predicts failure perfectly
      skill_tractors dropped and 9 obs not used

note: quarter13 dropped due to colinearity
note: quarter14 dropped due to colinearity
note: quarter15 dropped due to colinearity
note: quarter16 dropped due to colinearity
note: accsuffix_s dropped due to colinearity

Logistic regression                               Number of obs   =      12972
                                                  LR chi2(34)     =      57.35
                                                  Prob > chi2     =     0.0074
```

```
Log likelihood = -1098.5302                     Pseudo R2       =     0.0254

------------------------------------------------------------------------------
     outcome | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          ao |   1.648553   .2636069     3.13   0.002      1.20502    2.255339
    quarter5 |   .9498486   .5156673    -0.09   0.924      .3277495     2.75275
    quarter6 |   1.896089   .7073178     1.72   0.086      .9126965    3.939048
    quarter8 |   1.296118    .283255     1.19   0.235      .8445433    1.989147
    quarter9 |   1.103433   .2719785     0.40   0.690      .6806727    1.788765
   quarter10 |   1.238291    .478659     0.55   0.580      .5804869    2.641515
   quarter11 |   .8108277    .315216    -0.54   0.590      .3784573    1.737162
   quarter12 |   1.034298   .2589688     0.13   0.893      .6331705    1.689548
        male |    1.57943   .3251265     2.22   0.026      1.055067    2.364399
     pcu1230 |   1.311165   .6114376     0.58   0.561      .5256727    3.270389
     pcu1240 |   1.639533   .8487942     0.96   0.340      .5943592    4.522633
     pcu1250 |   1.742029   .9185394     1.05   0.292      .6197734    4.896413
     pcu1300 |   1.285949   .5964556     0.54   0.588      .5181014    3.191777
   fund_code |   .8675011   .1638486    -0.75   0.452      .5991009    1.256146
    age10_20 |   1.282146    .571484     0.56   0.577      .5352248    3.071418
    age30_40 |   1.285793   .3663068     0.88   0.378      .7356552    2.247337
    age40_50 |   1.712232   .4760671     1.93   0.053      .9928767     2.95277
    age50_60 |   1.680861   .4916154     1.78   0.076      .9474879    2.981877
    age60_70 |   1.617803   .5369577     1.45   0.147      .8441254    3.100588
    age70_80 |   1.230863   .6525826     0.39   0.695      .4354285    3.479383
  earn25_50p |   1.507636   .3128146     1.98   0.048      1.003883    2.264173
  earn50_75p |   1.633661   .3424926     2.34   0.019      1.083203    2.463849
 earn75_100p |   1.367563   .3236058     1.32   0.186      .8600582    2.174537
occu_mixed~k |   1.223965    .454957     0.54   0.587      .5907053    2.536104
occu_cropl~k |   .9603102   .2508721    -0.16   0.877       .575497    1.602433
occu_other~i |   1.021595   .2097297     0.10   0.917      .6831726    1.527662
  occu_other |   .9046914   .1973866    -0.46   0.646      .5899081    1.387447
ethnic_maori |   .9204894   .3428328    -0.22   0.824      .4436004    1.910054
ethnic_other |   .9841609   .3835999    -0.04   0.967      .4584482     2.11272
ethnic_unk~n |   .7990747   .3105833    -0.58   0.564      .3730297    1.711714
   skill_atv |   3.484627   2.554556     1.70   0.089      .8282211    14.66109
skill_chai~s |    4.89308   4.533867     1.71   0.087      .7959202     30.0812
 accsuffix_d |   .3195128   .3248199    -1.12   0.262      .0435661    2.343302
prior_clai~t |   1.456643   .2674602     2.05   0.041      1.01639    2.087593
------------------------------------------------------------------------------
```

(3) Model 24m_wc0 (24 months followup, outcome is EC claims with WC>0)

Cox regression:

Quarter4 and agegroup80_90 are included in this model because there are outcomes in those groups.

```
. bysort model: tab course outcome

-> model = 24m_wc0

           |        outcome                 person     outcomeRate Crude   mean followup
    course |       0       1 |     Total     months     (per 1000)  HR     duration(days)
-----------+-----------------+-----------------------------------------------------------
        AO |   2,469     142 |     2,611      47761.7       2.97    1.73    554.9
        AP |     248       3 |       251       1204.2       2.49    1.45    145.5
      none |  13,882     428 |    14,310     248895.1       1.72    1.00    527.6
-----------+-----------------+-----------------------------------------------------------
     Total |  16,599     573 |    17,172     297871         1.92            526.2
```

```
. stset followup_end_date_wc0 if model=="24m_wc0",id(personid)
time0(followup_start_date) origin(time followup_start_date) scale(30.3333)
failure(outcome==1)

                id:  personid
     failure event:  outcome == 1
obs. time interval:  (followup_start_date, followup_end_date_wc0]
 exit on or before:  failure
    t for analysis:  (time-origin)/30.3333
            origin:  time followup_start_date
            if exp:  model=="24m_wc0"

--------------------------------------------------------------------------------
    68688  total obs.
    51516  ignored at outset due to -if <exp>-
--------------------------------------------------------------------------------
    17172  obs. remaining, representing
    17172  subjects
      573  failures in single failure-per-subject data
   297861  total analysis time at risk, at risk from t =         0
                             earliest observed entry t =         0
                                  last observed exit t =  24.06596

. stcox ao ap quarter4 quarter5 quarter6 quarter8 quarter9 quarter10 quarter11
quarter12 quarter13 quarter14 quarter15 quarter16 male pcu1230 pcu1240 pcu1250
pcu1300 fund_code age10_20 age30_40 age40_50 age50_60 age60_70 age70_80 age80_90
earn25_50p earn50_75p earn75_100p occu_mixedlivestock occu_croplivestock
occu_otheragri occu_other ethnic_maori ethnic_other ethnic_unknown skill_atv
skill_chainsaws accsuffix_d accsuffix_s prior_claim_ent

         failure _d:  outcome == 1
   analysis time _t:  (followup_end_date_wc0-origin)/30.3333
             origin:  time followup_start_date
                 id:  personid

note: accsuffix_s dropped due to colinearity

Cox regression -- Breslow method for ties

No. of subjects =        16856                     Number of obs   =     16856
No. of failures =          570
Time at risk    =  291988.3758
                                                   LR chi2(41)     =    115.74
Log likelihood  =   -5325.2901                     Prob > chi2     =    0.0000

------------------------------------------------------------------------------
          _t | Haz. Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          ao |   1.634113   .1632452     4.92   0.000     1.343534    1.987539
          ap |   1.442554   .8693715     0.61   0.543     .4427369    4.700222
    quarter4 |   1.575693   1.586887     0.45   0.652     .2188887    11.34279
    quarter5 |   1.031484     .29641     0.11   0.914     .5872982    1.811615
    quarter6 |   1.278351   .3030047     1.04   0.300     .8033256     2.03427
    quarter8 |   1.005029   .1247421     0.04   0.968     .7880051    1.281822
    quarter9 |   .8984579   .1284386    -0.75   0.454     .6789138    1.188997
   quarter10 |   .9183579    .232087    -0.34   0.736     .5596245    1.507048
   quarter11 |    .708871   .1838771    -1.33   0.185     .4263541    1.178593
   quarter12 |   .7545908   .1320333    -1.61   0.108     .5355177    1.063284
   quarter13 |   .9453379   .2113169    -0.25   0.801     .6099764    1.465079
```

```
   quarter14 |   .2201165   .1578899    -2.11   0.035     .0539616    .8978851
   quarter15 |   .6386149   .4633571    -0.62   0.537      .154041    2.647535
   quarter16 |   .4218387   .3080086    -1.18   0.237     .1008406    1.764645
        male |   1.266508   .1491118     2.01   0.045     1.005523    1.595232
      pcu1230 |   .8132193   .1967526    -0.85   0.393      .506134    1.306622
      pcu1240 |   .8566838   .2477281    -0.53   0.593     .4860464    1.509953
      pcu1250 |   .7843663   .2347723    -0.81   0.417     .4362565    1.410249
      pcu1300 |   .9107874   .2173569    -0.39   0.695     .5705321    1.453965
   fund_code |   .7568753   .0902674    -2.34   0.020      .599111    .9561837
    age10_20 |   1.083677    .291601     0.30   0.765     .6395201    1.836307
    age30_40 |   1.073243   .1773036     0.43   0.669     .7763838    1.483609
    age40_50 |   1.165599   .1918571     0.93   0.352     .8441929    1.609372
    age50_60 |   1.414031    .240555     2.04   0.042     1.013101    1.973629
    age60_70 |    1.01227   .2096262     0.06   0.953     .6745666    1.519034
    age70_80 |   1.385843   .3970111     1.14   0.255     .7904326    2.429758
    age80_90 |   .8696044   .6314323    -0.19   0.847     .2095328    3.609038
  earn25_50p |    1.36893   .1716403     2.50   0.012     1.070669    1.750279
  earn50_75p |   1.422216   .1803107     2.78   0.005     1.109299    1.823401
 earn75_100p |   1.028934   .1508591     0.19   0.846     .7719463    1.371476
occu_mixed~k |    1.15034    .287368     0.56   0.575     .7049953    1.877007
occu_cropl~k |   1.248747   .1839589     1.51   0.132     .9355778    1.666745
occu_other~i |   1.290774   .1542862     2.14   0.033     1.021189    1.631528
  occu_other |   .8540951    .122064    -1.10   0.270     .6454398    1.130204
ethnic_maori |   1.146806   .2504811     0.63   0.531     .7474354    1.759569
ethnic_other |   1.362572    .285606     1.48   0.140     .9035259     2.05484
ethnic_unk~n |    .732384   .1863284    -1.22   0.221     .4448173    1.205858
   skill_atv |   1.869333   1.040246     1.12   0.261     .6280733    5.563691
skill_chai~s |   2.898439   2.277731     1.35   0.176     .6212258    13.52318
 accsuffix_d |   1.294269   .4759032     0.70   0.483     .6295606    2.660797
prior_clai~t |   1.422847   .1633068     3.07   0.002     1.136218    1.781782
------------------------------------------------------------------------------
```

Logistic regression:

```
. tab course outcome if followup_period ==24 & quarter<=8 & model=="24m_wc0"

           |        outcome
    course |         0          1 |     Total
-----------+----------------------+----------
        AO |     1,085         91 |     1,176
      none |     5,629        251 |     5,880
-----------+----------------------+----------
     Total |     6,714        342 |     7,056


. logistic outcome ao ap quarter4 quarter5 quarter6 quarter8 quarter9 quarter10
quarter11 quarter12 quarter13 quarter14 quarter15 quarter16 male pcu1230 pcu1240
pcu1250 pcu1300 fund_code age0_10 age10_20 age30_40 age40_50 age50_60 age60_70
age70_80 age80_90 age90_100 earn25_50p earn50_75p earn75_100p
occu_mixedlivestock occu_croplivestock occu_otheragri occu_other ethnic_maori
ethnic_other ethnic_unknown skill_atv skill_agrichemicals skill_chainsaws
skill_tractors accsuffix_d accsuffix_s prior_claim_ent if followup_period ==24 &
quarter<=8 & model=="24m_wc0",or

note: age80_90 != 0 predicts failure perfectly
      age80_90 dropped and 33 obs not used

note: age90_100 != 0 predicts failure perfectly
      age90_100 dropped and 3 obs not used
```

```
note: skill_agrichemicals != 0 predicts failure perfectly
      skill_agrichemicals dropped and 4 obs not used

note: skill_tractors != 0 predicts failure perfectly
      skill_tractors dropped and 2 obs not used

note: ap dropped due to colinearity
note: quarter9 dropped due to colinearity
note: quarter10 dropped due to colinearity
note: quarter11 dropped due to colinearity
note: quarter12 dropped due to colinearity
note: quarter13 dropped due to colinearity
note: quarter14 dropped due to colinearity
note: quarter15 dropped due to colinearity
note: quarter16 dropped due to colinearity
note: fund_code dropped due to colinearity
note: age0_10 dropped due to colinearity

Logistic regression                               Number of obs   =       6867
                                                  LR chi2(31)     =      66.01
                                                  Prob > chi2     =     0.0002
Log likelihood = -1323.2706                       Pseudo R2       =     0.0243

------------------------------------------------------------------------------
     outcome | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          ao |    1.70689   .2251695     4.05   0.000     1.318004     2.21052
    quarter4 |   1.713172   1.820752     0.51   0.612     .2133767    13.75481
    quarter5 |   1.012389   .3026575     0.04   0.967      .563479    1.818936
    quarter6 |   1.288838   .3173067     1.03   0.303     .7954922    2.088145
    quarter8 |   1.006818   .1291505     0.05   0.958     .7830011    1.294612
        male |    1.39547   .2241882     2.07   0.038     1.018525     1.91192
     pcu1230 |   .9403919   .3369893    -0.17   0.864     .4658873    1.898178
     pcu1240 |   1.166969   .4856298     0.37   0.711     .5162203    2.638054
     pcu1250 |   1.116641   .4691273     0.26   0.793     .4901215    2.544037
     pcu1300 |   1.120956   .3953647     0.32   0.746     .5615227    2.237742
    age10_20 |   1.101661   .3803488     0.28   0.779     .5599772    2.167332
    age30_40 |   1.152347   .2501933     0.65   0.514     .7529625    1.763571
    age40_50 |   1.244287    .269914     1.01   0.314     .8133467    1.903555
    age50_60 |   1.522058   .3432731     1.86   0.063     .9782684    2.368125
    age60_70 |   .9887817    .278393    -0.04   0.968     .5694339    1.716949
    age70_80 |   1.308208   .5316139     0.66   0.509     .5898964    2.901201
  earn25_50p |   1.433803   .2448202     2.11   0.035     1.026001    2.003693
  earn50_75p |   1.418343   .2472707     2.00   0.045     1.007824    1.996079
 earn75_100p |   1.181845   .2282532     0.87   0.387     .8094039    1.725661
occu_mixed~k |   1.254762   .4454435     0.64   0.523     .6257243     2.51617
occu_cropl~k |   1.178437   .2371659     0.82   0.415     .7943244    1.748294
occu_other~i |   1.360286   .2114894     1.98   0.048     1.002976    1.844889
  occu_other |   .9873207   .1763277    -0.07   0.943     .6957295    1.401122
ethnic_maori |    1.03905   .3114861     0.13   0.898     .5773826    1.869862
ethnic_other |   1.372648   .3922484     1.11   0.268     .7840062    2.403249
ethnic_unk~n |   .7569084   .2497064    -0.84   0.399     .3964873    1.444965
   skill_atv |   3.150678   2.878533     1.26   0.209     .5256863    18.88346
skill_chai~s |   5.186746   6.409327     1.33   0.183     .4603145    58.44338
 accsuffix_d |   1.596123   .7713954     0.97   0.333     .6189943    4.115724
 accsuffix_s |   1.333693   .2086161     1.84   0.066     .9815464    1.812177
prior_clai~t |    1.28231   .2012748     1.58   0.113     .9427271    1.744214
------------------------------------------------------------------------------
```

(4) Model 24m_wc21 (24 months followup, outcome is EC claims with WC>21)

Cox regression:

Quarter4 is included in this model because there are outcomes in that group.

```
. bysort model: tab course outcome

-> model = 24m_wc21

           |        outcome               person         outcomeRate Crude
      mean followup
    course |       0       1 |      Total  months         (per 1000)     HR
      duration(days)
-----------+----------------+-----------------------------------------------
---------
        AO |   2,507     104 |      2,611   48274.2    2.15  1.82  560.8
        AP |     249       2 |        251    1204.3    1.66  1.41  145.5
      none |  14,014     296 |     14,310  250466.5    1.18  1.00  530.9
-----------+----------------+-----------------------------------------------
---------
     Total |  16,770     402 |     17,172  299945.1    1.34        529.8


. stset followup_end_date_wc21 if model=="24m_wc21",id(personid)
time0(followup_start_date) origin(time followup_start_date) scale(30.3333)
failure(outcome==1)

                id:  personid
     failure event:  outcome == 1
obs. time interval:  (followup_start_date, followup_end_date_wc21]
 exit on or before:  failure
    t for analysis:  (time-origin)/30.3333
            origin:  time followup_start_date
            if exp:  model=="24m_wc21"

--------------------------------------------------------------------------
    68688  total obs.
    51516  ignored at outset due to -if <exp>-
--------------------------------------------------------------------------
    17172  obs. remaining, representing
    17172  subjects
      402  failures in single failure-per-subject data
 299945.1  total analysis time at risk, at risk from t =         0
                             earliest observed entry t =         0
                                  last observed exit t =  24.06596

. stcox ao ap quarter4 quarter5 quarter6 quarter8 quarter9 quarter10 quarter11
quarter12 quarter13 quarter14 quarter15 quarter16 male pcu1230 pcu1240 pcu1250
pcu1300 fund_code age10_20 age30_40 age40_50 age50_60 age60_70 age70_80
earn25_50p earn50_75p earn75_100p occu_mixedlivestock occu_croplivestock
occu_otheragri occu_other ethnic_maori ethnic_other ethnic_unknown skill_atv
skill_chainsaws accsuffix_d accsuffix_s prior_claim_ent21

         failure _d:  outcome == 1
   analysis time _t:  (followup_end_date_wc21-origin)/30.3333
             origin:  time followup_start_date
                 id:  personid
```

```
note: accsuffix_s dropped due to colinearity

Cox regression -- Breslow method for ties

No. of subjects =        16856                     Number of obs   =     16856
No. of failures =          400
Time at risk    =  294052.8396
                                                   LR chi2(40)     =     95.75
Log likelihood  =   -3729.8439                     Prob > chi2     =    0.0000

------------------------------------------------------------------------------
          _t | Haz. Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          ao |   1.699162   .2008478     4.48   0.000     1.347781    2.142152
          ap |   1.461166   1.076097     0.51   0.607     .3450003    6.188415
    quarter4 |   2.425971   2.451781     0.88   0.381     .3346785    17.58504
    quarter5 |   1.119236   .3830052     0.33   0.742     .5723192    2.188794
    quarter6 |   1.392193   .3904982     1.18   0.238     .8034241    2.412427
    quarter8 |   1.048166   .1584755     0.31   0.756     .7793535    1.409698
    quarter9 |    .973736   .1672136    -0.15   0.877     .6954561    1.363367
   quarter10 |   .8590673   .2721464    -0.48   0.632     .4617136    1.598386
   quarter11 |   .7609249   .2344805    -0.89   0.375     .4159512    1.392006
   quarter12 |   .8667241   .1790466    -0.69   0.489     .5781504    1.299334
   quarter13 |   .9117403   .2530649    -0.33   0.739     .5291874    1.570843
   quarter14 |   .3432256   .2480016    -1.48   0.139     .0832788    1.414572
   quarter15 |   .4909695   .5005114    -0.70   0.485     .0665748    3.620753
   quarter16 |   .3066028   .3141036    -1.15   0.249     .0411671    2.283503
        male |    1.40672   .2062496     2.33   0.020     1.055375    1.875032
     pcu1230 |   1.146473   .3765611     0.42   0.677     .6022613    2.182441
     pcu1240 |   1.127208   .4277327     0.32   0.752     .5358031    2.371389
     pcu1250 |   1.300049   .4925651     0.69   0.489     .6186643    2.731899
     pcu1300 |    1.16542   .3801497     0.47   0.639     .6149337    2.208701
   fund_code |   .7565999   .1083838    -1.95   0.052     .5713874    1.001848
    age10_20 |   1.207142   .4011021     0.57   0.571     .6293989    2.315211
    age30_40 |   1.094533    .225906     0.44   0.662     .7303741    1.640259
    age40_50 |   1.427736    .286005     1.78   0.075     .9641283    2.114274
    age50_60 |   1.546577   .3224719     2.09   0.037     1.027757    2.327303
    age60_70 |   1.273182   .3121792     0.99   0.325     .7873703    2.058741
    age70_80 |   1.827988   .5951398     1.85   0.064     .9657105    3.460189
  earn25_50p |    1.43944   .2172629     2.41   0.016     1.070821    1.934952
  earn50_75p |   1.533005   .2338635     2.80   0.005     1.136817    2.067265
 earn75_100p |   1.204012   .2113168     1.06   0.290     .8535637    1.698344
occu_mixed~k |   1.289269   .3564854     0.92   0.358     .7498677    2.216677
occu_cropl~k |   1.238098   .2146334     1.23   0.218     .8814408     1.73907
occu_other~i |   1.089789   .1634518     0.57   0.566     .8122228     1.46221
  occu_other |   .7964572   .1372338    -1.32   0.187     .5681931    1.116424
ethnic_maori |   1.169871    .306656     0.60   0.549     .6998646    1.955518
ethnic_other |    1.48178   .3595137     1.62   0.105     .9210069    2.383992
ethnic_unk~n |   .9281207   .2535204    -0.27   0.785     .5433691    1.585309
   skill_atv |   2.448899   1.403858     1.56   0.118     .7961784    7.532364
skill_chai~s |   3.669322   2.972387     1.60   0.109      .749994    17.95205
 accsuffix_d |   1.078199   .5000755     0.16   0.871     .4344165    2.676034
prior_cla~21 |   1.605411   .2666266     2.85   0.004     1.159361    2.223073
------------------------------------------------------------------------------
```

Logistic regression:

. tab course outcome if followup_period ==24 & quarter<=8 & model=="24m_wc21"

```
           |        outcome
    course |         0          1 |     Total
-----------+----------------------+----------
        AO |     1,108         68 |     1,176
      none |     5,711        169 |     5,880
-----------+----------------------+----------
     Total |     6,819        237 |     7,056


. logistic outcome ao ap quarter4 quarter5 quarter6 quarter8 quarter9 quarter10
quarter11 quarter12 quar
> ter13 quarter14 quarter15 quarter16 male pcu1230 pcu1240 pcu1250 pcu1300
fund_code age0_10 age10_20 ag
> e30_40 age40_50 age50_60 age60_70 age70_80 age80_90 age90_100 earn25_50p
earn50_75p earn75_100p occu_m
> ixedlivestock occu_croplivestock occu_otheragri occu_other ethnic_maori
ethnic_other ethnic_unknown sk
> ill_atv skill_agrichemicals skill_chainsaws skill_tractors accsuffix_d
accsuffix_s prior_claim_ent if
> followup_period ==24 & quarter<=8 & model=="24m_wc21",or

note: age80_90 != 0 predicts failure perfectly
      age80_90 dropped and 33 obs not used

note: age90_100 != 0 predicts failure perfectly
      age90_100 dropped and 3 obs not used

note: skill_agrichemicals != 0 predicts failure perfectly
      skill_agrichemicals dropped and 4 obs not used

note: skill_tractors != 0 predicts failure perfectly
      skill_tractors dropped and 2 obs not used

note: ap dropped due to colinearity
note: quarter9 dropped due to colinearity
note: quarter10 dropped due to colinearity
note: quarter11 dropped due to colinearity
note: quarter12 dropped due to colinearity
note: quarter13 dropped due to colinearity
note: quarter14 dropped due to colinearity
note: quarter15 dropped due to colinearity
note: quarter16 dropped due to colinearity
note: fund_code dropped due to colinearity
note: age0_10 dropped due to colinearity

Logistic regression                               Number of obs   =       6867
                                                  LR chi2(31)     =      63.75
                                                  Prob > chi2     =     0.0005
Log likelihood = -995.49525                       Pseudo R2       =     0.0310

------------------------------------------------------------------------------
     outcome | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          ao |   1.899102   .2932273     4.15   0.000     1.403202    2.570256
    quarter4 |    2.67602   2.870356     0.92   0.359     .3269435    21.90313
    quarter5 |   1.097976   .3895188     0.26   0.792     .5477976    2.200725
    quarter6 |   1.425478   .4116859     1.23   0.220     .8093357    2.510685
    quarter8 |   1.058672    .164099     0.37   0.713     .7813062    1.434503
        male |   1.398448   .2718703     1.73   0.085      .955357    2.047044
     pcu1230 |   1.559912   .8124511     0.85   0.393     .5620402    4.329448
```

```
     pcu1240 |   1.780136   1.031546     1.00   0.320      .571745    5.542479
     pcu1250 |   2.135364   1.221795     1.33   0.185     .6957262    6.553983
     pcu1300 |   1.676689   .8664968     1.00   0.317     .6089195    4.616845
    age10_20 |   1.269607   .5475058     0.55   0.580     .5452518    2.956254
    age30_40 |   1.207106   .3391224     0.67   0.503     .6960018    2.093537
    age40_50 |   1.635148   .4468903     1.80   0.072     .9570208    2.793783
    age50_60 |   1.922584   .5464158     2.30   0.021     1.101453    3.355865
    age60_70 |   1.467997   .4953628     1.14   0.255     .7576949    2.844171
    age70_80 |   2.178063   .9950178     1.70   0.088     .8896329     5.33249
  earn25_50p |   1.497397   .3101939     1.95   0.051      .997714    2.247336
  earn50_75p |   1.553605   .3275316     2.09   0.037     1.027756    2.348503
 earn75_100p |   1.450065   .3359749     1.60   0.109      .920804    2.283536
occu_mixed~k |   1.395718    .559733     0.83   0.406     .6359677    3.063092
occu_cropl~k |   1.173749   .2782201     0.68   0.499     .7375819    1.867842
occu_other~i |   1.183426   .2272987     0.88   0.381     .8121795    1.724368
  occu_other |   .9576949    .204298    -0.20   0.839     .6304442    1.454815
ethnic_maori |   1.055336   .3786255     0.15   0.881     .5223994    2.131957
ethnic_other |   1.778646   .5507416     1.86   0.063     .9694442    3.263295
ethnic_unk~n |   1.023381   .3573755     0.07   0.947     .5161649    2.029018
   skill_atv |   4.286773   3.992632     1.56   0.118     .6907724    26.60272
skill_chai~s |   6.358245   8.024007     1.47   0.143      .535962    75.42938
 accsuffix_d |   .7853266   .5785384    -0.33   0.743     .1853459    3.327498
 accsuffix_s |   1.280101   .2399868     1.32   0.188     .8864728    1.848516
prior_clai~t |   1.231517   .2338271     1.10   0.273     .8488352    1.786723
-------------------------------------------------------------------------------
```

Part 2: FarmSafe Outcome Evaluation – Follow-up Study

A report for the
Accident Compensation Corporation of New Zealand

This study was funded and supported by the Accident Compensation Corporation (ACC), Wellington, New Zealand. Views and / or conclusions in this report are those of the project team and may not reflect the position of the ACC.

Colin Cryer
Ari Samaranayaka
Dave Barson
Gabrielle Davie
John Langley

Injury Prevention Research Unit
Department of Preventive and Social Medicine
University of Otago
P O Box 913
Dunedin
New Zealand

April 2008

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Acknowledgements

This study was funded and supported by the Accident Compensation Corporation (ACC), Wellington, New Zealand. Views and / or conclusions in this report are those of the project team and may not reflect the position of the ACC.

We would like to thank ACC and Telford Rural Polytechnic for preparing and supplying the data which was the basis of this work. We also acknowledge the New Zealand Health Information Service (NZHIS) as the source of data for some of the analyses presented in this report.

We thank Brandon de Graff for carrying out the data linkage of Telford Rural Polytechnic FarmSafe™ enrolment data to the NZHIS NMDS of hospital discharges.

Thank you to those in the ACC who commented on our draft report, particularly to Peter Larking who also provided guidance regarding the form of the Executive Summary.

Finally, we thank Lesley Day, MUARC, Australia, who peer reviewed the results and our interpretation of those results.

Abbreviations

ACC	Accident Compensation Corporation
AO	Attendance at only the FarmSafe™ Awareness Programme (Awareness Only)
ATV	All Terrain Vehicle
CI	Confidence Interval
ERC	Earnings-Related Compensation
FS	FarmSafe™
ICD	WHO International Classification of Diseases
ICISS	ICD-based Injury Severity Score
IPRU	Injury Prevention Research Unit, University of Otago
MOE	Medical Fees only, Other or Entitlement payment
MVTC	Motor Vehicle Traffic Crash
NMDS	National Minimum Data Set of hospital discharges
NZHIS	New Zealand Health Information Service
NZQA	New Zealand Qualification Authority
SBD	Sheep, Beef and Dairy
Telford	Telford Rural Polytechnic
TTL	Threat to Life
WCdays	Number of days for which earnings-related compensation was paid
WHO	World Health Organisation

1. Background and aims

1.1. Background

Agriculture is an important part of the New Zealand economy, contributing over 60% of our export earnings and employing 9% of the New Zealand workforce. Injury in the agricultural workplace is a serious public health problem, contributing disproportionately to ACC claims and associated costs.

FarmSafe™ (FS) is a large-scale 'real life' intervention, with a substantial financial investment from ACC and vote Education, implemented by organisations independent of the researchers. It includes three programmes: 'Awareness', 'Plans', and 'Skills'. Research on the effectiveness of this and other farm injury interventions is limited. [1 2 3]

Work undertaken by IPRU to date to evaluate FS has focused on the process and impact evaluation of the 'Awareness' programme and a pilot outcome evaluation of the FS 'Awareness' and 'Plans' programmes – the latter using secondary data sources. This latter evaluation (Part 1) has not demonstrated a positive impact on injury reduction. In fact, in the outcome evaluation, those attending the FS 'Awareness' workshops had an increased rate of ACC earnings-related claims (ERCs) during 12 and 24 months of follow-up compared with matched controls. There is a need to determine if this is a real increase as a result of attendance at FS Awareness, or a methodological artifact.

At a meeting with the ACC in Wellington on 25 January 2007, we discussed these puzzling results. We sought to identify possible projects aimed at providing an explanation of those results – to investigate whether the increased ACC earnings-related claims rates observed in the group exposed to the FS Awareness Programme were due to increased of rates of injury, or due to extraneous factors such as bias caused by increased rates of claims, given an injury has occurred. The potential project topics that were discussed included:

1. A replication of the modeling carried out in the original work (the pilot FS outcome evaluation described in Part 1) but with "all ACC claims" as the outcome.

2. For the ACC claims-related outcomes, to investigate what changes to the rates have occurred following attendance at FS Awareness, contrasted with rates for all SBD farmers and farm workers.

3. Linkage of FS Awareness enrolments to hospital data and compare rates of hospitalisation (>0 days stay, and for serious non-fatal injury discharges) for the FS group before to after attendance.

This further work (described here) focuses on all of these.

The background to topic (1) above is as follows. In the original Pilot FS outcome evaluation (described in Part 1), two injury[a] outcomes were investigated:

- earnings-related entitlement claims (ERCs) – (WCdays[b]>0)
- earnings-related entitlement claims of over 21 days duration – (WCdays>21).

A third outcome of "all ACC claims" was not considered at the time since these are dominated by minor injuries. During our discussion of the results in Part 1, some stakeholders suggested that, within farming, the "Medical Fees only" claims may be less susceptible to the changes in claims-making behaviour than earnings-related claims. Consequently, it was hypothesised that using these new outcomes, an increase in rates of injury, compared to those not exposed, would not be observed.

Additionally, project topics (2) and (3) investigated changes in claims-making behaviour in the following manner. For those people exposed to FS Awareness, we would check whether the annual rates of ACC claims, hospitalisations (excluding cases admitted and discharged on the same day) and serious non-fatal hospital discharges increased following attendance at FS. If there was no change in minor or serious injury rates resulting from attendance at FS Awareness, no change in the eligibility to claim during this period, and no change in claims-making behaviour, then the rates should not change beyond what would be expected at random. This hypothesis of no change was investigated. We also tracked the claims-related outcomes in those not exposed to either FS Awareness or Plans, and also in the whole population of SBD farmers and farm workers, whether exposed or not, as a comparison.

[a] Gradual process claims, including claims for occupational diseases, were excluded from the analysis.
[b] Number of days for which earnings-related compensation was paid.

1.2. Part 2 Aims and Questions

Aim:

To investigate, using secondary data sources, the finding that attendance at a FS 'Awareness' workshop is associated with higher rates of claims following injury - to determine whether this is due to an increase in injury incidence, or is an artifact due to uncorrected bias.

Specifically, we aimed to answer the questions:

(a) Are the results of the pilot outcome evaluation (Part 1) replicated when using "all claims" and "medical fees only" claims as an outcome?

(b) Amongst people attending FS Awareness, do the rates of ACC medical fees only claims, as well as earnings-related claims, change from the period before attendance to the period after; contrasted with the unexposed experience as well as with all SBD farmers / workers?

(c) Do the rates of hospital admission for injury (with (i) a stay of 1 day or more, and (ii) for injury with a significant threat-to-life) change from the period before attendance to the period after?

2. Methods

2.1. Injury Definition

We take as the theoretical definition of injury that given in the WHO[c] Injury Surveillance Guidelines. [4] That is:

> *"An injury is the physical damage that results when a human body is suddenly or briefly subjected to intolerable levels of energy. It can be a bodily lesion resulting from acute exposure to energy in amounts that exceed the threshold of physiological tolerance, or it can be an impairment of function resulting from a lack of one or more vital elements (ie. air, water, warmth), as in drowning strangulation or freezing. The time between exposure to the energy and the appearance of the injury is short". (p5)*

Injury of all intents have been included in this work. This was inevitable for the ACC data-based analysis, since it is not possible to distinguish between intentional and unintentional injury. For consistency, we also included all intents when analyzing the hospital data.

The case definition of injury changed according to the part of analysis being described (see sections 2.6.1, 2.6.2 and 2.6.3).

2.2. Definition of a farm, farmers and farm workers

The definition of a farm, farmers and farm workers has been included in Part 1, section 2.2.2.

2.3. Target population

The target population was sheep, beef and dairy (SBD) farmers and their farm workers in New Zealand. From the 2001 and 2006 Censuses, we estimate that there were around 70,000 SBD farmers / workers in New Zealand during the period

[c] World Health Organization

under study. Sheep, beef and dairy farms (and hence the workers on these farms) were identified were identified from ACC as one with a Premium Classification Unit (PCU) code of one of the following: 01220, 01230, 01240, 01250, and 01300. Farmers and farm workers were identified from Census data as those people having an industry code of the same as those listed above: ie. 01220, 01230, 01240, 01250, and 01300.

These SBD farmers / workers were distributed across the constituent groups as follows: dairy (48%), beef (13%), sheep (25%), and sheep & beef (13%). Between the 2001 and 2006 Censuses, there was a substantial increase in people reporting their main occupation as beef farmers / workers, and a small decrease in reported dairy farmers. 13% of SBD farmers / workers were under 25, 29% under age 35. 45% were aged between 35-54, 16% aged 55-64, and 9% over 64, of which 2% were over 75.

Up to the end of 2005, there had been almost 20,000 attendances at a FS programme, of which 13,000 were to the Awareness programme, 1,500 to the Plans programme, and 5,500 to a Skills programme. The main Skills workshops attended were agrichemical skills (3,100) and ATV skills (1,150).

2.4. Source data

The source data were the same as for Part 1, that is:

- Telford Rural Polytechnic FS enrolment data
- ACC claims data

The requests for these data are shown in Part 1, Appendix 1.

The Telford enrolment data was requested for the period from the inception of FS to the end of 2005. The first attendees at the FS workshops was mid-2002.

ACC claims data was requested for injuries occurring in the period 1 July 2001 to 30 June 2005. Data were requested for this period to permit a description of the claims experience both before and after attendance at FS.

Additionally, in this part of the report (Part 2), we also used the NZHIS National Minimum Data Set (NMDS) of hospital discharges for the period 2001 to 2006.

These data are held on the IPRU injury database for records that include an external cause code (and so includes all injury discharges).

Denominators for rates were either derived from the Telford enrolment data, or were based on interpolations between the 2001 and 2006 Census data. Detail is given in the methods description (Section 2.6).

2.5. Ethics /Privacy

The IPRU have Research Ethics Approval from the Multi-region Ethics Committee for research that involves the analysis of the administrative data sources used in this study. This work was also approved by the ACC's Research Ethics Committee.

2.6. Methods description

2.6.1. A replication of the original modeling but with "all ACC injury claims" as the outcome.

For this component, the methods used in Parts 1 and 2 were consistent. We selected only those attendees who had had an ACC claim (the "index" claim) prior to attendance at FS. People who had not attended either Awareness or Plans were eligible to be selected into the unexposed group. For every farmer / worker exposed to FS Awareness, 5 unexposed farmers/workers were selected into the comparison group. An unexposed farmer/worker could be selected if (s)he had had a claim within 30 days of the index claim for the exposed person to which (s)he was matched.

Case definition of work-related injury

The case definition of injury was all ACC claims, but with gradual process / disease claims removed using the algorithm shown in Part 1, Appendix 4. ACC claims records were those which had an injury date in the period July 2001 to June 2005. They were limited to those compensated from the Self-Employed, Employers and Residual accounts and with work-related flag set to "yes".

Method

In this follow-up work, we used the same modeling method as in Part 1. The modeling method used was described in Part 1, section 2.2.7, for earnings-related compensation outcomes. This modeling approach was replicated here for "all claims" and for "medical fees only" claims.

Source data

This dataset comprises SBD farmers / workers who attended FS Awareness (the "exposed") matched to people not exposed to either the FS Awareness or Plans programmes. They were matched on the date of the last ACC claim. For this analysis, the following new variables were extracted to the dataset, used in Part 1, from Telford and ACC data.

- Whether 'any claim' occurred during the follow-up period (12 months or 24 months after attendance at FS Awareness),
- Date of the first such claim.
- Whether 'a medical fees only' claim occurred during the follow-up period (12 months or 24 months),

- Date of the first such claim.

Modeling

The combinations of these 2 outcomes (i.e., 'any claim' and 'medical fee only' claim) and 2 follow-up periods (i.e., 12 months and 24 months) resulted in four different models. Similar to Part 1, logistic and Cox's regression models were fitted for those 4 combinations. Covariates used in these regressions were the same as in part 1 (section 2.2.7), with the following necessary changes made for covariates.

- In Part 1, FS Plans was one of the exposures. In the present regressions, Plans was not an exposure. However, Plans was included as a covariate, thus making the results for the two sets of analyses (Part 1 and Part 2) comparable.
- The "history of prior claims" covariate specifies the number of claims during the 12 months period immediately prior to starting the follow-up[d]. The type of claims counted here was those of the same type as the outcome variable. Accordingly, WCdays>0 and WCdays>21 earnings-related claims in the 12 months prior to attending FS Awareness were included as covariates in Part 1 for models with WCdays>0 and WCdays>21 outcomes, respectively. In this present analysis (Part 2), we used "any claims" and "medical fees only" claims as covariates in their respective models.

Consistent with the Part 1 analyses:

- 'history of prior claims' was used as a continuous covariate.
- Quarter was used as a categorical covariate to adjust for temporal effects. It designates the quarter at the start of follow-up. There were no cases where follow-up commenced in the first 3 quarters of the project. For the majority of people included in the analysis, follow-up commenced in quarters 7, 8, 9, and 12.
- Age is the 'age at the start of follow-up'. Age group 20-29 was used as the reference group since a considerable proportion of the outcomes relate to this age group.

[d] For 24 people, follow-up started before they had complete 12 months in the cohort (i.e., for those people, we do not have information on the claims history for the entire 12 months period immediately prior to start of follow-up). However, for everyone in the dataset, we have 'prior claims history' information for at least 330 days. Any bias this caused, therefore, was assumed to be small.

2.6.2. Changes to the ACC claims rates from before to after FS.

Rationale

If attendance at FS Awareness is affecting claims-making behaviour, then we might expect to find the following:

- In the group who did not attend FS Awareness, very little change in the rate of claims from the 12 months prior to follow-up to the rate during follow-up

- In the group who attended FS Awareness, an increase in claims rates following attendance compared to rates pre-attendance. .

This applies to each of the four outcomes investigated: all claims, medical fees only claims, earnings related claims of any duration (WCdays>0), and earnings-related claims of over 21 days duration (ie. WCdays>21).

Approach

For those people exposed to FS Awareness, we investigated whether the annual rate of claiming prior to attendance at FS Awareness was less than the annual rate of claiming following attendance. That is, if we set the time of attendance for an individual as time 0, rates (with 95% CIs) were estimated for the four periods: -2 to -1 years, -1 to 0, 0 to 1, and 1 to 2 years.

If there was no change in minor or serious injury rates resulting from attendance at FS, no change in the eligibility to claim during this period, and no change in claims-making behaviour, then the rates should not change beyond what would be expected at random. The hypothesis of no change was investigated.

As comparators, we agreed:

1. to track the number of claims by year over this period amongst those not identified as exposed;
2. to investigate changes to rates in all SBD farmers and farm workers (referred to as “All SBD”), irrespective of exposure.

The Exposed and the All SBD groups are not mutually exclusive; the Exposed group is a subgroup of the All SBD group. When using the All SBD group for this investigation, there is a “dilution effect” (the exposed group is approximately 15% of

the control group - approximately 11,000 out of 71,000 people). That is, the trends produced for (2) will lie intermediate to the trends in rates for the exposed and the unexposed. Nevertheless, the All SBD group still provides a valid comparator group / trend.

Case definition of injury

ACC claims with gradual process / disease claims removed using the algorithm shown in Part 1, Appendix 4. ACC claims records were those which had an injury date in the period July 2001 to June 2005. They were limited to those compensated from the Self-Employed, Employers and Residual accounts and with work-related flag set to "yes".

Methods

In this part of the analysis, we used a linked dataset of ACC claims to Telford enrolment data. All of the ACC dataset relating to SBD farmers / workers and work-related injury claims were included in the linkage, not just the claims used in the 5:1 matching that was used in the original analysis described in Part 1, and in section 2.6.1 of this part (Part 2) of this report. The 5:1 matched data removed some selection bias; cases were selected only if they had had a claim in the 12 months prior to attendance at FS. To use these data in this current analysis would result in biased estimates of claims occurrence in the 12 months immediately prior to attendance. This was not a problem when using the full set of SBD data.

The 4 types of outcomes investigated were: all ACC claims, Medical Fees Only claims, all earnings-related claims (WCdays>0), and earnings-related claims of over 21 days duration (WCdays>21).

In this subproject we define:

- an "Exposed" person as any SBD farmer / worker that attended FS Awareness during the period 1 July 2001 to 30 June 2005, irrespective of whether they had any ACC claim (Telford enrollees).
- an "Unexposed" person as any SBD farmer / worker that did not attend FS Awareness in this same period (counts of cases are derived from ACC claimants with Telford enrollees removed).
- the "All SBD" group comprises any SBD farmer / worker, including those who attended FS Awareness and / or Plans.

See *Figure 1*.

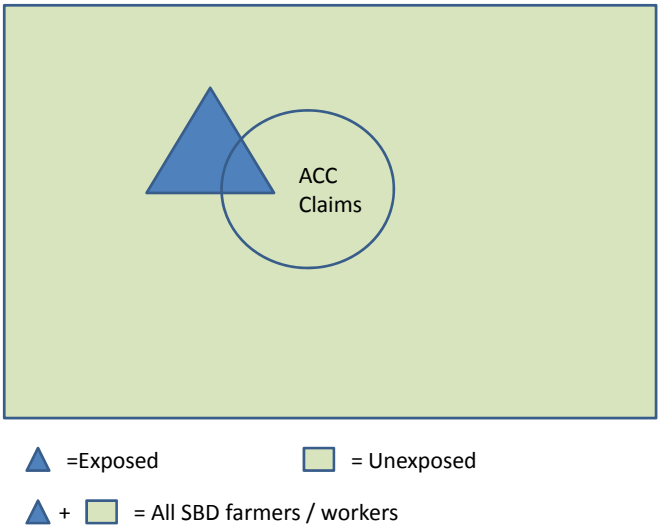

Figure 1: Diagrammatical representation of the exposed, unexposed, and all SBD groups.

Each of the outcomes was counted for four distinct time periods. The definition of time periods depends on whether the person is in the exposed, the unexposed, or the All SBD group.

For the exposed people, time 0 is the date he/she attended FS Awareness; it is different from person to person.

Period 1 is the 12 month interval ending one year prior to time (-2 to -1).

Period 2 is the 12 month interval immediately prior to time 0 (-1 to 0)

Period 3 is the 12 months interval immediately following time 0 (0-1)

Period 4 is the 12 months beginning one year following time 0 (1-2)

For the unexposed people, and the All SBD group, there is no time 0 (defined by attendance at FS Awareness). All unexposed were defined as belonging to the same intervals,

Year 1 is the period 01 Jul 2001 to 30 Jun 2002,
Year 2 is the period 01 Jul 2002 to 30 Jun 2003,
Year 3 is the period 01 Jul 2003 to 30 Jun 2004,
Year 4 is the period 01 Jul 2004 to 30 Jun 2005.

For the exposed people, they may not be counted for the whole of each interval since the study period (the years for which we have ACC claims data) may start or finish half way through an interval. Therefore, for each exposed person, we counted the length of time of observation in each period (i.e. person-years).

Using counts of outcomes occurring in each period, and person-time information derived from the Telford enrolment data, rates for the exposed group were calculated, for each of the outcomes in each period.

Denominators were not available to estimate rates for the unexposed group. We investigated the trend in counts, therefore. (The validity of this approach depends on the implicit assumption that the denominators for the rates remain approximately the same over the 4-year period; they increase slightly, in fact.)

To calculate rates for the All SBD group, SBD farming population numbers in March 2001 and March 2006 were acquired from the Census data. They were interpolated to approximate the farming populations at December each year, the middle month of the project years which spans from July to June.

It is impossible to define ‘before’ and ‘after’ periods for the All SBD group that are comparable with the exposed group, since periods for the exposed were defined in terms of attendance at FS Awareness, but the time intervals presented for the All SBD group relate to fixed 12 month periods, the same for all in the group. As an aid, we have presented the median time of attendance at FS Awareness amongst the exposed as a broken vertical line on the figure for All SBD. This median time of attendance was 25 months from the start of the project. We considered, therefore, years 3 and 4 for the non-exposed group to be approximately comparable to the time after exposure in the exposed groups (Periods 3 and 4).

All rates were age standardized, using the direct method, to compare between time points. For the exposed

- Age of each exposed person at the time of attending the FS was found using their date of birth and date of attending FS from the Telford enrolment data
- The above ages were converted to 'ages at each of the 4 time periods' by subtracting 1.5 years to estimate age at period 1, 0.5 years for period 2, and adding 0.5 years for period 3, and 1.5 years for period 4.

For the All SBD group:

- We interpolated the 2001 and 2006 census data to approximate the SBD farming population at the middle of each year (i.e., to December in in each year) for each age group.
- The age when injured of each claimant in the ACC data was found using date of birth and date of injury.
- Claim type was determined using the "MOE" (see abbreviations) ACC data variable. There were 2924 claims with MOE missing. Where claim type was unknown, they could only be included in the 'all ACC claims' outcome.
- 0.1% of claims relate to people with a recorded age in the 0-14 age group. We did not have denominators for this age group. These claims and this age group were not included in the age-standardised rates.

We used the same standard population for both the exposed and All SBD, namely the age distribution of SBD farmers / workers from the 2006 Census.

Confidence intervals were estimation using the Stata routine[e].

[e] StataCorp 2007, Stata Statistical Software: Stata base reference manual. Release 10. Volume 1 (A-H). College Station. TX: StataCorp LP. page 360-374.

2.6.3. Rates of hospitalisation for the FS Awareness attendees from before to after attendance.

Case definition of injury

The case definition was NMDS discharges, with readmissions removed, whose principal diagnosis was coded to the International Classification of Diseases 10th Revision (ICD10) code range S00-T78 inclusive. This ICD range excludes medical injuries and injury sequelae (ie late effects of injury).

Method

To address the third question, we used similar methods to that described in section 2.6.2 but different outcomes For this part of the analysis, Telford enrolment data for the period 1 July 2001 to 30 June 2005 was linked to the IPRU injury subset of the NMDS (hospital discharges), for patients with a discharge date in the period 2001 to 2006. (For details of the linkage procedure, see Appendix A).

Two outcomes were created:

- Incident cases who were admitted to hospital for at least a day (Daystay>0)
- Incident cases who were identified as serious in terms of threat-to-life (TTL) (ie. cases with an ICISS$\leq$0.941).

In the above, ICISS is the ICD-based Injury Severity Score. The definition of "serious" indicated above captures injury that is associated with at least a 6% likelihood of death. Cases satisfying this definition of serious injury almost always are admitted to hospital. This is the definition of serious TTL injury used for the NZIPS serious injury indicators. [5 6]

The premise behind using these outcomes is that for a population of SBD farmers / workers:

- any effect of FS Awareness on claims making behaviour (rather than injury rates) is less likely to affect admissions to hospital than ACC claims;
- it will be least likely to affect admission to hospital for serious injury, ie. injury with an ICISS$\leq$0.941..

These outcomes were generated for

a) Injury resulting from any activity (eg. farming as well as domestic and leisure activities),

and also for

b) Injury resulting from non-MVTC work-related activities, (identified as an ACC Account code of Self-employed or Employer, or as an NMDS activity code of 2: “Working for income”).

Telford data was used to identify SBD farmers / workers and to determine exposure status, and NMDS was used to identify the outcome.

For each outcome, the rates for the group who attended FS Awareness were produced and the trends over time presented. These were contrasted with the trends in ACC claims for: this same group, as well as with the trend for all SBD famers / workers. (We were unable to contrast this with the numbers or rates of incident hospitalised or serious injury cases for the non-attenders or for all SBD farmers / workers since we cannot identify farmers from the NMDS for those not exposed to FS.)

For each outcome, the counts and the age-standardised rates were estimated for each period. The definition of the time periods was the same as for the exposed in section 2.6.2. Denominators were obtained from the person-years of exposure, derived from the Telford data, as described in section 2.6.2. The methods of age-standardisation and confidence interval estimation were the same as those described in the previous section.

We used Poisson regression to test whether the change from before to after attendance at FS Awareness could be due to chance. The variables ‘age group’ and ‘time periods’ were used as categorical predictor variables, in order to compare age standardised rates. Model fit was assessed by comparing observed and predicted outcomes, and using the Pearson goodness of fit test.

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3. Results

3.1. A replication of the modeling with "all ACC injury claims" as the outcome.

We considered all ACC claims, and medical fees only claims as the outcomes. We investigated 2,867 people who attended Awareness, compared with 14,335 who attended neither Awareness nor Plans.

Cox and logistic regression models were fitted for all 4 combinations (2 outcomes, 2 follow-up periods). The modeling results upon which the presentation below is based are reproduced in Appendix B.

Kaplan-Meier survival estimates from two Cox regressions (2 outcomes, 24 months follow-up) are also presented. The general conclusion from these results is that exposure is associated with higher claim rates.

3.1.1. Cox's regression

For each outcome and follow-up period, attendance at Awareness was associated with increased injury rates (*Table 1*). These associations could be due to confounding and so were explored further in the Cox's and logistic regressions that adjusted for the potential confounders captured by the ACC claims and levy data (*Table 2*).

The results consistently show that attendance at Awareness was associated with increased rates (estimated 42 to 47% greater) of injury resulting in any type of ACC claim, as well as for Medical Fees Only claims, for both 12 or 24 months follow up.

Table 1: The crude rates of injury during follow-up for the data used in the Cox's regression analyses.

Outcome	Follow-up (months)	Expo-sure [a]	No. of out-comes (r)	Total at-risk	Person-months (pm)	Rate (per 1000 pm) [=r/pm*1000]	Crude RR[b]
All claims	12	A	597	2,867	27,870	21.4	1.45
		None	2152	14,335	145,523	14.8	
All claims	24	A	882	2,867	42,885	20.6	1.52
		None	3139	14,335	232,556	13.5	
Medical Fees only	12	A	488	2,867	28,686	17.0	1.42
		None	1775	14,335	148,024	12.0	
Medical Fees only	24	A	736	2,867	44,928	16.4	1.49
		None	2636	14,335	239,073	11.0	

[a] A=exposed to Awareness; None=no exposure to FS Awareness and Plans during the period. [b] RR=rate ratio

Table 2: Rate ratio estimates for Awareness from Cox's regressions after adjusting for confounding.

	Follow-up	Awareness	
Outcome	(Months)	RR	95% CIs
All claims	12	1.45	(1.32 – 1.59)
All claims	24	1.47	(1.35 – 1.59)
Med Fees only	12	1.42	(1.28 – 1.58)
Med Fees only	24	1.42	(1.31 – 1.55)

3.1.2. Logistic regression

The logistic regression results relating to the association between attendance at the FS Awareness Programme and injury risk are similar to those for the Cox's regression (*Table 3*).

Table 3: Odds ratio estimates for Awareness from logistic regression models after adjusting for confounding.

	Follow-up	Awareness	
Outcome	**(Months)**	**OR[a]**	**95% CIs**
All claims	12	1.51	(1.36 – 1.69)
All claims	24	1.59	(1.44 – 1.76)
Med Fees Only	12	1.47	(1.31 – 1.66)
Med Fees Only	24	1.51	(1.36 – 1.68)

[a]=odds ratio.

3.1.3. Kaplan-Meier plots

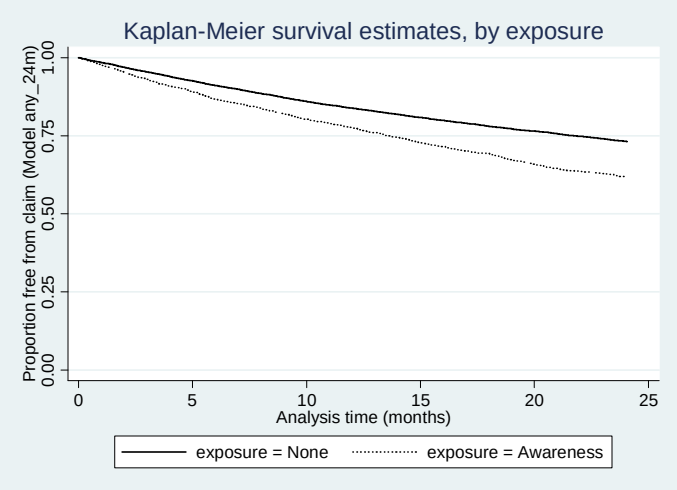
Figures 2a and 2b below show the Kaplan-Meier plots relating to the Cox's regressions. Figure 2a shows the estimated proportion of the SBD farmers / workers who attended FS Awareness and did not make any claim during the 24 months of follow-up since attendance at FS. It also shows the same for the matched controls, who were unexposed to FS Awareness or Plans.

Figure 2b presents estimates of the proportion who did not make a Medical Fees Only claim during the period of follow-up.

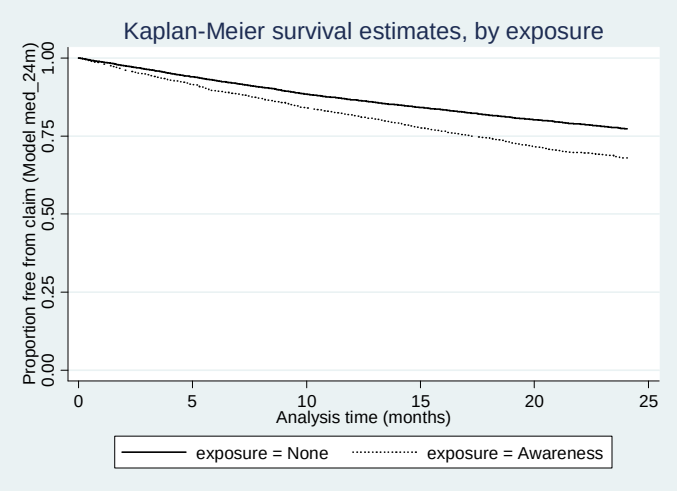
Both figures show that the proportion free from any claim, or free from Medical Fees Only claims, reduced in both groups at a fairly constant rate; however, the proportion in the group who attended FS Awareness reduced more quickly than the controls who did not attend FS Awareness or Plans.

Figure 2: Kaplan-Meier plots showing the proportion of people free from an ACC claim during follow-up.

(a) All claims



(b) Medical Fees Only claims



3.1.4. Summary of the modeling results

Irrespective of the modeling approach used, the results were fairly consistent, showing a statistically significant increased risk / rate of injury after attendance at FS Awareness compared with the unexposed. Estimates ranged from 42% to 47% increased rate; and 47% to 59% increased risk.

3.2. Changes to the ACC claims rates before to after FS.

In 3.1, we considered only a subset of FS Awareness attenders in order to control for selection bias. For the investigation presented in this section we considered all 11,500 Awareness attenders during the period of investigation. This was contrasted with rates for each of the 4 ACC outcomes for all 70,000 SBD farmers / workers in the 4 12-month periods: July 01 to June 02, July 02 to June 03, July 03 to June 04, and July 04 to June 05.

3.2.1. Exposed – counts and rates

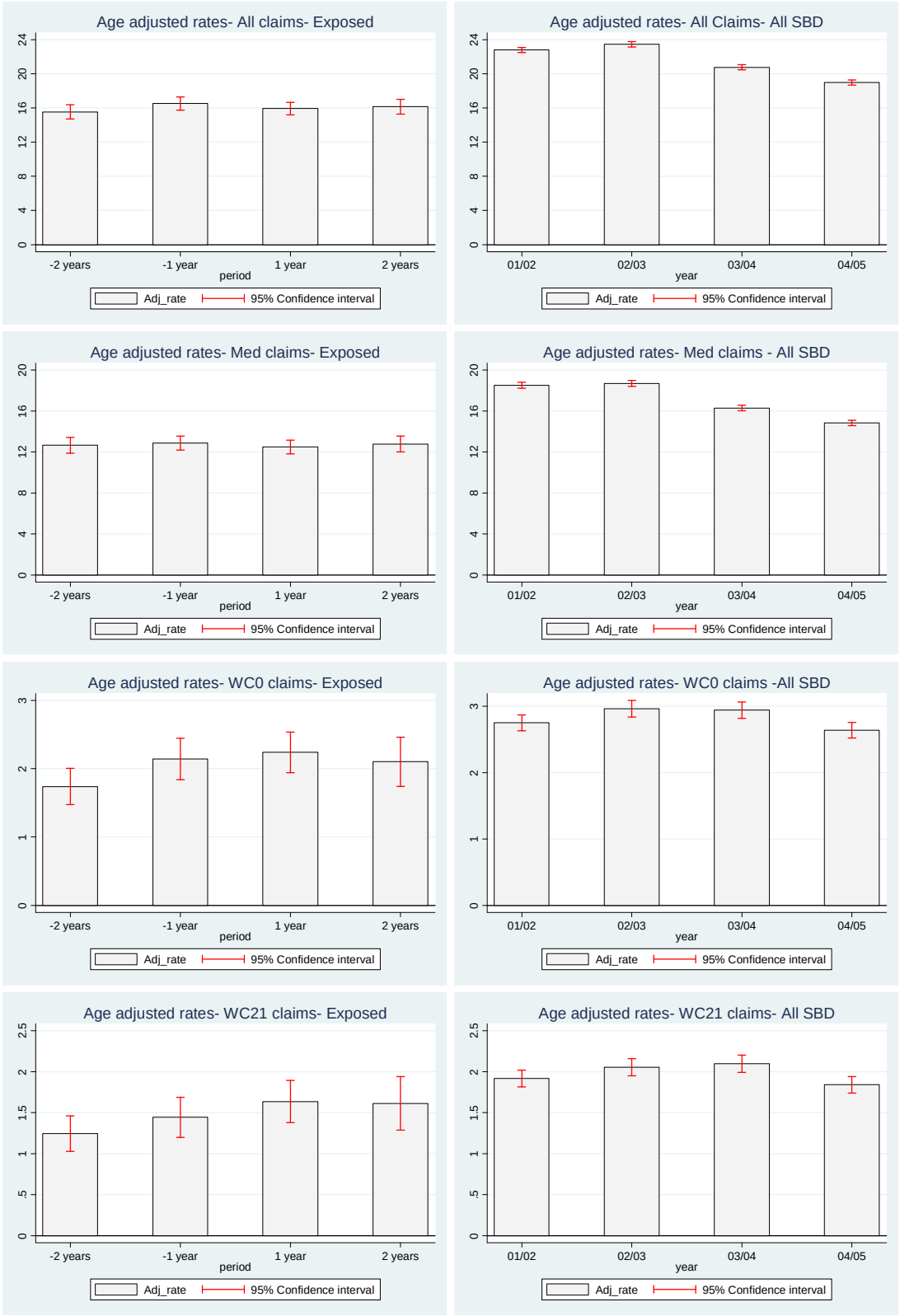
Claims counts, crude and age-adjusted rates for the exposed group, for each of the four periods, are shown in *Table 4*

Table 4 : Age adjusted rates (per 100) and confidence intervals for exposed group

					Adjusted rate		
period	Outcome	Fre-quency	Person-years	Crude rate	Adj_Rate	CI Lower	CI Upper
-2 to -1	Any Claim	1524	10186	15.0	15.5	14.7	16.4
-1 to 0	Any Claim	1892	11531	16.4	16.5	15.8	17.3
0 to 1	Any Claim	1720	10663	16.1	15.9	15.2	16.7
1 to 2	Any Claim	1280	7750	16.5	16.2	15.3	17.0
-2 to -1	Med Fees Only	1224	10186	12.0	12.6	11.9	13.4
-1 to 0	Med Fees Only	1474	11531	12.8	12.9	12.2	13.5
0 to 1	Med Fees Only	1341	10663	12.6	12.5	11.8	13.2
1 to 2	Med Fees Only	1016	7750	13.1	12.8	12.0	13.5
-2 to -1	WC0	188	10186	1.85	1.74	1.47	2.00
-1 to 0	WC0	245	11531	2.12	2.14	1.84	2.44
0 to 1	WC0	246	10663	2.31	2.24	1.94	2.54
1 to 2	WC0	163	7750	2.10	2.10	1.74	2.46
-2 to -1	WC21	135	10186	1.33	1.24	1.03	1.46
-1 to 0	WC21	168	11531	1.46	1.44	1.20	1.69
0 to 1	WC21	176	10663	1.65	1.64	1.38	1.89
1 to 2	WC21	121	7750	1.56	1.61	1.29	1.94

Figure 3 (graphs on the left side) shows the trends in age-standardised rates for people exposed to FS Awareness in periods -2 to -1 years (before attending Awareness) through to 1 to 2 years (after attending Awareness). For Any ACC Claims and Medical Fees Only claims, there was little change in the rates over the four periods. For the ERC outcomes (WCdays>0 – shown as WC0; WCdays>21 – shown as WC21), there was an apparent increase in rates from-2 to -1 years before to 0 to 1 years after attending Awareness, with little difference observable between the last 2 periods.

Figure 3: Age adjusted rates and confidence intervals for exposed people and all SBD farmers / workers at 4 time periods (note different scales in each panel).



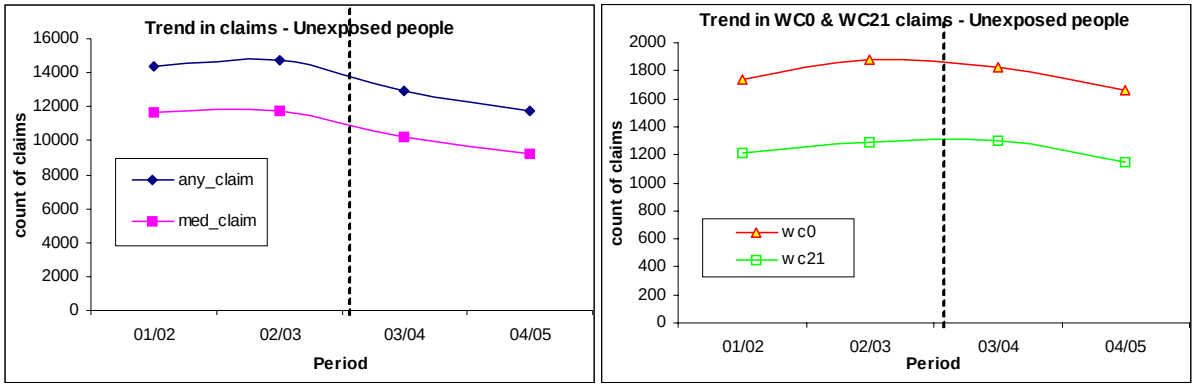
3.2.2. Unexposed – trends in counts

Table 5 and *Figure 4* show the counts of outcomes for unexposed SBD farmers / workers.

Table 5: Numbers of outcomes in unexposed group:

Outcome type	Year 1	Year 2	Year 3	Year 4
Any_claim	14407	14718	12945	11785
Med Fees Only	11694	11744	10175	9194
WC0	1737	1875	1827	1662
WC21	1210	1295	1301	1150

Figure 4: Trend in counts of claims among unexposed people.



The dashed line shows the median for attendance at FS Awareness amongst the exposed, ie. the date before which 50% of the exposed people attended FS Awareness.

The time periods in Figure 3 (figures on the left side) and Figure 4 are not comparable. The time periods in Figure 3 are referenced to time zero (i.e., time of attending FS Awareness). Consequently, the calendar date of time zero is different from person to person. There is no corresponding time zero in Figure 4, in which the points are plotted for calendar years for everyone. Therefore we used the median date of attending FS as the surrogate time zero. 50% of the exposed people attended FS prior to this median date and other 50% attended after that date. This “time zero” is common to everyone in the unexposed group. When calculating this median date we considered FS awareness attendances during the project period (1 July 2001 to 30 June 2005) only. The median date of attendance at FS Awareness for this group was 25 months from the start of the project, i.e., July 2003. and is marked in Figure 4 by a dashed vertical line.

Figure 4 shows a slight downward trend for All ACC Claims, and for Medical Fees Only claims. The number of SBD farmers / workers increased over this period (Table 6). Consequently, if we could calculate rates, we might expect the rates to decline more steeply. (We could have derived rates from Census data, by removing the contribution made by the exposed group from the all SBD farmers / workers person-years to obtain the person-years for the unexposed. Instead, rates were presented for all SBD farmers / workers - using the methods described in 2.6.2 - and these results are presented in the next section.)

3.2.3. All SBD

Counts, crude, and age-adjusted rates for the All SBD group (all SBD farmers / workers) are shown in Table 6. Figure 3 (figures on the right side) shows the trends in age-standardised rates for All SBD. For All ACC Claims and Medical Fee Only claims, there was a distinct reduction in the rate of claims from years 2 through 4. For the ERC outcomes, there were changes in the rates across the 4 years, but no apparent increase or decrease in rates from time 01/02 & 02/03 to time 03/ 04 & 04/05.

Table 6: Crude and age-adjusted rates (per 100) and confidence intervals for the All SBD group

					Adjusted rate		
period	Outcome	Fre-quency	person years	Crude rate	Adj_Rate	CI Lower	CI Upper
1	All ACC claims	16141	70113	23.0	22.8	22.5	23.1
2	All ACC claims	16635	70460	23.6	23.5	23.2	23.8
3	All ACC claims	14749	70806	20.8	20.8	20.5	21.1
4	All ACC claims	13531	71153	19.0	19.0	18.7	19.3
1	Med Fees Only	13111	70113	18.7	18.5	18.2	18.8
2	Med Fees Only	13247	70460	18.8	18.7	18.4	19.0
3	Med Fees Only	11565	70806	16.3	16.3	16.0	16.6
4	Med Fees Only	10573	71153	14.8	14.8	14.6	15.1
1	WC0	1953	70113	2.79	2.75	2.63	2.87
2	WC0	2104	70460	2.99	2.97	2.84	3.09
3	WC0	2092	70806	2.96	2.94	2.82	3.07
4	WC0	1879	71153	2.64	2.64	2.52	2.76
1	WC21	1356	70113	1.93	1.92	1.82	2.02
2	WC21	1457	70460	2.07	2.06	1.95	2.16
3	WC21	1491	70806	2.10	2.10	1.99	2.20
4	WC21	1311	71153	1.84	1.84	1.74	1.94

3.2.4. Summary of findings

For Medical Fees Only claims, there is no suggestion of a change in rates following attendance at FS Awareness for the exposed, but there appears to be factors within the industry that are resulting in the underlying trend across all SBD farmers / workers of reducing Medical Fees Only claims rates during the same period.

For the ERC claims outcomes, there appears to have been a small increase in the rates of claiming following attendance at FS Awareness for the exposed, although the start of this change seemed to occur prior to attendance. This is within the context of little change (or perhaps a small reduction in the last year) in rates across all SBD farmers / workers.

3.3. Changes to the rates of hospitalisation

Like 3.2, for this investigation we considered all 11,500 FS Awareness attenders during the period mid-2002 to mid-2005.

3.3.1. Linking Telford enrolment data to NMDS

Linkage results

The linkage results are described in Appendix A. There were 922 people in the Telford enrolment data who had attended FS Awareness and had at least one record in the IPRU injury subset of the NMDS, with an injury date between 1 July 2001 and 30 June 2005. Upon filtering the NMDS data for first admissions with a primary diagnosis in the range S00-T78, the number of records that linked reduced to 750 injury events, relating to 711 individuals.

Excluding discharges with 0 days stay in hospital reduced these 750 injury events to 546 (for 531 people). Of these, there were 470 events (for 461 people) with injury dates within the 2 year period either side of a participant's attendance at their first FS Awareness course. There were 65 events that occurred more than 2 years prior to, and 11 that were more than 2 years after, attendance at FS Awareness.

There were 92 injury events (for 92 people who had attended FS Awareness) that were serious threat to life (TTL) injury admissions, ie that had an ICISS$\leq$0.941. Of these there were 78 events (for 78 people) with injury dates within the 2 year period either side of a participant's attendance to their first awareness course. 12 events occurred more than 2 years prior to, and 2 events occurred more than 2 years after, attendance at FS Awareness.

Consequently, for the analysis of the outcome that includes all activities (work, leisure, etc.) with Daystay>0 as the outcome, there were 470 injury events (relating to 461 people) and for the analysis with ICISS$\leq$0.941 as the outcome, there were 78 injury events (relating to 78 people).

Of the 470 Daystay>0 cases and 78 ICISS<0.941 cases described in the last paragraph, 310 Daystay>0 and 38 ICISS≤0.941 cases were identified as work-related.

3.3.2. Results

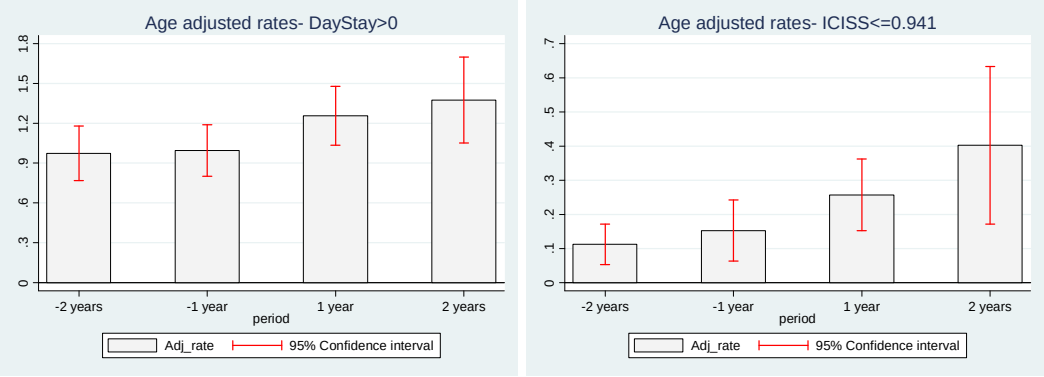
All activities

Crude and age-adjusted rates, for the two hospital discharge-based outcomes, are shown in Table 7. Trends in the age-adjusted rates are shown graphically in Figure 5.

Table 7: Age adjusted rates (per 100) for the two hospital discharge-based outcomes – all activities

					Age adjusted rate		
period	Outcome	Fre-quency	N	Crude	Adj_Rate	CI Lower	CI Upper
1	Daystay>0	110	10190	1.08	0.97	0.77	1.18
2	Daystay>0	121	11531	1.05	1.00	0.80	1.19
3	Daystay>0	141	10663	1.32	1.26	1.04	1.48
4	Daystay>0	98	7750	1.26	1.38	1.05	1.70
1	ICISS≤0.941	14	10190	0.14	0.11	0.05	0.17
2	ICISS≤0.941	16	11531	0.14	0.15	0.06	0.24
3	ICISS≤0.941	27	10663	0.25	0.26	0.15	0.36
4	ICISS≤0.941	21	7750	0.27	0.40	0.17	0.63

Figure 5: Age adjusted rates for the in-patient outcomes – all activities



These figures suggest larger rates after attendance at FS Awareness than before.

In order to compare rates statistically before and after exposure, we combined periods 1 and 2 (“Before”), and periods 3 and 4 (“After”). Crude and age adjusted rates and confidence intervals for ‘before’ and ‘after’ are shown in Table 8. The age-adjusted rates are shown graphically in Figure 6. They show an increase in rates after attendance.

Table 8: Crude and age adjusted rates (per 100) for the in-patient outcomes before and after attendance at FS Awareness – all activities

					Age adjusted rate		
Period	Outcome	Fre-quency	N	Crude Rate	Adj_Rate	CI Lower	CI Upper
Before	Daystay>0	231	21721	1.06	0.99	0.85	1.13
After	Daystay>0	239	18413	1.30	1.31	1.12	1.50
Before	ICISS≤0.941	30	21721	0.14	0.14	0.08	0.19
After	ICISS≤0.941	48	18413	0.26	0.32	0.20	0.44

Figure 6: Age adjusted rates for the in-patient outcomes before and after attendance at FS Awareness – all activities

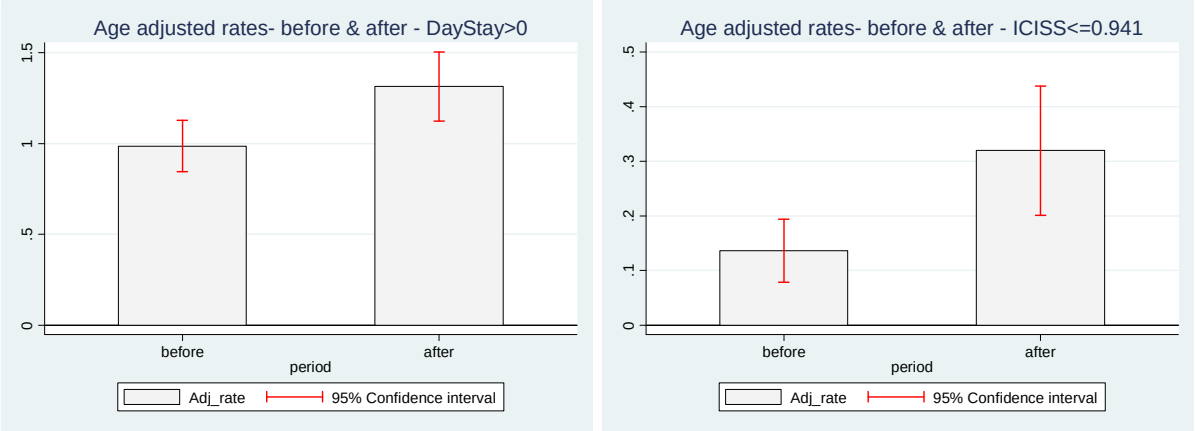


Table 8 and Figure 6 indicate strongly that the rates increase following attendance.

We used Poisson regression to test whether the change could be due to chance alone. Model fit was found to be acceptable by comparing observed and predicted outcomes, and using the Pearson goodness of fit test. The results are shown in Table 9.

Table 9: Rate ratio estimates for FS Awareness only from Cox's regressions after adjusting for age.

Outcome	RR[a]	95% CIs	z	P
Daystay>0	1.26	(1.05 – 1.51)	2.50	0.012
ICISS≤0.941	1.95	(1.24 – 3.08)	2.87	0.004

[a] RR=rate ratio.

For both outcomes, the results show a statistically significant increase in rates following attendance at FS. This analysis estimates a 26% increase in discharges

from hospital for people admitted for injury for at least one day, and a 95% increase in serious TTL injury.

Poisson regression assumes independent observations, which can be violated if some people have multiple outcomes. There were no such multiple serious TTL injury (ICISS$\leq$0.941) outcomes in the dataset (i.e., the 78 outcomes related to 78 people). For the other outcome (Daystay>0), there were 9 people who experienced more than one injury event during the period; nevertheless this is unlikely to affect the results to a large degree.

Work-related injury

Crude and age-adjusted rates, for the two hospital discharge-based outcomes, are shown in Table 10. Trends in the age-adjusted rates are shown graphically in Figure 7.

Table 10: Age adjusted rates (per 100) for the two hospital discharge-based outcomes for work-related injury.

					Age adjusted rate		
period	Outcome	Fre-quency	N	Crude	Adj_Rate	CI Lower	CI Upper
1	Daystay>0	71	10190	0.70	0.65	0.49	0.81
2	Daystay>0	88	11531	0.76	0.74	0.57	0.90
3	Daystay>0	85	10663	0.80	0.78	0.60	0.96
4	Daystay>0	66	7750	0.85	0.91	0.65	1.17
1	ICISS≤0.941	9	10190	0.09	0.08	0.03	0.12
2	ICISS≤0.941	6	11531	0.05	0.05	0.01	0.10
3	ICISS≤0.941	12	10663	0.11	0.13	0.05	0.21
4	ICISS≤0.941	11	7750	0.14	0.24	0.05	0.42

Figure 7: Age adjusted rates for the work-related in-patient outcomes

These figures suggest larger rates after attendance at FS Awareness than before; however, the confidence intervals shown in Figure 7 are wide indicating that the estimates are relatively imprecise.

In order to compare rates before and after exposure, we combined periods 1 and 2 (“Before”), and periods 3 and 4 (“After”). Crude and age adjusted rates and confidence intervals for ‘before’ and ‘after’ are shown in Table 11. The age-adjusted

rates are shown graphically in Figure 8. They show an increase in rates after attendance.

Table 11: Age adjusted rates (per 100) for the work-related in-patient outcomes before and after attendance at FS Awareness:

					Age adjusted rate		
Period	outcome	Fre-quency	N	Crude Rate	Adj_Rate	CI Lower	CI Upper
Before	Daystay>0	159	21721	0.73	0.70	0.58	0.82
After	Daystay>0	151	18413	0.82	0.84	0.68	0.99
Before	ICISS≤0.941	15	21721	0.07	0.06	0.03	0.10
After	ICISS≤0.941	23	18413	0.12	0.17	0.08	0.27

Figure 8: Age adjusted rates (per 100) for the work-related in-patient outcomes before and after attendance at FS Awareness:

We used Poisson regression to test whether the change could be due to chance alone. Model fit was found to be acceptable by comparing observed and predicted outcomes, and using the Pearson goodness of fit test. The results are shown in Table 12.

Table 12: Rate ratio estimates for FS Awareness for the work-related in-patient outcomes from Cox's regressions after adjusting for age.

Outcome	RR[a]	95% CIs[b]	z	P
Daystay>0	1.13	(0.90 – 1.41)	1.06	0.29
ICISS≤0.941	1.80	(0.94 – 3.46)	1.77	0.08

[a] RR=rate ratio. [b] CIs=confidence intervals.

For neither outcome do the results show a statistically significant increase in rates following attendance at FS. Nevertheless, the analysis estimates an 80% increase in serious TTL injury following attendance at FS Awareness, with only a small likelihood of obtaining this result by chance alone (8 in 100). The confidence intervals on these estimates are wide. Small numbers of outcomes are responsible for this lack of precision in the analysis.

3.3.3. Summary of findings

These results show, for people who attended FS Awareness, an increased rate of injury resulting in (a) at least one days stay in hospital, and (b) serious TTL injury – following attendance. The results show a statistically significant increase when making the comparison for injury occurring during any activity (Figure 5), but not when restricted to work-related injury (Figure 7). However, the trends appear very similar, and the lack of statistical significance in the latter case is likely to be due, at least in part, to the smaller number of work-related non-MVTC related injury outcomes leading to lower precision in the comparisons.

4. Discussion relating to both Parts 1 and 2

4.1. Discussion of results

We carried out a pilot outcome evaluation of the FS 'Awareness' and 'Plans' programmes. The aim of this work was to investigate whether a method could be identified for evaluating the effect of attendance at the FS programmes on injury outcomes; a method that uses secondary data sources, and with bias controlled to a sufficient degree that the results would not be misleading. A method was identified that provides some significant control for the effect of selection bias – that would result if those who attend a newly introduced initiative such as FS were different to those who were slower to attend.

We were able to use the pilot method to investigate the association between FS Awareness attendance and subsequent rates of ACC claims for injury. We found that those attending the FS 'Awareness' workshops had an increased rate of ACC earnings-related compensation (ERC) claims. The concern was that this was caused by information bias – ie. for farmers / workers who attended FS Awareness, that attendance did not increase rates of injury, but rather that it encouraged an ERC claim following the occurrence of an injury. Recent Australian work supports the view that this is a concern. [7]

Further work was commissioned to get a better explanation of those results.

4.1.1. Principal findings

We found that attendance at Awareness was associated with an increased rate of all ACC claims, medical fees only claims, and earnings-related compensation claims, for work-related injury, during the 12 and 24 months follow-up post-attendance (*Table 13*). The increased rates were unlikely to be due to chance alone.

Table 13: Rate ratio estimates for Awareness only from Cox's regressions after adjusting for confounding.

Outcome	Follow-up (Months)	Exposed vs Unexposed RR	95% CIs
All claims	12	1.45	(1.32 – 1.59)
	24	1.47	(1.35 – 1.59)
Medical Fees Only	12	1.42	(1.28 – 1.58)
	24	1.42	(1.31 – 1.55)
ERC>0	12	1.60	(1.25 - 2.06)
	24	1.63	(1.34 - 1.99)
ERC>21	12	1.62	(1.20 - 2.19)
	24	1.70	(1.35 - 2.14)

The goal of the Awareness programme is to raise awareness of farm safety amongst the target farm populations. Those who developed and are implementing the programme have indicated that their aim is for it to change the safety culture within these populations, and this is only likely to be achieved over several years. Some change in safety culture has already been discernable, however, from a companion evaluation. [8]

But does attendance at FS Awareness increase rates of injury? The results presented in Table 13 indicate that claims for injury, including disabling injury, were greater in those who attended FS Awareness compared with matched controls who did not attend Awareness or Plans. We do not expect educational interventions on their own to reduce rates of occupational injury. [3 9] The corollary to this is that neither do we expect attendance to increase those rates. The questions are, therefore:

- Are the increases in rates an artefact - eg. due to the influence of FS Awareness on claims-making behaviour, rather than on injury occurrence?
- Or, are the rate increases a consequence of attending FS Awareness – ie. that attendance increases underlying injury rates?
- Or, are the results due to increases in the underlying injury rate that are independent of attendance at the program – eg. as a consequence of the characteristics of the group of farmers / workers who attended FS Awareness?

The methods used in Part 1 of this report were designed to minimise selection bias. However, in regard to the first of these, could the results shown in Table 13 be due to bias caused by FS Awareness attendance influencing claims-making behaviour? A recent study has found that those with farm training of any type were more likely to report that they would attend a GP or a hospital emergency department if they sustained a minor injury. [7] Is this phenomenon also influencing ACC ERC claims-making behaviour? This issue was further investigated in Part 2 of this report; the results of this investigation are reported in sections 3.2 and 3.3, of Part 2, and are discussed below.

Figure 3 (reproduced here from the Results) show the trends in age-adjusted rates for the four ACC based outcomes, for people who attended FS Awareness (exposed), and for all SBD farmers / workers. These results suggest that one of the reasons for the results shown in *Table 13* is as follows.

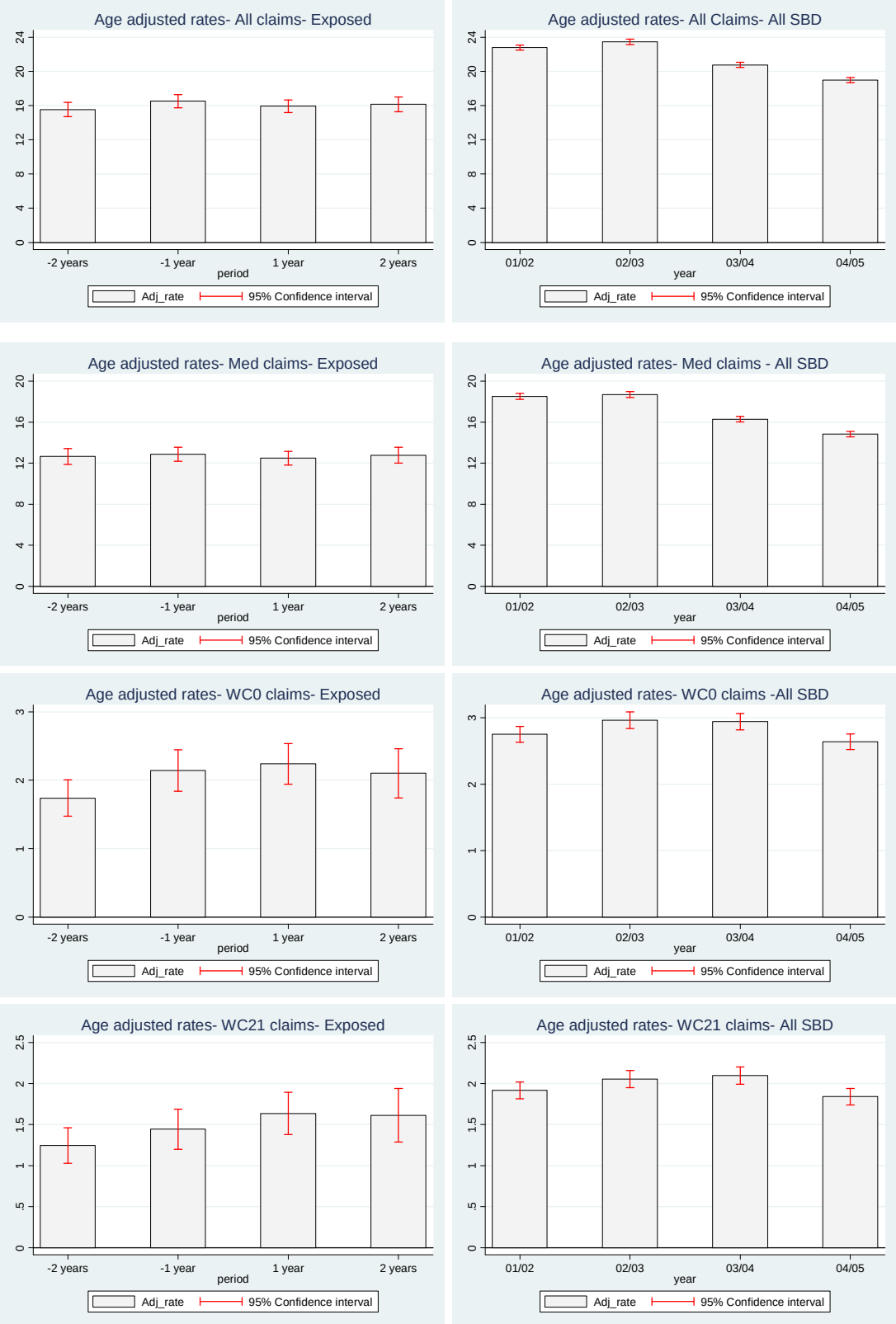
For Medical Fees Only claims, there is no suggestion of a change in rates following attendance at FS Awareness for the exposed. But there appears to be factors within the industry that are resulting in an underlying trend across all SBD farmers / workers of reducing Medical Fees Only claims rates during the same period. So in the exposed group, this downward pressure of reducing claims seems to be accompanied by compensating upward pressure which maintains the Medical Fees only claims rates at a fairly constant level. That compensating upward pressure could be a change in claims making behaviour.

For the ERC claims outcomes, there appears to have been a small increase in the rates of claiming following attendance at FS Awareness for the exposed, although the start of this change seemed to occur prior to attendance. This is within the context of little change (or perhaps a small reduction in the last year of the study period) in rates across all SBD farmers / workers. One reason for these differing trends could still be that attendance at the Awareness course could be affecting earnings-related claims making behaviour.

So the rate of injury claims (for all 4 claims-based outcomes) for the exposed relative to the unexposed have increased over the four years of investigation; from before attendance at Awareness to after attendance.

It should be noted, however, that the rates for the exposed group started much lower than for all SBD farmers / workers. Lower rates would be observed if the people who self-selected to attend FS were more safety conscious – and this translated into a lower underlying rate of claims for this group. During the period of investigation, the rates appeared to get closer together by the end of follow-up; however, the rates for the exposed group were still less than the rates for the unexposed during the whole of the study period.

Figure 3: Age adjusted rates and confidence intervals for exposed people and all SBD farmers / workers at 4 time periods (note different scales in each panel).



Figures 5 and 7 (from the Results) show the before-after comparisons of age standardised rates for the exposed group for two outcomes based on hospital discharges. Figure 5 shows the comparison for SBD farmers / workers injured during any activity (work or non-work), whereas Figure 7 gives this information for work-related non-MVTC related injury only.

Figure 5: Age adjusted rates for the in-patient outcomes

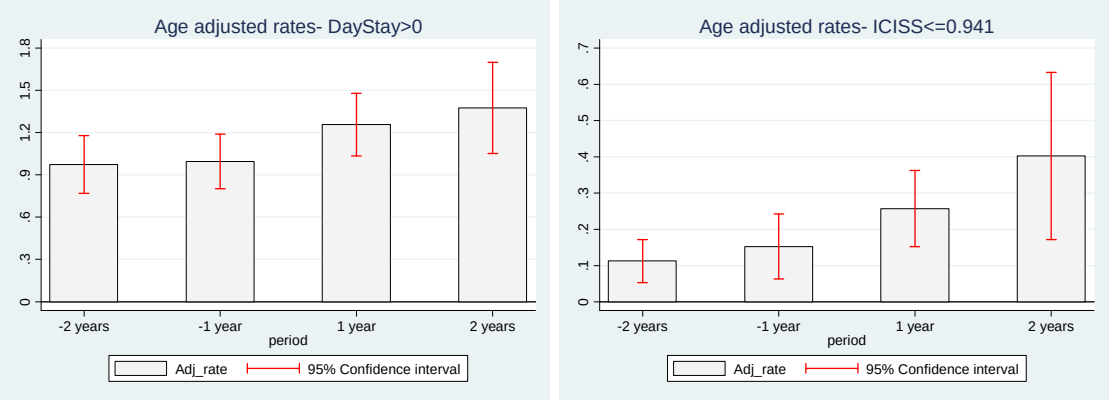


Figure 7: Age adjusted rates for the work-related in-patient outcomes

These results show, for people who attended FS Awareness, an increased rate of injury resulting in (a) at least one days stay in hospital, and (b) serious TTL injury – following attendance. The results show a statistically significant difference when making the comparison for injury occurring during any activity (Figure 5), but not when restricted to work-related injury (Figure 7). However, the trends appear very similar, and the lack of statistical significance in the latter case is likely to be due, at

least in part, to the smaller number of work-related injury outcomes leading to lower precision in the comparisons.

These results are highly suggestive that serious TTL injury has increased over the period of investigation. This injury outcome is less susceptible to biasing factors. Serious TTL injuries, as defined by this ICISS threshold, are a set of injuries that, if sustained, invariably result in the person being admitted to hospital. The results relating to this outcome are effectively free from the influence of claims-making behaviour and the extraneous factors that can affect admissions to hospital. [6]

The results in Figures 5 and 7 for inpatient outcomes show some consistency with those in Figure 3 for the ACC ERC claims outcomes WCdays>0 and >21. They are consistent with the following:

- the rates of claims for exposed increased relative to the unexposed during this 4-year period;
- the rates of ACC ERC claims and discharges / serious TTL injury increased during this 4-year period.

However, there exist the following caveats:

- the rates of ACC claims for the exposed for all of the ACC claims-based outcomes were all less (and remained less throughout the period of investigation) than for the unexposed;
- the rates of discharges / serious TTL injury are at their highest in period 4.

The first caveat relates to the fact that the exposed were different to the unexposed in terms of their injury rates. It seems that these early adopters had a lower injury rate than the average for SBD farmers / workers before attendance. So in this respect, we are not comparing like with like. We have endeavoured to remove this source of selection bias, however, in our matched comparison presented in section 3.1.

The results alluded to in the second caveat are not straightforward in that they exhibit a steady increase year on year, from 2 years before exposure to 2 years after exposure. If this phenomenon was demonstrated in a longer time series (ie. steady increase over time), one would not attribute any of this change to the intervention. Unfortunately the time series is too short – and so one cannot dismiss a change in injury rates that is coincident with attendance at FS Awareness.

The consistency of all of the findings, using these various methods of analysis and data sources, is reassuring. It suggests that we have made no significant errors in our analyses of these data.

Could these results have been obtained due to changes in the industry? There have been changes over recent years. These include: an aging workforce, changing exposure durations and patterns of exposure, shifts in commodity production, shifts in size of operation, changing weather patterns. For these phenomena to explain the results, there would need to be a differential effect on those who attended FS Awareness compared to the remaining SBD farmer / worker population.

4.1.2. Limitations

The results based on the ACC claims outcomes, either in the matched analysis or in the analysis of time trends for 2 years before to 2 years after attendance at FS Awareness, could be biased if the effect of attendance at FS increased the likelihood of either making a claim, or attending a medical practitioner, or both. This does not explain the observed increase in rates of ERCs in the period prior to attendance - before this group of farmers / workers had attended FS.

The results based on hospital discharge data are less likely to be influenced by changes in claims-making behaviour. They are, however, based on a before-after comparison – a weak study design. The period for which we have data is too short to carry out a time series analysis. With a longer time period, a more sound analysis would be possible.

This is a retrospective evaluation employing observational study methods. Although we have endeavoured to control bias, and have used several approaches to do so, there may be sources of bias (that we can only speculate about) that are driving these results. These trends and comparisons could be affected by changes in the farming industry that have occurred in the period under consideration. The results could be obtained if there were differential trends, for the exposed and unexposed, in, for example:

- the changing proportion of sheep and beef farmers / workers compared with dairy farming
- the trend towards bigger farms

4.1.3. What new knowledge this study brings (Conclusions)

The rates of ERC claims and hospitalisations were higher after attendance at FS Awareness; however, the results suggest that the upward trends were apparent before attendance.

For the group of SBD farmers / workers who attended FS Awareness, although their rates of ACC ERC claims for injury increased markedly over the four years, their claims rates remained less than the whole cohort of SBD farmers / workers over the whole period.

The association between attendance at FS Awareness and increased rates of claims and hospitalisations cannot be regarded as causative. Our results are inconsistent with previous published work evaluating educational interventions, which have shown no change in injury rates (upwards or downwards). The most likely explanation for our results is some unexplained bias.

FS Awareness was not designed and introduced to prevent injury, but rather to change the safety climate. It is the full FS package of Awareness, Plans and Skills that aims to reduce injury in the farming population. The full package is yet to be evaluated for its effect on injury rates.

It is difficult to see how FS Awareness attendance could be causing an increased rate of work-related injury, despite the associations that we found. We have endeavoured to reduce any bias associated with each of the parts of the analysis. It is still feasible that some unrecognized bias exists, however. Therefore, it is not possible to determine whether the increased injury rates are a consequence of the FS Awareness programme, or some other factors which were not able to be controlled in our analyses.

These findings may be the result of the inevitable use of a weaker retrospective design for the evaluation of the FS programme – ie. one commissioned only after the programme had been ongoing for 3 years – rather than the stronger approach of one designed and put in place prospectively when the FS programmes were being developed and implemented.

4.2. Recommendations / Implications for the ACC

We recommend that in future, prior to the introduction of new national prevention initiatives, that the intervention be investigated for its efficacy using small scale trials.

a) When a new intervention is being developed, the evaluation design needs to be developed in tandem.
b) The evaluation research should be carried out in a prospective manner, ideally using a controlled trial design, without which it is not possible to clearly define the impact of the program.

Further, if the intervention is found to be efficacious under controlled conditions, the proposed intervention should be tested and evaluated for its effectiveness under "field" conditions.

If the intervention effect is positive, we recommend that only then would the intervention be implemented on a national basis.

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6. Appendix A: Record Linkage

Biostatistical and data management team, IPRU.

Purpose of linkage

To identify those people in the Telford enrolment data who appear in the IPRU injury subset of the NZHIS NMDS of publicly funded hospital discharges - to determine the number of injury events prior to, and post their attendance at a FS Awareness course.

Linkage Methodology

The software used for the record linkage was AutoMatch. The process involved selecting a matching and blocking strategy in a series of successive passes. Blocking creates groups of record pairs to be examined reducing the number of comparisons, and within these groups key variables are examined to determine the probability of a good match. Once the match score is assigned, the results are output and examined for accuracy, and by ranking the matches in order from best to worst, a cut-off point can be chosen. Those that fall below this cut-off can be discarded as non-matches. This process is continued until as many good matches as possible are found while minimising the number of false-positive results.

The linkage was conducted in two stages: the first was to link people between the Telford enrolment data and the NMDS, while the second stage involved linking ACC claims made by people in the Telford data to NMDS in an attempt to verify the accuracy of the first linkage.

Telford to NMDS Linkage

Data Sets

Telford FS enrolments

IPRU received a file of all Telford enrolments in the period 1st July 2001 to 30th June 2005. Duplicate entries of people were removed by selecting the record based on

the first Awareness course taken for an individual (identified via the NZQA[f] ID). There were 11,531 records selected for the linkage.

NZHIS NMDS

Cases were selected from the IPRU datasets containing injury related publicly funded discharges from New Zealand hospitals. These data sets were originally sourced from NZHIS. The data for linkage was extracted from those discharge events which had an injury date that fell in the period 1 July 2001 to 30 June 2005. Since each hospital record is only added to the data set when a discharge occurs, the dataset for linkage was created by selecting cases from the IPRU datasets for 2001 through to 2006 (the latest year held) as a discharge in 2006 could be for an injury event in the first half of 2005 that was followed by a lengthy hospital stay.

This resulted in 532,650 publicly funded discharges which had an injury date in the specified period. This included potential readmissions, and was not filtered by diagnosis code. These discharge events were then grouped by primary NHI number, and filtered for uniqueness, resulting in 367,005 different people (i.e. unique NHI numbers).

Linkage Process:

Table 1: Fields used in the record linkage

Telford Enrolment data	NZHIS data set
NZQA_ID (unique identifier)	NHIPrimary (unique identifier)
First given name	First given name
Second given name	Second given name
Third given name	Third given name
First name initial letter	First name initial letter
Surname	Surname
Date of birth	Date of birth
Year of birth	Year of birth
Month of birth	Month of birth
Day of birth	Day of birth
Soundex of Surname*	Soundex of Surname*
Sex	Sex

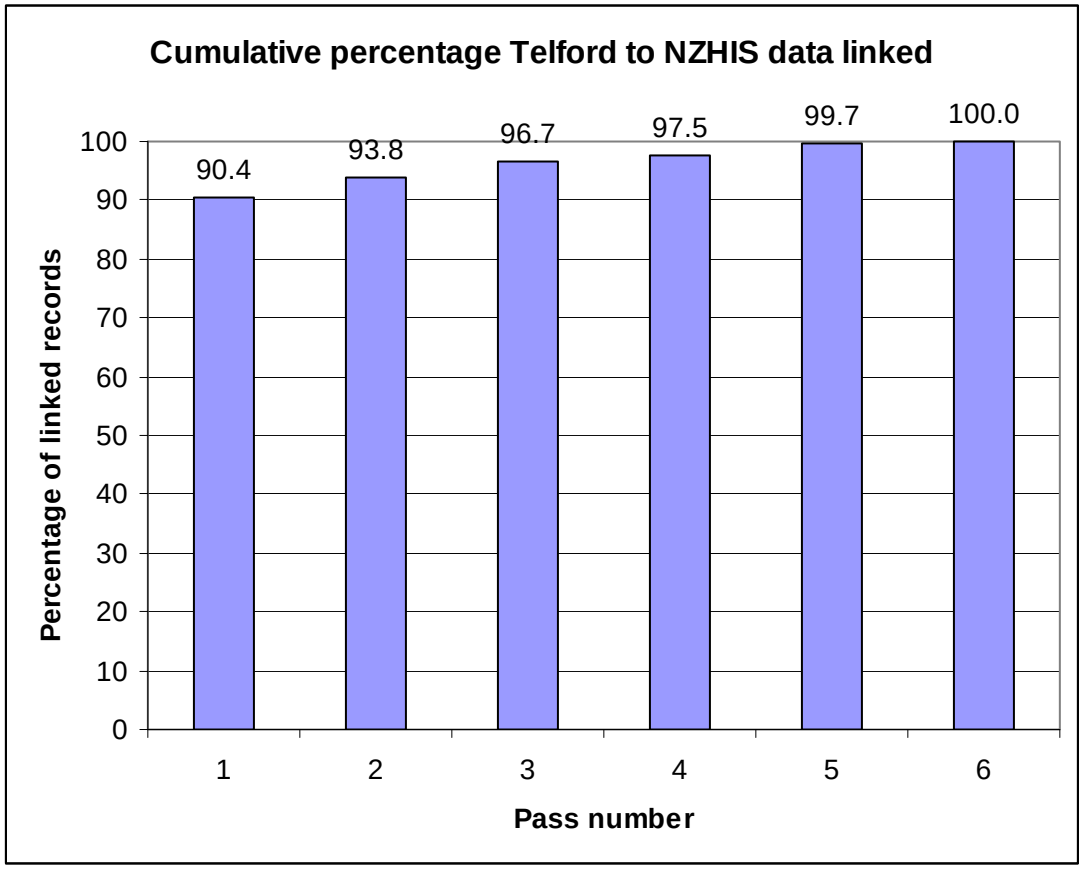
*Soundex is a phonetic algorithm that creates a code value for use in matching names based on the sound of the name to allow for variations in spelling. E.g., "Smith" and "Smyth" are considered to have the same value by Soundex, whereas they are different in a straight character comparison.

[f] New Zealand Qualification Authority.

Table 2: Blocking and matching variables used at each pass

Pass number	Blocking variables	Matching variables
1	First given name Surname Date of birth	Surname
2	Surname Date of birth Year of birth Month of birth Sex	First given name Second given name
3	First name initial letter Year of birth Month of birth Day of birth Soundex of Surname* Sex	First given name Surname
4	Year of birth Month of birth Day of birth Sex First given name Second given name	Surname
5	Surname Sex	Year of birth Month of birth Day of birth First given name Second given name
6	Sex Year of birth	Month of birth Day of birth First given name Second given name Surname

Figure 1: percentage of matches per pass



Stage one linkage result:

Figure 1 shows the percentage of matched record-pairs after each pass of the linkage process. There were 916 matched record pairs, which equates to 7.94% of the Telford Awareness enrolments.

Telford/ACC to NMDS Linkage

Purpose

To find links between ACC claims and NZHIS NMDS injury events using injury date information to assist in finding extra cases that may have been missed in stage one of the linkage.

Data Sets

The NMDS was the same as that used in the previous stage, but the data being linked to it comprised all ACC claims made by people enrolled in a Telford FS Awareness course: 7539 claims to be linked to the 532,650 discharges in the NZHIS set.

Linkage Process:

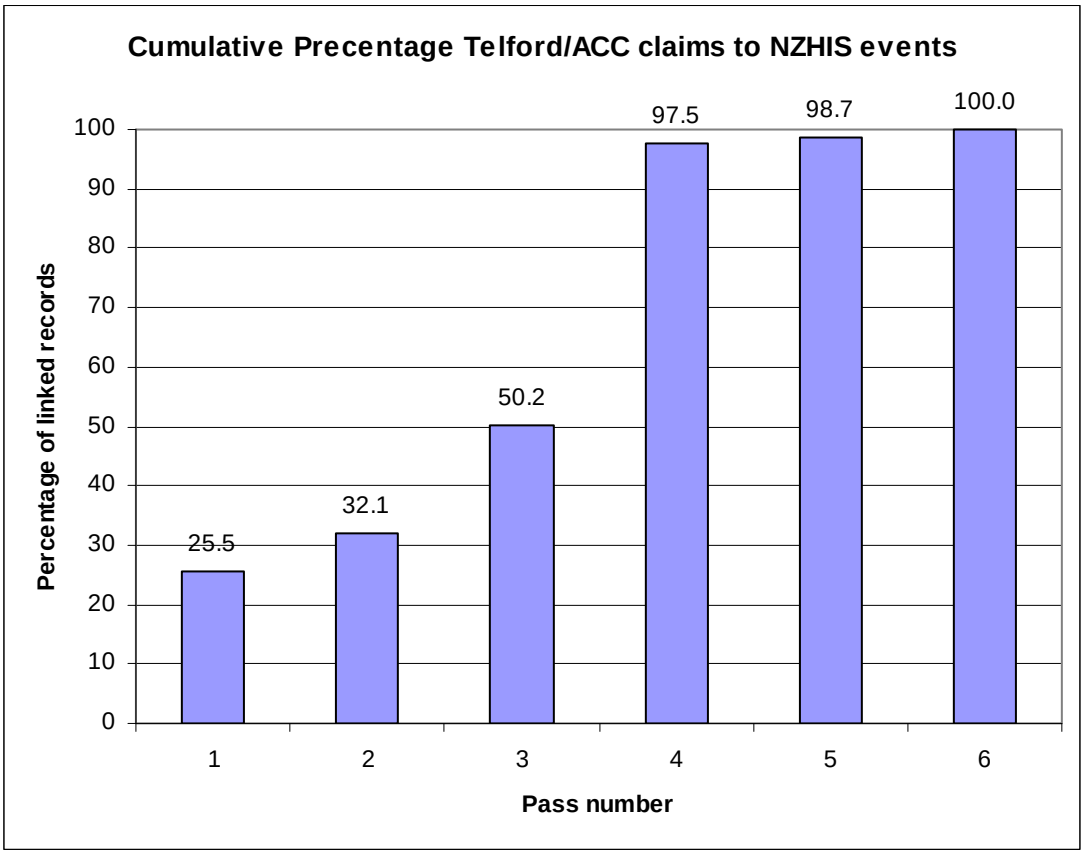
Table 3: Fields used in the record linkage

Telford/Acc claim data	NZHIS data set
Case_ID (unique identifier)	Record_ID (unique identifier)
NHI	NHI
First given name	First given name
Second given name	Second given name
Third given name	Third given name
First name initial letter	First name initial letter
Surname	Surname
Date of birth	Date of birth
Year of birth	Year of birth
Month of birth	Month of birth
Day of birth	Day of birth
Date of injury	Date of injury
Year of injury	Year of injury
Month of injury	Month of injury
Day of injury	Day of injury
Soundex of Surname	Soundex of Surname
Soundex of first name	Soundex of first name
Sex	Sex
Ethnicity	Ethnicity

Table 4: Blocking and matching variables used at each pass

Pass number	Blocking variables	Matching variables
1	NHI First given name Surname Date of birth Date of injury Sex	Surname
2	NHI Surname Date of birth Sex	Date of Injury
3	Sex Date of birth	First given name Surname Date of injury
4	Day of birth Sex	Surname First given name Second given name NHI
5	NHI Sex	NHI
6	Sex First given name Second given name Surname	Date of birth Date of injury

Figure 2: percentage of matches per pass



Stage two linkage result:

There were 529 matched record pairs by the end of the final pass of the second linkage: 7% of the Telford enrolments who had an ACC claim. When these claims were grouped by ACC person IDs and primary NHI numbers to filter out multiple claims by the same person, the final outcome of the linkage resulted in 478 individuals present in both the ACC and NMDS injury datasets.

Creation of Analysis Set

The results of both linkage stages were compared, and it was discovered that stage two had discovered 6 people that did not exist in the stage one linkage. These 6 were added to the initial result set for a total of 922 people who had enrolled in a FS Awareness course being found in the NMDS record, with an injury date between 1 July 2001 and 30 June 2005.

Upon filtering the NMDS for first admissions with a primary diagnosis in the range S00-T78, the number of people with eligible injury dates dropped to 711, with a total of 750 injury events between them.

7. Appendix B: Output from the statistical modeling

Overall Objective of FS follow-up:
To investigate, using secondary data sources, the findings that attendance at an 'awareness' workshop is associated with higher rates of claims following injury – to determine whether this is a real result or an artifact due to uncorrected bias.

Replication of the modeling carried out in the pilot FS OC study but with 'all acc claims' and 'medical fees only claims' as the outcome.

In this work we use the same dataset that was used for logistic and cox regressions in pilot outcome evaluation. This dataset contains exposure (i.e., FS attendance) and outcome (i.e., claims) information from 1:5 matched exposed and control people (not the information for all claimants). For this analysis, following new variables were extracted to the dataset from Telford and ACC data.

- Whether 'any claim' occurred during the follow-up period (12 months or 24 months),
- Date of that claim, date of the first such claim if more than one such claims occurred,
- Whether 'a medical fee only claim' occurred during the follow-up period (12 months or 24 months),
- Date of that claim, date of the first such claim if more than one such claims occurred,

The combinations of these 2 outcomes (i.e., 'occurring an any claim' and 'occurring a medical fee only claim') and 2 follow-up periods (i.e., 12 months and 24 months) will form four different models: named; any_12m, any_24m, med_12m, med_24m. Similar to FS outcome evaluation pilot study, logistic and Cox regressions were fitted for those 4 models. Covariates used in these regressions were the same as in the pilot study. However, following changes had to be made for covariates.

- In pilot study, plans course was one of the exposures. In present regression plans course is not an exposure. However, plans course was included as a covariate, thus making the results from two analyses comparable.
- The 'history of prior claims' covariate specifies the number of claims during 12 months period immediately prior to starting the followup. The type of claims counted here was 'those of the same type as the outcome variable'. Accordingly, wcdays>0 Eclaims and wcdays>21 Eclaims were included as covariates in pilot study for models with wc0 and wc21 outcomes respectively. Instead, in present analysis, we use 'any claims' and 'medical claims' as covariates in models with 'any claims' and 'medical claims' regressions.
- No person in this matched dataset has attended the motobikes skills course, therefore skills_motobikes was not included as a covariate. This is consistent with pilot analysis. Few outcomes were observed among the people attended other skills courses. This allows for us to include them as covariates. We can expect CI for these variables to be wide because only few outcomes present. (Agrichemical and tractors were not included in pilot analysis because there were no Ecalim outcomes).

Notes:

- In consistent with pilot analysis 'history of prior claims' was used as a continuous covariate. May be better to use it as a categorical variable (range for the prior_claim_med variable is from 0 to 4, range for the prior_claim_any variable is from 0 to 5).
- Fund =10 and ACCsuffix=S are identical, they both refers to self_employed. Therefore one is redundant in the presence of other, thus one is dropped from regression due to colinearity. Therefore I did not use fund variable (which is binary), instead used ACCsuffix variable (which has 3 levels).
- When using acc_suffix as a covariate, acc_suffix=E (i.e., self employed but with employees) was used as the reference group because a fair proportion (about 30%) of outcomes are from that category under each model. Same group was used as the reference group in pilot analysis.
- Consistent with the pilot analysis, quarter was used as a categorical covariate. It is the 'quarter at the start of followup'. No cases from first 3 quarters of the project. Majority of outcomes are form quarters 7, 8, 9, and 12 in all models. Therefore I used quarter 7 as the reference group. Same reference group was used in pilot analysis.
- Age is the 'age at the start of the followup', same as in pilot analysis.
- There were no outcomes from agegroups "0_10" or "90_100" under any model, so those groups excluded from regressions. Of the remaining agegroups, agegroup "20_30" was used as the reference group (considerable proportion of outcomes is from that agegroup). This is same as in pilot analysis.
- Previous claims history variable contains the number of claims during 12 months immediately prior to starting the followup. For small number of people, followup started before they complete 12 months in the cohort (i.e., for those people, we do not have information on the claims history for the entire 12 months period immediately prior to start of followup). This problem was present in pilot analysis too. However it is not a big issue, because number of such people is only 24 in each model: 4 exposed people and 20 matched-control people. Also, for everyone in the dataset, we have 'prior claims history' information for at least 330 days (i.e., for everyone in the dataset, first awareness course attendance is at least 330 days after the project starting date of 30th June 2001).

Results:

Cox and logistic regressions were fitted for all 4 models. Resultant regression results are in following 8 tables. Kaplan-Meier survival estimates plots from four Cox regressions are also presented. The general conclusion from these results is, exposure is associated with higher claim rates.

A) any_12m model

Cox regression:

```
. stcox exposed plans quarter4 quarter5 quarter6 quarter8 quarter9 quarter10 quarter11
quarter12 quarter13 quarter14 quarter15 quarter16 male pcu1230 pcu1240 pcu1250 pcu1300
age10_20 age30_40 age40_50 age50_60 age60_70 age70_80 age80_90 earn25_50p earn50_75p
earn75_100p occu_mixedlivestock occu_croplivestock occu_otheragri occu_other ethnic_maori
ethnic_other ethnic_unknown skill_atv skill_agrichemicals skill_chainsaws skill_tractors
accsuffix_d accsuffix_s prior_claim_any

No. of subjects =        16886                     Number of obs   =     16886
No. of failures =         2734
Time at risk    =  169964.7252
                                                   LR chi2(43)     =    545.10
Log likelihood  =   -25879.112                     Prob > chi2     =    0.0000

------------------------------------------------------------------------------
          _t | Haz. Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     exposed |   1.448318   .0711444     7.54   0.000      1.31538    1.594692
       plans |   .8852457   .1342126    -0.80   0.421      .657677    1.191558
    quarter4 |   1.169959   .5272949     0.35   0.728     .4836581    2.830109
    quarter5 |   1.038984    .146034     0.27   0.786      .788803    1.368514
    quarter6 |   1.140248   .1399797     1.07   0.285     .8964038    1.450424
    quarter8 |   1.017766   .0634512     0.28   0.778      .900702    1.150045
    quarter9 |   1.043568   .0722421     0.62   0.538     .9111615    1.195215
   quarter10 |   .9476484   .1115816    -0.46   0.648     .7523534    1.193638
   quarter11 |   .8984191    .094905    -1.01   0.311     .7304018    1.105086
   quarter12 |   .9881773   .0695133    -0.17   0.866     .8609087     1.13426
   quarter13 |   1.062987    .101063     0.64   0.521     .8822682    1.280724
   quarter14 |   .9881983   .1545357    -0.08   0.939     .7273311    1.342629
   quarter15 |   .7992342   .2865716    -0.63   0.532      .395794    1.613909
   quarter16 |   .5864884   .1736488    -1.80   0.072      .328272    1.047816
        male |    1.56797   .0900823     7.83   0.000     1.400989    1.754852
     pcu1230 |   .9827456   .1103063    -0.16   0.877      .788678    1.224567
     pcu1240 |   .9415636   .1247589    -0.45   0.650     .7262128    1.220774
     pcu1250 |   .8832471   .1203835    -0.91   0.362     .6761864    1.153714
     pcu1300 |   .9659966    .107776    -0.31   0.757     .7762601    1.202109
    age10_20 |   .8989637   .1299352    -0.74   0.461     .6771899    1.193366
    age30_40 |   1.199975   .0935154     2.34   0.019         1.03    1.398001
    age40_50 |   1.240126   .0965355     2.76   0.006     1.064647    1.444529
    age50_60 |   1.175519   .0965022     1.97   0.049      1.00081    1.380726
    age60_70 |   1.208879   .1115305     2.06   0.040     1.008908    1.448486
    age70_80 |   .9883437   .1363901    -0.08   0.932      .754125    1.295307
    age80_90 |   .9533845   .2746253    -0.17   0.868     .5420969    1.676715
  earn25_50p |   1.138889    .063257     2.34   0.019     1.021418    1.269871
  earn50_75p |   1.135587   .0643409     2.24   0.025      1.01623    1.268961
 earn75_100p |   1.093837   .0702535     1.40   0.163     .9644565    1.240573
occu_mixed~k |   .9944691    .112965    -0.05   0.961      .795977    1.242459
occu_cropl~k |   1.090874    .075952     1.25   0.212     .9517208    1.250372
occu_other~i |     1.0089   .0607596     0.15   0.883     .8965727    1.135299
  occu_other |   .8900761   .0559241    -1.85   0.064     .7869471     1.00672
ethnic_maori |   .9200349   .1030232    -0.74   0.457     .7387353    1.145829
ethnic_other |   .8375564      .0984    -1.51   0.131       .66529    1.054429
ethnic_unk~n |   .6980876   .0814841    -3.08   0.002     .5553332    .8775384
   skill_atv |    1.04307   .3330136     0.13   0.895     .5579002    1.950162
skill_agri~s |   .7278193   .5183993    -0.45   0.656     .1801954    2.939704
skill_chai~s |   1.699216   .7296499     1.23   0.217     .7323846    3.942374
skill_trac~s |   1.352439   .7066989     0.58   0.563     .4856616    3.766185
 accsuffix_d |   .9735643   .1929594    -0.14   0.892     .6601724    1.435727
 accsuffix_s |   1.622955   .0911287     8.62   0.000     1.453823    1.811762
prior_clai~y |   1.380009   .0361039    12.31   0.000      1.31103    1.452617
------------------------------------------------------------------------------
```

Logistic regression:

```
. logistic outcome exposed plans quarter4 quarter5 quarter6 quarter8 quarter9 quarter10
quarter11 quarter12 quarter13 quarter14 quarter15 quarter16 male pcu1230 pcu1240 pcu1250
pcu1300 age10_20 age30_40 age40_50 age50_60 age60_70 age70_80 age80_90 earn25_50p
earn50_75p earn75_100p occu_mixedlivestock occu_croplivestock occu_otheragri occu_other
ethnic_maori ethnic_other ethnic_unknown skill_atv skill_agrichemicals skill_chainsaws
skill_tractors accsuffix_d accsuffix_s prior_claim_any if model=="any_12m",or

Logistic regression                                 Number of obs   =      16886
                                                    LR chi2(43)     =     884.74
                                                    Prob > chi2     =     0.0000
Log likelihood = -7035.1274                         Pseudo R2       =     0.0592

------------------------------------------------------------------------------
     outcome | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     exposed |   1.514582   .0853209     7.37   0.000     1.356257    1.691388
       plans |   .8723258   .1520566    -0.78   0.433     .6198752    1.227589
    quarter4 |   1.172959   .6060034     0.31   0.757     .4261019     3.22888
    quarter5 |   1.054432   .1678066     0.33   0.739     .7718892    1.440397
    quarter6 |   1.170335    .163496     1.13   0.260     .8900143    1.538945
    quarter8 |   1.017089   .0711308     0.24   0.809     .8868077    1.166509
    quarter9 |   1.040907    .080954     0.52   0.606     .8937409    1.212305
   quarter10 |   .9456101   .1238172    -0.43   0.669     .7315714    1.222271
   quarter11 |   .8876234   .1039747    -1.02   0.309     .7055381    1.116701
   quarter12 |   .9788784   .0770154    -0.27   0.786     .8389935    1.142086
   quarter13 |    1.01434   .1077901     0.13   0.893     .8236252    1.249216
   quarter14 |   .5888565   .0975658    -3.20   0.001     .4255754    .8147837
   quarter15 |   .2429261   .0896883    -3.83   0.000     .1178177    .5008846
   quarter16 |   .0563052   .0167127    -9.69   0.000     .0314696    .1007408
        male |   1.644216   .1023961     7.98   0.000     1.455288    1.857671
     pcu1230 |   .9759975   .1226082    -0.19   0.847     .7629882    1.248474
     pcu1240 |   .9476919   .1408026    -0.36   0.718     .7082728    1.268043
     pcu1250 |   .8586666   .1304964    -1.00   0.316     .6374743    1.156609
     pcu1300 |   .9516491   .1187947    -0.40   0.691     .7451111    1.215437
    age10_20 |   .8832241   .1360168    -0.81   0.420     .6531088    1.194418
    age30_40 |   1.221072   .1036767     2.35   0.019     1.033877    1.442161
    age40_50 |   1.262898   .1074148     2.74   0.006     1.068981    1.491992
    age50_60 |   1.186918   .1065513     1.91   0.056     .9954218    1.415254
    age60_70 |   1.217246   .1237802     1.93   0.053     .9972881    1.485716
    age70_80 |   .9697184   .1468103    -0.20   0.839     .7207394    1.304707
    age80_90 |   .9320707    .292979    -0.22   0.823     .5033726     1.72587
  earn25_50p |   1.160412   .0720605     2.40   0.017     1.027432    1.310602
  earn50_75p |   1.159263   .0734469     2.33   0.020     1.023889    1.312536
 earn75_100p |   1.114409   .0792831     1.52   0.128     .9693639    1.281156
occu_mixed~k |   1.010631   .1301456     0.08   0.935     .7851958    1.300791
occu_cropl~k |   1.098335   .0866594     1.19   0.235     .9409666    1.282021
occu_other~i |   1.008875   .0670377     0.13   0.894     .8856801    1.149207
  occu_other |   .8690562   .0598743    -2.04   0.042     .7592829    .9946998
ethnic_maori |   .9105443   .1110316    -0.77   0.442     .7169779    1.156369
ethnic_other |   .8237482   .1066218    -1.50   0.134     .6391742    1.061622
ethnic_unk~n |   .6717648   .0845534    -3.16   0.002     .5249025    .8597177
   skill_atv |   1.057813   .3859227     0.15   0.878     .5174455    2.162486
skill_agri~s |   .7579501   .6148757    -0.34   0.733     .1545667    3.716766
skill_chai~s |   1.756059   .9241306     1.07   0.285     .6260257    4.925906
skill_trac~s |   1.424216   .8534293     0.59   0.555     .4400604    4.609345
 accsuffix_d |   .9784295   .2101027    -0.10   0.919     .6423135    1.490431
 accsuffix_s |   1.722081   .1061152     8.82   0.000     1.526167    1.943143
prior_clai~y |   1.436623   .0431914    12.05   0.000     1.354415     1.52382
------------------------------------------------------------------------------
```

(B) any_24m model

Cox regression:

```
. stcox exposed plans quarter4 quarter5 quarter6 quarter8 quarter9 quarter10 quarter11
quarter12 quarter13 quarter14 quarter15 quarter16 male pcu1230 pcu1240 pcu1250 pcu1300
age10_20 age30_40 age40_50 age50_60 age60_70 age70_80 age80_90 earn25_50p earn50_75p
earn75_100p occu_mixedlivestock occu_croplivestock occu_otheragri occu_other ethnic_maori
ethnic_other ethnic_unknown skill_atv skill_agrichemicals skill_chainsaws skill_tractors
accsuffix_d accsuffix_s prior_claim_any

No. of subjects =        16886                     Number of obs   =     16886
No. of failures =         3992
Time at risk    =  269460.7576
                                                   LR chi2(43)     =    877.00
Log likelihood  =   -37085.023                     Prob > chi2     =    0.0000

------------------------------------------------------------------------------
          _t | Haz. Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     exposed |   1.465151   .0593958     9.42   0.000     1.353242    1.586314
       plans |   .9796427   .1190402    -0.17   0.866     .7720313    1.243084
    quarter4 |    1.00078   .3808347     0.00   0.998     .4747056    2.109857
    quarter5 |   1.010758   .1122019     0.10   0.923      .813125    1.256426
    quarter6 |   1.088022   .1054253     0.87   0.384     .8998276    1.315576
    quarter8 |   .9961646   .0481543    -0.08   0.937     .9061169    1.095161
    quarter9 |   .9901774   .0539199    -0.18   0.856     .8899407    1.101704
   quarter10 |   .9377611   .0908684    -0.66   0.507     .7755528    1.133895
   quarter11 |   .8925057   .0819153    -1.24   0.215      .745567    1.068404
   quarter12 |   .9734756   .0604215    -0.43   0.665     .8619715    1.099404
   quarter13 |   1.035371    .093404     0.39   0.700     .8675741    1.235622
   quarter14 |   .9616968   .1473671    -0.25   0.799     .7122017    1.298594
   quarter15 |   .7938929   .2835623    -0.65   0.518     .3942123    1.598798
   quarter16 |   .5672091   .1670616    -1.93   0.054     .3184466    1.010299
        male |   1.604076   .0762564     9.94   0.000     1.461368     1.76072
     pcu1230 |   .9926977   .0925032    -0.08   0.937     .8269876    1.191613
     pcu1240 |   .9562803   .1051893    -0.41   0.684     .7708224    1.186359
     pcu1250 |   .8972583   .1010884    -0.96   0.336     .7194788    1.118966
     pcu1300 |   .9086372    .084258    -1.03   0.302     .7576325    1.089739
    age10_20 |   .8246137   .1005697    -1.58   0.114     .6492892     1.04728
    age30_40 |   1.184333   .0761735     2.63   0.009     1.044063    1.343449
    age40_50 |   1.247069   .0799088     3.45   0.001     1.099886    1.413947
    age50_60 |   1.139038    .077205     1.92   0.055       .99734    1.300869
    age60_70 |    1.08763   .0839184     1.09   0.276     .9349859    1.265195
    age70_80 |   .9461122   .1082903    -0.48   0.628     .7559892    1.184049
    age80_90 |   .6645075   .1826174    -1.49   0.137     .3877716    1.138738
  earn25_50p |   1.186735   .0550024     3.69   0.000     1.083683    1.299586
  earn50_75p |   1.230707   .0579046     4.41   0.000     1.122292    1.349596
 earn75_100p |   1.164468   .0622005     2.85   0.004     1.048722    1.292989
occu_mixed~k |   .9883676   .0931833    -0.12   0.901     .8216128    1.188967
occu_cropl~k |   1.014528   .0598416     0.24   0.807     .9037665    1.138864
occu_other~i |   1.014118   .0502282     0.28   0.777     .9203003    1.117501
  occu_other |   .8816341   .0456719    -2.43   0.015     .7965132    .9758516
ethnic_maori |   .8483967   .0809441    -1.72   0.085     .7036996    1.022847
ethnic_other |    .840906   .0816061    -1.79   0.074      .695252    1.017074
ethnic_unk~n |   .6748574   .0657602    -4.04   0.000     .5575301    .8168751
   skill_atv |   .8791157   .2519877    -0.45   0.653     .5012561    1.541816
skill_agri~s |   1.160322   .5239388     0.33   0.742     .4788744    2.811481
skill_chai~s |   1.474533   .5883876     0.97   0.330     .6745228    3.223385
skill_trac~s |   1.580924   .7134851     1.01   0.310     .6527637    3.828828
 accsuffix_d |   .9430133    .161483    -0.34   0.732     .6741504    1.319103
 accsuffix_s |   1.716351   .0798651    11.61   0.000     1.566745    1.880244
prior_clai~y |   1.359619   .0299101    13.96   0.000     1.302242    1.419524
------------------------------------------------------------------------------
```

Logistic Regression:

```
. logistic outcome exposed plans quarter4 quarter5 quarter6 quarter8 quarter9 quarter10
quarter11 quarter12 quarter13 quarter14 quarter15 quarter16 male pcu1230 pcu1240 pcu1250
pcu1300 age10_20 age30_40 age40_50 age50_60 age60_70 age70_80 age80_90 earn25_50p
earn50_75p earn75_100p occu_mixedlivestock occu_croplivestock occu_otheragri occu_other
ethnic_maori ethnic_other ethnic_unknown skill_atv skill_agrichemicals skill_chainsaws
skill_tractors accsuffix_d accsuffix_s prior_claim_any if model=="any_24m",or

Logistic regression                                     Number of obs   =      16886
                                                        LR chi2(43)     =    1727.02
                                                        Prob > chi2     =     0.0000
Log likelihood = -8371.5292                             Pseudo R2       =     0.0935

------------------------------------------------------------------------------
     outcome | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     exposed |   1.592287   .0808442     9.16   0.000     1.441464    1.758891
       plans |   .9793713   .1525351    -0.13   0.894     .7217295    1.328986
    quarter4 |   .9231069   .4309959    -0.17   0.864     .3696821    2.305024
    quarter5 |   1.012156   .1393046     0.09   0.930     .7728506    1.325561
    quarter6 |   1.123547   .1360805     0.96   0.336     .8861281    1.424578
    quarter8 |   .9914313    .058852    -0.14   0.885     .8825406    1.113757
    quarter9 |   .9416173   .0626952    -0.90   0.366     .8264171    1.072876
   quarter10 |   .7574603   .0866207    -2.43   0.015     .6053677    .9477646
   quarter11 |   .5832392   .0616634    -5.10   0.000     .4740812     .717531
   quarter12 |   .5248192   .0374665    -9.03   0.000     .4562922    .6036377
   quarter13 |   .4968362   .0506436    -6.86   0.000     .4068632    .6067056
   quarter14 |   .2911901   .0473838    -7.58   0.000     .2116728     .400579
   quarter15 |   .1212725   .0446769    -5.73   0.000     .0589086    .2496583
   quarter16 |     .02718   .0080293   -12.20   0.000     .0152333     .048496
        male |   1.738603   .0943255    10.19   0.000     1.563218    1.933665
     pcu1230 |   .9813231   .1097565    -0.17   0.866     .7881503    1.221842
     pcu1240 |    .951529   .1260097    -0.38   0.708     .7340042    1.233518
     pcu1250 |   .8759035   .1179213    -0.98   0.325     .6727606    1.140386
     pcu1300 |   .8691175   .0966648    -1.26   0.207     .6988861    1.080813
    age10_20 |   .7938553   .1067423    -1.72   0.086     .6099416    1.033224
    age30_40 |   1.198534   .0887433     2.45   0.014     1.036632    1.385722
    age40_50 |   1.277426   .0946955     3.30   0.001     1.104679    1.477186
    age50_60 |   1.150001   .0902677     1.78   0.075     .9860169    1.341257
    age60_70 |   1.070136   .0963595     0.75   0.452     .8970015    1.276688
    age70_80 |   .9157633   .1219156    -0.66   0.509     .7054444    1.188786
    age80_90 |   .6071814   .1856488    -1.63   0.103     .3334718    1.105548
  earn25_50p |   1.250976   .0692988     4.04   0.000     1.122266    1.394447
  earn50_75p |   1.317221   .0742728     4.89   0.000     1.179404    1.471142
 earn75_100p |    1.23027   .0775061     3.29   0.001     1.087365    1.391956
occu_mixed~k |   1.013297   .1171512     0.11   0.909     .8078412    1.271006
occu_cropl~k |   .9992699   .0715736    -0.01   0.992     .8683898    1.149876
occu_other~i |    1.01021   .0588804     0.17   0.862     .9011538    1.132463
  occu_other |   .8494894   .0512038    -2.71   0.007     .7548331    .9560157
ethnic_maori |   .8250554   .0895925    -1.77   0.077     .6668857    1.020739
ethnic_other |   .8105108   .0921198    -1.85   0.065     .6486557    1.012753
ethnic_unk~n |   .6259873   .0688092    -4.26   0.000      .504662    .7764805
   skill_atv |   .8668534   .3022502    -0.41   0.682     .4376761    1.716874
skill_agri~s |   1.614341   1.089625     0.71   0.478     .4299946    6.060763
skill_chai~s |   1.596832   .8294281     0.90   0.368     .5769358    4.419684
skill_trac~s |   1.703591   .9557445     0.95   0.342     .5673178    5.115692
 accsuffix_d |    .935437   .1803278    -0.35   0.729      .641099     1.36491
 accsuffix_s |   1.927326   .1043951    12.11   0.000     1.733202    2.143193
prior_clai~y |   1.447194   .0395561    13.52   0.000     1.371705    1.526837
------------------------------------------------------------------------------
```

C) med_12m model

Cox Regression:

```
. stcox exposed plans quarter4 quarter5 quarter6 quarter8 quarter9 quarter10 quarter11
quarter12 quarter13 quarter14 quarter15 quarter16 male pcu1230 pcu1240 pcu1250 pcu1300
age10_20 age30_40 age40_50 age50_60 age60_70 age70_80 age80_90 earn25_50p earn50_75p
earn75_100p occu_mixedlivestock occu_croplivestock occu_otheragri occu_other ethnic_maori
ethnic_other ethnic_unknown skill_atv skill_agrichemicals skill_chainsaws skill_tractors
accsuffix_d accsuffix_s prior_claim_med

No. of subjects =        16886                     Number of obs   =     16886
No. of failures =         2251
Time at risk    =  173258.4322
                                                   LR chi2(43)     =    473.19
Log likelihood  =   -21331.752                     Prob > chi2     =    0.0000

------------------------------------------------------------------------------
          _t | Haz. Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     exposed |   1.422016   .0770806     6.50   0.000     1.278689    1.581408
       plans |   .8577795   .1456504    -0.90   0.366     .6149534     1.19649
    quarter4 |   1.146275   .5773334     0.27   0.786     .4271416    3.076135
    quarter5 |   .9852831   .1544831    -0.09   0.925     .7246039    1.339743
    quarter6 |   1.123131   .1503601     0.87   0.386     .8639231     1.46011
    quarter8 |   .9544169   .0651793    -0.68   0.495     .8348485     1.09111
    quarter9 |   1.018333   .0768726     0.24   0.810     .8782812    1.180717
   quarter10 |   .9322085   .1200872    -0.54   0.586     .7242045    1.199955
   quarter11 |   .9040097   .1032714    -0.88   0.377     .7226605    1.130868
   quarter12 |   .9310366   .0718156    -0.93   0.354     .8004039     1.08299
   quarter13 |    1.00813   .1054391     0.08   0.938      .821278    1.237492
   quarter14 |   1.063923   .1747882     0.38   0.706     .7710266    1.468085
   quarter15 |   .8632356   .3311143    -0.38   0.701     .4070343    1.830744
   quarter16 |   .5914829     .19197    -1.62   0.106     .3130968    1.117393
        male |   1.546865   .0974701     6.92   0.000     1.367153    1.750201
     pcu1230 |   .9462384   .1138187    -0.46   0.646     .7475039    1.197809
     pcu1240 |   .8455666   .1220807    -1.16   0.245     .6371673    1.122127
     pcu1250 |   .8221359    .120935    -1.33   0.183     .6162162    1.096867
     pcu1300 |   .8862969   .1061572    -1.01   0.314     .7008509    1.120812
    age10_20 |   .9473697   .1538533    -0.33   0.739     .6891027    1.302432
    age30_40 |   1.235123   .1084246     2.41   0.016     1.039891    1.467008
    age40_50 |   1.274614   .1116697     2.77   0.006     1.073505    1.513397
    age50_60 |   1.127348   .1044983     1.29   0.196     .9400629    1.351946
    age60_70 |   1.239648   .1273098     2.09   0.036     1.013635    1.516057
    age70_80 |   .9375456   .1448451    -0.42   0.676     .6926071    1.269106
    age80_90 |   1.165559   .3390094     0.53   0.598     .6591098    2.061157
  earn25_50p |   1.106054   .0673389     1.66   0.098     .9816421    1.246233
  earn50_75p |   1.111099   .0689518     1.70   0.090     .9838511    1.254804
 earn75_100p |   1.103236   .0778826     1.39   0.164     .9606783    1.266947
occu_mixed~k |    .929901   .1202601    -0.56   0.574     .7216963    1.198172
occu_cropl~k |   1.070399   .0817241     0.89   0.373     .9216314    1.243181
occu_other~i |   .9375015   .0638043    -0.95   0.343     .8204291     1.07128
  occu_other |   .8612438   .0598999    -2.15   0.032     .7514925    .9870237
ethnic_maori |    .887643   .1133058    -0.93   0.350      .691169    1.139967
ethnic_other |   .9286628   .1156062    -0.59   0.552     .7276034    1.185281
ethnic_unk~n |   .7085068   .0908422    -2.69   0.007      .551069    .9109238
   skill_atv |   .7328655   .2897286    -0.79   0.432      .337686    1.590506
skill_agri~s |    .900883   .6426333    -0.15   0.884     .2225741    3.646381
skill_chai~s |   1.967254   .9188457     1.45   0.147     .7875707    4.913957
skill_trac~s |   2.417963   1.330741     1.60   0.109     .8222154     7.11072
 accsuffix_d |   1.031227   .2264633     0.14   0.889     .6705413    1.585926
 accsuffix_s |   1.700712   .1064926     8.48   0.000      1.50429    1.922782
prior_clai~d |   1.381209   .0409744    10.89   0.000      1.30319    1.463897
------------------------------------------------------------------------------
```

Logistic regression:

```
. logistic outcome exposed plans quarter4 quarter5 quarter6 quarter8 quarter9 quarter10
quarter11 quarter12 quarter13 quarter14 quarter15 quarter16 male pcu1230 pcu1240 pcu1250
pcu1300 age10_20 age30_40 age40_50 age50_60 age60_70 age70_80 age80_90 earn25_50p
earn50_75p earn75_100p occu_mixedlivestock occu_croplivestock occu_otheragri occu_other
ethnic_maori ethnic_other ethnic_unknown skill_atv skill_agrichemicals skill_chainsaws
skill_tractors accsuffix_d accsuffix_s prior_claim_med if model=="med_12m",or

Logistic regression                               Number of obs   =      16886
                                                  LR chi2(43)     =     740.00
                                                  Prob > chi2     =     0.0000
Log likelihood =  -6259.826                       Pseudo R2       =     0.0558

------------------------------------------------------------------------------
     outcome | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     exposed |   1.471461   .0891158     6.38   0.000     1.306765    1.656914
       plans |   .8342869   .1583674    -0.95   0.340     .5750918    1.210302
    quarter4 |   1.136077   .6366852     0.23   0.820      .378768    3.407547
    quarter5 |   .9925362   .1719535    -0.04   0.966     .7067708    1.393844
    quarter6 |   1.144948    .170829     0.91   0.364     .8546423    1.533865
    quarter8 |   .9495572   .0713327    -0.69   0.491     .8195531    1.100184
    quarter9 |   1.012253   .0842313     0.15   0.884     .8599221    1.191568
   quarter10 |   .9293925   .1307469    -0.52   0.603     .7054272    1.224464
   quarter11 |   .8961397   .1117782    -0.88   0.379      .701783    1.144323
   quarter12 |   .9204441   .0778912    -0.98   0.327     .7797687    1.086498
   quarter13 |   .9575108   .1097105    -0.38   0.705     .7649164    1.198598
   quarter14 |   .6309989   .1090926    -2.66   0.008     .4496406    .8855065
   quarter15 |   .2600651   .1022329    -3.43   0.001     .1203567    .5619449
   quarter16 |   .0560288   .0181893    -8.88   0.000     .0296534    .1058639
        male |   1.604699   .1080842     7.02   0.000     1.406246     1.83116
     pcu1230 |   .9400736   .1246704    -0.47   0.641      .724899    1.219119
     pcu1240 |   .8409829   .1336033    -1.09   0.276     .6159714     1.14819
     pcu1250 |   .8043764   .1298498    -1.35   0.177     .5862064    1.103743
     pcu1300 |   .8687775   .1146497    -1.07   0.286     .6707773    1.125224
    age10_20 |   .9376628   .1600153    -0.38   0.706     .6710984    1.310108
    age30_40 |     1.2525   .1174976     2.40   0.016     1.042141    1.505322
    age40_50 |   1.299653   .1219018     2.79   0.005     1.081405    1.561947
    age50_60 |   1.133051   .1125086     1.26   0.208     .9326695    1.376485
    age60_70 |   1.251226   .1387421     2.02   0.043     1.006817    1.554967
    age70_80 |   .9251257   .1537113    -0.47   0.639     .6679932    1.281237
    age80_90 |   1.154566   .3652889     0.45   0.650     .6210266    2.146482
  earn25_50p |   1.120526   .0748211     1.70   0.088     .9830701    1.277201
  earn50_75p |   1.128139   .0768033     1.77   0.077     .9872182    1.289176
 earn75_100p |   1.122653   .0863279     1.50   0.132     .9655867    1.305268
occu_mixed~k |   .9334563   .1328821    -0.48   0.629     .7061895    1.233862
occu_cropl~k |   1.070281    .090538     0.80   0.422     .9067596     1.26329
occu_other~i |   .9299134   .0682866    -0.99   0.322     .8052597    1.073863
  occu_other |    .840265   .0629263    -2.32   0.020      .725556    .9731093
ethnic_maori |   .8733829   .1189585    -0.99   0.320     .6687556    1.140623
ethnic_other |   .9210308   .1248838    -0.61   0.544     .7060877    1.201406
ethnic_unk~n |   .6834983   .0932695    -2.79   0.005     .5230984    .8930824
   skill_atv |   .7343789   .3119711    -0.73   0.467     .3193903    1.688568
skill_agri~s |   1.004977   .8179391     0.01   0.995     .2038793    4.953808
skill_chai~s |   2.116318   1.168201     1.36   0.174     .7173327     6.24369
skill_trac~s |   2.538586   1.555339     1.52   0.128     .7639733    8.435396
 accsuffix_d |   1.045093   .2448819     0.19   0.851     .6602444    1.654265
 accsuffix_s |   1.779771   .1199061     8.56   0.000     1.559614    2.031005
prior_clai~d |    1.42474   .0474434    10.63   0.000     1.334722    1.520829
------------------------------------------------------------------------------
```

(D) med_24m model
Cox Regression:

```
. stcox exposed plans quarter4 quarter5 quarter6 quarter8 quarter9 quarter10 quarter11
quarter12 quarter13 quarter14 quarter15 quarter16 male pcu1230 pcu1240 pcu1250 pcu1300
age10_20 age30_40 age40_50 age50_60 age60_70 age70_80 age80_90 earn25_50p earn50_75p
earn75_100p occu_mixedlivestock occu_croplivestock occu_otheragri occu_other ethnic_maori
ethnic_other ethnic_unknown skill_atv skill_agrichemicals skill_chainsaws skill_tractors
accsuffix_d accsuffix_s prior_claim_med

No. of subjects =        16886                     Number of obs   =     16886
No. of failures =         3349
Time at risk    =   277950.767
                                                   LR chi2(43)     =    796.45
Log likelihood  =   -31146.414                     Prob > chi2     =    0.0000

------------------------------------------------------------------------------
          _t | Haz. Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     exposed |   1.423977   .0632228     7.96   0.000     1.305301    1.553442
       plans |   1.042493   .1351519     0.32   0.748     .8085759    1.344081
    quarter4 |   1.027416   .4223006     0.07   0.948      .459066    2.299414
    quarter5 |    .958805   .1179575    -0.34   0.732     .7533742    1.220253
    quarter6 |    1.04523   .1109724     0.42   0.677      .848867    1.287017
    quarter8 |   .9639327   .0507019    -0.70   0.485     .8695095     1.06861
    quarter9 |   .9930878     .05854    -0.12   0.906     .8847314    1.114715
   quarter10 |   .9427428   .0993255    -0.56   0.576     .7668533    1.158975
   quarter11 |   .9015912   .0899294    -1.04   0.299     .7414919    1.096258
   quarter12 |   .9358575   .0638208    -0.97   0.331     .8187702    1.069689
   quarter13 |   1.001777   .0995924     0.02   0.986     .8244196    1.217289
   quarter14 |   1.054983   .1696228     0.33   0.739     .7698165    1.445785
   quarter15 |     .87172   .3330572    -0.36   0.719     .4122487    1.843294
   quarter16 |   .5841294   .1886013    -1.67   0.096     .3102248     1.09987
        male |   1.615237   .0841103     9.21   0.000     1.458517    1.788796
     pcu1230 |   .9807677   .0982975    -0.19   0.846     .8058503    1.193653
     pcu1240 |   .9055994   .1079546    -0.83   0.406     .7169126    1.143947
     pcu1250 |   .8488374   .1034596    -1.34   0.179     .6684621    1.077885
     pcu1300 |   .8603831   .0859661    -1.51   0.132     .7073644    1.046503
    age10_20 |    .821448   .1149521    -1.41   0.160      .624402    1.080677
    age30_40 |     1.2335   .0891214     2.90   0.004     1.07063    1.421148
    age40_50 |   1.329061   .0954054     3.96   0.000     1.154628    1.529845
    age50_60 |   1.126496   .0857378     1.56   0.118      .970386     1.30772
    age60_70 |   1.143362   .0976767     1.57   0.117     .9670887    1.351766
    age70_80 |   .9328124   .1181582    -0.55   0.583     .7277357     1.19568
    age80_90 |   .7656315   .2193576    -0.93   0.351     .4366626    1.342436
  earn25_50p |   1.153072   .0579909     2.83   0.005     1.044835    1.272523
  earn50_75p |   1.195067   .0610327     3.49   0.000     1.081237     1.32088
 earn75_100p |   1.175361   .0684161     2.78   0.006     1.048635    1.317403
occu_mixed~k |   .9427948    .099331    -0.56   0.576     .7668957    1.159039
occu_cropl~k |   1.009402   .0644865     0.15   0.884      .890604    1.144047
occu_other~i |   .9757277     .05364    -0.45   0.655     .8760611    1.086733
  occu_other |   .8509366   .0485649    -2.83   0.005     .7608818    .9516499
ethnic_maori |   .8085216   .0877186    -1.96   0.050     .6536459    1.000094
ethnic_other |   .8425975   .0898775    -1.61   0.108     .6836359    1.038521
ethnic_unk~n |   .6767919   .0721704    -3.66   0.000     .5491443     .834111
   skill_atv |   .6603706   .2224407    -1.23   0.218     .3412457    1.277934
skill_agri~s |   1.074941   .5423087     0.14   0.886     .3999014    2.889459
skill_chai~s |   1.684482   .7201767     1.22   0.223     .7286968    3.893908
skill_trac~s |   2.608885   1.226715     2.04   0.041     1.038041    6.556853
 accsuffix_d |   .8519597   .1711104    -0.80   0.425     .5747261    1.262924
 accsuffix_s |    1.79819    .092462    11.41   0.000       1.6258    1.988858
prior_clai~d |   1.353289   .0333531    12.28   0.000     1.289472    1.420265
------------------------------------------------------------------------------
```

Logistic regression:

```
. logistic outcome exposed plans quarter4 quarter5 quarter6 quarter8 quarter9 quarter10
quarter11 quarter12 quarter13 quarter14 quarter15 quarter16 male pcu1230 pcu1240 pcu1250
pcu1300 age10_20 age30_40 age40_50 age50_60 age60_70 age70_80 age80_90 earn25_50p
earn50_75p earn75_100p occu_mixedlivestock occu_croplivestock occu_otheragri occu_other
ethnic_maori ethnic_other ethnic_unknown skill_atv skill_agrichemicals skill_chainsaws
skill_tractors accsuffix_d accsuffix_s prior_claim_med if model=="med_24m",or

Logistic regression                                   Number of obs   =      16886
                                                      LR chi2(43)     =    1495.31
                                                      Prob > chi2     =     0.0000
Log likelihood = -7662.9012                           Pseudo R2       =     0.0889

------------------------------------------------------------------------------
     outcome | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     exposed |   1.509299   .0806228     7.71   0.000     1.359272    1.675885
       plans |   1.067086   .1717809     0.40   0.687     .7783446    1.462942
    quarter4 |   .9788196   .4770142    -0.04   0.965     .3766009     2.54404
    quarter5 |   .9593471   .1404475    -0.28   0.777     .7200467    1.278177
    quarter6 |   1.066732   .1361278     0.51   0.613     .8306765    1.369869
    quarter8 |   .9635513   .0601817    -0.59   0.552     .8525313    1.089029
    quarter9 |   .9539633   .0666468    -0.67   0.500     .8318867    1.093954
   quarter10 |   .7700139   .0931946    -2.16   0.031     .6074043    .9761561
   quarter11 |   .5922836   .0664483    -4.67   0.000     .4753717    .7379485
   quarter12 |   .5074345   .0386658    -8.90   0.000     .4370384    .5891697
   quarter13 |   .4837159   .0529939    -6.63   0.000     .3902441    .5995762
   quarter14 |   .3208621   .0543566    -6.71   0.000     .2302067    .4472176
   quarter15 |   .1336372   .0523892    -5.13   0.000     .0619776    .2881508
   quarter16 |   .0279886   .0090403   -11.07   0.000     .0148609     .052713
        male |   1.730956   .1005538     9.44   0.000     1.544679    1.939695
     pcu1230 |    .978975   .1148282    -0.18   0.856     .7779121    1.232006
     pcu1240 |   .9021454   .1257917    -0.74   0.460     .6864175    1.185673
     pcu1250 |   .8344602   .1183051    -1.28   0.202     .6320146    1.101753
     pcu1300 |   .8288232   .0968101    -1.61   0.108     .6592314    1.042044
    age10_20 |   .7981375    .120142    -1.50   0.134     .5942212    1.072031
    age30_40 |   1.249217   .1006926     2.76   0.006     1.066663    1.463015
    age40_50 |   1.376193   .1106111     3.97   0.000     1.175612    1.610996
    age50_60 |   1.135103   .0968025     1.49   0.137     .9603817     1.34161
    age60_70 |   1.136364   .1097887     1.32   0.186     .9403283    1.373269
    age70_80 |    .911168   .1303031    -0.65   0.515     .6884478    1.205941
    age80_90 |   .7103359   .2239359    -1.08   0.278     .3829301    1.317674
  earn25_50p |   1.198223   .0700496     3.09   0.002     1.068502    1.343693
  earn50_75p |   1.258183   .0748485     3.86   0.000     1.119712    1.413778
 earn75_100p |   1.232559   .0825451     3.12   0.002     1.080941    1.405442
occu_mixed~k |   .9496824   .1176743    -0.42   0.677     .7449151    1.210738
occu_cropl~k |   .9963385   .0749619    -0.05   0.961     .8597352    1.154647
occu_other~i |   .9696989   .0607951    -0.49   0.624     .8575727    1.096485
  occu_other |   .8200266   .0529354    -3.07   0.002     .7225704    .9306272
ethnic_maori |   .7749983   .0929443    -2.13   0.034     .6126571    .9803565
ethnic_other |   .8068712   .0979622    -1.77   0.077      .636004    1.023643
ethnic_unk~n |   .6318719     .07447    -3.90   0.000     .5015448    .7960647
   skill_atv |   .6527381   .2513835    -1.11   0.268     .3068477    1.388529
skill_agri~s |   1.315263   .9007287     0.40   0.689     .3436259    5.034301
skill_chai~s |   1.891417   1.009662     1.19   0.233     .6643633    5.384794
skill_trac~s |   2.814864   1.601224     1.82   0.069     .9231129    8.583411
 accsuffix_d |   .8409124   .1839875    -0.79   0.428     .5476613    1.291188
 accsuffix_s |   1.976184   .1147257    11.73   0.000     1.763647    2.214334
prior_clai~d |   1.423371   .0421393    11.92   0.000      1.34313    1.508406
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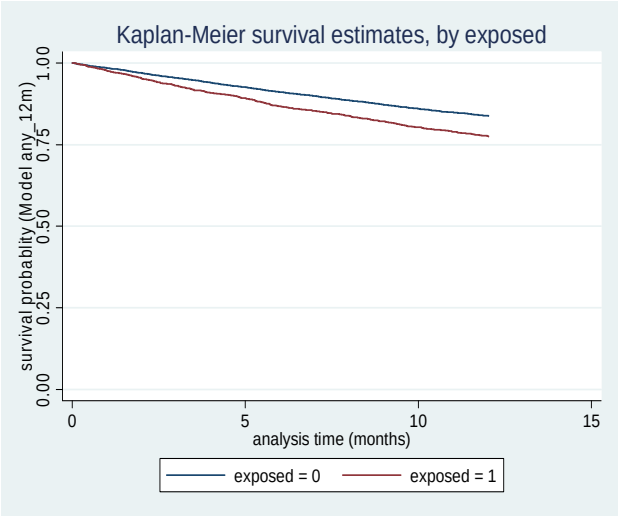
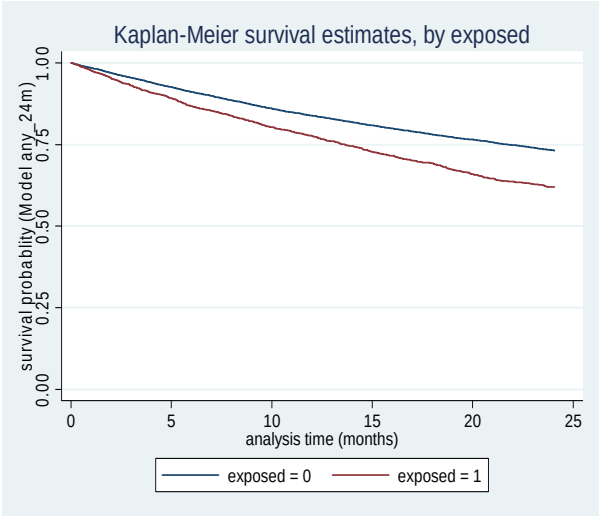
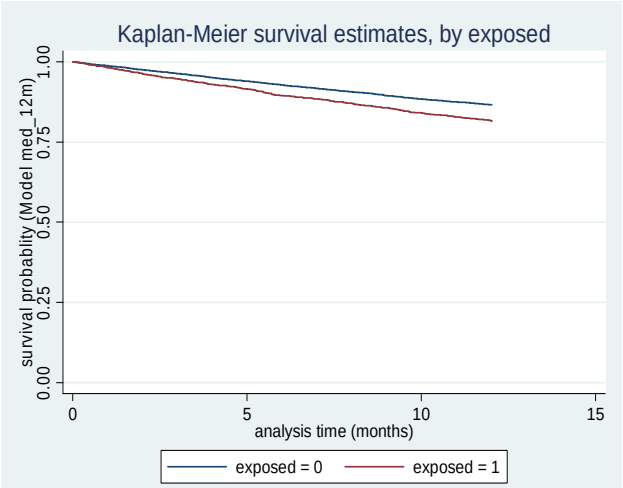
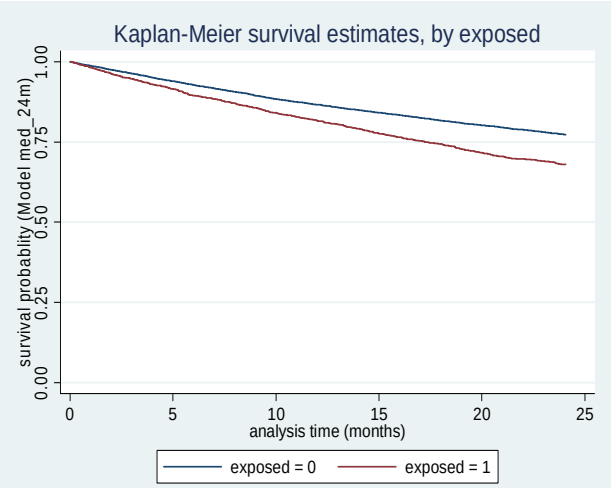

Kaplan-Meier survival estimates, by exposed
survival probablity (Model any_12m)
0.00
0.25
0.50
0.75
1.00
0
5
10
15
analysis time (months)
exposed = 0
exposed = 1


Kaplan-Meier survival estimates, by exposed
survival probablity (Model any_24m)
0.00
0.25
0.50
0.75
1.00
0
5
10
15
20
25
analysis time (months)
exposed = 0
exposed = 1


Kaplan-Meier survival estimates, by exposed
survival probablity (Model med_12m)
0.00
0.25
0.50
0.75
1.00
0
5
10
15
analysis time (months)
exposed = 0
exposed = 1


Kaplan-Meier survival estimates, by exposed
survival probablity (Model med_24m)
0.00
0.25
0.50
0.75
1.00
0
5
10
15
20
25
analysis time (months)
exposed = 0
exposed = 1