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LIST OF ABBREVIATIONS

ARIMA	AutoRegressive Integrated Moving-Average procedure
BLS	Bureau of Labor Statistics
CDC	Centers for Disease Control and Prevention
CFOI	Census of Fatal Occupational Injuries
CPS	Current Population Survey
DHHS	Department of Health and Human Services
EUR	European Union Currency, Euro. €1 EUR = $0.9 USD
FACE	Fatality Assessment and Control Evaluation
FIM	Finnish Currency, Markka. €1 EUR = 5.95 FIM
FTE	Full-time Employee Equivalent
GDP	Gross Domestic Product
GLM	General Linear Models Procedure
Ha	Hectare
ICD10	International Classification of Diseases, Tenth Edition
MATA	Finnish farmers' employment accident insurance program
Mela	Farmers Social Insurance Institution, Finland
NIOSH	National Institute for Occupational Safety and Health
NSC	National Safety Council
NTOF	National Traumatic Occupational Fatalities Surveillance System
OD	Occupational Disease
ODTS	Organic Dust Toxic Syndrome
OR	Odds Ratio
OSHA	Occupational Safety and Health Administration
OWAS	Ovako Work Posture Analysis System
PMR	Proportional Mortality Ratio
PTO	Power Take-off
ROPS	Rollover protective structure
RR	Relative Risk
SAS	Statistical Analysis System
SIR	Standardized Incidence Ratio
STD	Standard Deviation
TISF	Traumatic Injury Surveillance of Farmers
US	United States of America
USDA	United States Department of Agriculture

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ABSTRACT

This study aimed to describe costs and lost time from injuries and occupational diseases, and to measure the effect of a no-claims bonus intervention using Finnish farmers' workers' compensation data.

During 1996, there were 10,092 injuries (7.37/100 workers) and 830 occupational diseases (0.61/100 workers) in a population of 137,002 persons in agriculture. The total insurance cost was €23.5 Million Euros, which was 0.7% of the national gross farm income, 2,2% of the net farm income, and 2.5% of the insured farm income. The costs consisted of medical (16%), lost-time per diem (37%), accident pension (23%), survivors' pension (3%), impairment allowance (7%), rehabilitation (6%) and other costs (9%). The mean cost of 1996 claims was €1340 for injuries, €6636 for occupational diseases, and €1743 for all claims.

The total compensated lost time from 1996 injuries and occupational diseases was 1431 person years, which is 1.04% of the person years in agriculture in 1996. Occupational diseases comprised 8% of the claims and 29% of the lost time. The mean lost time was longer for occupational diseases (185 days) compared to injuries (37 days) ($p<0.0001$), and longer for women (62 days) compared to men (42 days) ($p=0.001$).

Biological and organic dusts, saws, sawmills, wood splitters, wood chippers, slippery terrain, stairs, scaffoldings, ladders, power take-offs, roofs, large animals, and vehicles were among causes associated with high costs and long disabilities. Working with large animals, commuting, transporting, harvesting, grain handling, construction, and forest work were among tasks associated with high costs and long disabilities.

The preventive effect of a no-claims bonus was assessed using the interrupted time series analysis. Injury claims reduced about 10% after the intervention ($p<0.0001$). The reduction occurred in minor and moderately severe injuries. No shifting of claims to other insurances was found. Under-reporting of minor injuries appears to explain part of the reduction, but the reduction in moderately severe claims may be attributable to the preventive effect, assuming that the farmers know the true value of the bonus and seek compensation when it is financially feasible for them.

SIGNIFICANT FINDINGS

This study used insurance data from the Finnish employment accident insurance system known as MATA, which is mandatory for all farmers with five or more hectares of farmland. During 1996, there were 137,002 insured farmers and family members, 10,092 injuries (7.37/100 workers), and 830 occupational diseases (0.61/100 workers).

This study characterized injury and occupational disease costs and identified risk factors for costs. The total costs in 1996 were €23.5 Million consisting of medical (16%), lost time per diem (37%), accident pension (23%), survivors' pension (3%), impairment allowance (7%), rehabilitation (6%), and other costs (9%). The total costs were 0.7% of the gross farm income, which is low compared to 2.8% estimated in the US. The mean cost of 1996 claims was €1743. Occupational diseases were about five times more costly than injuries on the average. Only 0.6% of the claims were permanent pensions, but they represented nearly one quarter of the costs. The risk of permanent pension was 1.8 times greater for women compared to men, and 6.8 times greater for occupational diseases compared to injuries.

About 1% of productive time was lost from injuries and occupational diseases. The average lost time was 37 days for injuries and 185 days for occupational diseases. Men were at greater risk for short-term disability from injuries, and women were at greater risk for long-term disability from occupational diseases. Disability time increased with age. Older persons had more fractures, amputations, and other severe conditions, and older persons took longer to recover from similar conditions as did younger persons.

Most severe claims in terms of cost and lost time were related to large animals, organic dust, and various hazards in the working environment rather than machinery, which is commonly considered responsible for most serious injuries. Slips and falls, falls from elevation, pushed or run over by animals or machinery, and occupational diseases were associated with high costs and long disabilities. Women were at greater risk of occupational diseases, especially respiratory diseases and dermatitis. This is interesting as the traditional working roles have changed and both men and women participate relatively equally in animal care, which is the source of most occupational diseases.

The studies of costs and lost time identified important priority areas for prevention. More efforts should be directed to the prevention of respiratory disease from biological and organic dusts when working in animal confinements. Dermatitis and cumulative trauma from repetitive motion are also priorities in animal production work. Injuries from large animals are frequent and severe and animal handling facilities should be designed to avoid these injuries. Falls from scaffoldings, ladders, stairs, and wagons caused severe injuries. Proper permanent stairs or ladders should be used instead of temporary ladders in places where the ladders are used frequently. Better scaffolding, proper guardrails, and fall protection should be used in on-farm construction work. Riding on hay and grain wagons is a hazardous practice and should be avoided. Injuries from saws, sawmills, wood splitters, wood chippers, and power take-offs are caused by poorly designed or poorly guarded machinery. Improving machinery guarding remains an important priority for reducing injuries.

This study found that the insurance bonus system reduced injury claims by about 10%. The four year average injury and occupational disease rate reduced as much as 17% after the intervention year (1997). The reduction occurred in minor injuries and in moderately severe categories as well. The reduction in minor injuries below the value of

the bonus was less than expected, and the reduction in moderately severe injuries was greater than expected. The reduction in the injury rate may be explained partly by under-reporting of minor injuries, but part of the reduction may be due to preventive effect. No shifting of claims to other insurances was observed.

This study indicates that a financial incentive is effective in reducing claims. Based on this experience, insurers could use similar incentives more widely. Fewer claims, whether caused by under-reporting or true preventive effect, would reduce administration costs and offer competitive advantages to insurers. The bonus did not constitute a major barrier for farmers to receive compensation for legitimate claims as the value of the bonus was only about €60 on the average. This study supports a more active role for the insurance industry in prevention. Further research and development is needed to design and test incentive programs encouraging safe behaviors and safety improvements on the farm.

This study addressed all areas listed in the specific aims. The study provided descriptive statistics of occupational injuries and diseases, including frequencies and rates by age, sex, cause, work activity, length of disability, cost, year, month, and other applicable variables (Specific Aim 1). Risk factors were identified for occupational injury, including age, sex, farm income, non-farm income, and number of previous injuries (Specific Aim 2). The effects of the no-claims bonus intervention was measured. The effects of the Rollover Protective Structure as a preventive measure for tractor fatalities was assessed based on literature (Specific Aim 3). The generalizability of the Finnish injury and occupational disease data was discussed in various areas of the study (Specific Aim 4).

USEFULNESS OF THE FINDINGS

This study produced agricultural injury and illness information that has not been reported in the literature. The benchmark information includes total population based injury and illness rates, costs, lost time, and risk factors associated with cost and lost time. The preventive effect of a unique premium bonus system was measured.

The injury and occupational disease costs were determined and compared to the national agricultural gross and net income. The cost components for medical care, lost time, and other costs were also reported. The lost time was reported in relation to person years in agriculture. The magnitude of injury costs in relation to occupational disease costs was also determined. This information is valuable in understanding the magnitude of the losses and determining the appropriate level of national investments in research and prevention. The cost breakdown between injuries and occupational diseases gives indication how much of the resources should be placed in preventing injuries versus occupational diseases.

This study was able to utilized very specific categorical work activity, cause, incident type, and ICD10 health outcome variables. Mean and total costs were calculated for each category, and the high cost categories were identified using statistical methods. This analysis yielded information on high cost injury/illness characteristics, which is directly applicable for prevention. The same was done using lost time as outcome. This information is very valuable in identifying work tasks, causes, and health outcomes that are most frequent and costly, and thus high priorities for

prevention. The cost and lost time data by cause and work activity has already been utilized in the Iowa Certified Safe Farm Study for developing a comprehensive farm hazard checklist. Injury frequency, cost, and lost time data are extremely useful in developing hazard checklist.

This study has been highly productive resulting in one dissertation, four published peer reviewed articles, three articles to be submitted later this year, and sixteen presentations in scientific meetings. The project enabled leveraging resources from two other sources, and expanding the study beyond the original scope. This study was considered a success by the Finnish collaborating partner, Farmers Social Insurance Institution. A Memorandum of Understanding between the Farmers Social Insurance Institution and The University of Iowa has been drafted to continue research collaboration, and will be signed later this year. This collaboration will enable utilizing the exceptionally rich data resources of the Finnish Farmers Social Insurance Institution and the research experience of The University of Iowa to benefit the agricultural community in the United States, and internationally.

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SCIENTIFIC REPORT

CHAPTER 1

INTRODUCTION

This study aimed to provide information for prevention of agricultural injuries and occupational diseases by investigating injury and illness characteristics and risk factors. The study had four main components. The first component was a review of literature on agricultural populations, injuries, and work-related illnesses. The second component was an analytical study of injury and occupational disease costs and risk factors associated with costs. The third component was an analytical study of lost time from injuries and occupational diseases and risk factors associated with lost time. The fourth component was an intervention effectiveness study measuring the impact of an insurance premium bonus system.

This study used data from workers' compensation insurance, which covers all self-employed farmers, fishermen, and reindeer herders in Finland. The project was partially funded by NIOSH (RO3 OH03929) and based on a research agreement between the Finnish Farmers Social Insurance Institution and The University of Iowa.

DEFINITIONS OF TERMS

Claim number

Consecutive number of insurance claims for each insured person.

Cost-of-living and wage index

Official index used for adjusting payments and benefits in Finnish social insurance programs, known as the TEL Index. The index is confirmed annually by the Finnish Social Insurance Institution.

Personal claim rate

Personal injury/illness claim rate based on past claims experience. Calculated in this study as follows:

Personal claim rate = (Claim number / Years insured) * 10.

Euro

Common European currency; abbreviation: EUR, character: €. All costs in this study were converted from the Finnish currency, Markka (FIM) into Euros. The Markka is permanently tied to the Euro (1 EUR = 5.95 FIM). Starting 1/1/2002, the Euro has been the official currency of Finland. As of 4/5/02, €1 EUR = $0.878 USD.

Impairment allowance

An impairment allowance can be paid if the injury/illness causes a permanent impairment and help is required to cope with daily activities. The impairment allowance can be paid after one year from the incident. The allowance is 1-60% of the annual income depending on the severity of the impairment. The payment is usually paid in one installment.

Injury

An injury is described in MATA as a sudden unexpected forceful event with an external cause, which results in bodily damage or an ailment, and which occurs in the course of agricultural work.

Insured farm income

A specific income determined by Mela for each farm and each insured person. Arable land, forestland, animal production, taxable income, and personal adjustments are considered when determining the income for the farm. The farm income is usually divided evenly between the spouses or owners. The insured farm income reflects the value of work on the farm. The premiums and certain benefits are based on the insured farm income.

Long-term disability

Disability lasting longer than one calendar year from the incident. An accident pension is paid for the disability time starting one year from the incident. The pension can be permanent or temporary, and full or partial. In this study, three categories of long-term disability were used: 1) cases with any disability time (pension) beyond one year from the incident, 2) cases with disability time (pension) beyond the data extraction date, August 1, 2000, and 3) permanent disability (pension) cases.

Lost-time per diem

A daily compensation for lost work time and productivity. Physicians assign the disability time. The per diem is paid for all days of the week, up to one year from the incident. Per diem is paid only if the disability lasts at least three days after the incident day. One per diem payment is 1/360 of the annual insured income.

No-claims bonus

Insured persons who have no compensated claims during the previous year receive a 10% reduction in their premiums. Each claim-free year thereafter adds 10% to this bonus up to the 50% level in five consecutive claim-free years. Each compensated claim reduces the bonus by 10%, but the 0% level is never exceeded. The no-claims bonus was implemented on July 1, 1997.

MATA insurance

Abbreviation used in the Finnish language for the farmers' employment accident (workers' compensation) insurance system. MATA has been mandatory for all farmers since July 1, 1982, and provides compensation for agricultural injuries and occupational diseases. Farmers Social Insurance Institution (Mela) administers the MATA insurance.

Mela

Abbreviation used in the Finnish language for the Farmers Social Insurance Institution, Finland. Mela is a semi-private insurance company, which was established by legislation to administer the farmers' work-related pension system in 1970. Mela currently administers a broad range of social security programs for the Finnish agricultural populations, including the MATA insurance.

Occupational disease

Specific illnesses defined by legislation, which are probably predominantly due to specific physical, chemical, or biological factors associated with work.

Short-term disability

Disability lasting up to one year. A daily per diem compensation is paid for each disability day up to one year. Per diem is paid only if the disability lasts at least three days after the incident day. Physicians assign the length of disability.

Years insured

Number of years the person has been insured by MATA.

CHAPTER 2

REVIEW OF LITERATURE

Summary

The purposes of this literature review were to summarize current agricultural injury and illness information, provide background for the analytical studies, and facilitate interpretation of the results. The literature review was conducted using MEDLINE, NIOSHTIC, conference proceedings, and other sources, focusing primarily on information from Finland and the United States.

Agriculture had the highest fatality rate (22.5/100,000 workers in 2000) in the United States. Tractor is the leading cause of death and approximately 150 tractor overturn fatalities occur each year. In Finland the agricultural fatality rate was lower (6.5/100,000 workers, 1987-1992 average), and tractor overturn fatalities were rare due to rollover protective structures on most tractors. Surveillance of nonfatal injuries and illnesses is not adequate for providing consistent national rates for US farmers. Workers' compensation data for hired farm workers indicate 7.9 injuries/100 workers in a year. Surveys and studies have shown annual injury rates ranging from 0.5 to 29%. In Finland the annual non-fatal injury rate was 7.3% and the occupational disease rate was 0.46% on the average in 1987-2001. Research has shown high rates of respiratory and musculoskeletal symptoms, hearing loss, and skin disorders in agriculture. The overall cancer rate is lower; however, certain cancers are elevated in agriculture.

Gaps in the literature include non-fatal injury and occupational disease rates, costs, lost time due to disability, and intervention effectiveness. These areas are addressed in this study.

Agricultural Population in the United States

Population information is necessary for establishing injury and illness rates, detecting changes over time, and designing appropriate prevention programs. The Census of Agriculture, United States Department of Agriculture (USDA) surveys, and the Bureau of Labor Statistics (BLS) Current Population Survey (CPS) provide information on agricultural workforce in the United States. The CPS information is collected from a sample of about 50,000 households, and it provides an estimate of average employment in the agriculture sector. Monthly surveys include those over 15 years of age who worked in agriculture for pay or profit, and those working unpaid for more than 15 hours during the week prior to the survey. The CPS data include production agriculture, agricultural services, forestry, fishing, and hunting. The CPS data show that the agricultural workforce (self-employed and employed workers) decreased during the 1940's, 50's, and 60's. Since the 1970's, the agricultural workforce has stayed relatively unchanged at about 3.3 million, but the number of agricultural production workers has decreased and the number of agricultural service workers has increased (Bureau of Labor Statistics, 2001).

The USDA National Agricultural Statistics Service (NASS) conducts a quarterly farm labor survey from a sample of 14,500 farms. These data include agricultural production and agricultural service workers. According to this survey there were 1.24

million hired agricultural workers in 2000; 952,000 workers were hired directly by farm operators, and agricultural service employees made up the remaining 285,000 workers. Migrant workers accounted for 11.9 percent of the hired workforce (USDA National Agricultural Statistics Service, 2001). Estimation of the number of migrant and seasonal workers remains a challenge. The official labor statistics may underestimate the number, and unofficial estimates have been as high as 5 million (Mobed et al., 1992).

The Census of Agriculture is conducted every five years and provides detailed information on farm production, as well as basic information on farm operators and hired farm workers, regardless of how long they have been employed. The Census has reported higher numbers of workers compared to NASS and CPS. The hired labor force in agriculture was 3.35 million in the 1997 Census. Most of the workers (2.46 million) worked less than 150 days during the year. In this survey, it is possible that one worker is counted several times, as workers may work on several farms during one year (USDA National Agricultural Statistics Service, 1997).

The numbers of farm family members, other farm residents, and others exposed to farm hazards are difficult to estimate. Some estimates exist for children; 923,000 children under 15 years of age and 346,000 adolescents 15-19 years of age resided on US farms and ranches in 1991 (Daquel and Dahmann, 1991). Additionally, 800,000 children lived in hired farm worker households (Oliveira and Cox, 1989). A recent NIOSH survey estimated that the number of youth under the age of 20 years who lived or worked on a farm in 1998 was 1,930,306 (+/- 23,179) (Myers and Hendricks, 2001).

The number of farms peaked in the 1930's at nearly seven million and decreased rapidly during the 1940's, 50's, and 60's. Since the 1970's the change has been slow, and in both 1992 and 1997 Census of Agriculture the number of farms was about 1.9 million. Although the number of farms and farm operators has remained relatively stable in the past two decades, the nature of farming has changed. Farming has become increasingly a part-time activity. Only 50% of owner/operators have farming as their principal occupation (USDA National Agricultural Statistics Service, 1997). Income from farming is only 10% of the average farm household income along with employment income (52%), business income (17%), interest and dividends (7%), social security (9%), and other income (6%) (USDA Economic Research Service, 1999).

The economic situation has forced family farms to either specialize and increase farm size and production or farm only part time and find off-farm income. Both trends have potential adverse effects on health and safety. Exposure times may be longer on large farms, and part-time farmers may have to do their farm work during evenings and weekends. Livestock production has consolidated especially in the poultry and swine sectors. The number of hog operations reduced from over 666,555 in 1980 to 86,360 in 2000 (USDA National Agricultural Statistics Service, 2002). About 2.5% of farms generated 50% of the farm sales in 1997 (USDA Economic Research Service, 2001). Specializing in more labor-intensive production, organic farming, and direct marketing to consumers have offered alternatives for some farmers to make a living on smaller farms.

Health and safety is traditionally compromised during hard economic times. The ten-year average annual net farm income was $28.7 billion in the 1980's and improved to $45.2 billion in the 1990's. The number of farms slightly decreased during that time. The balance sheet shows a slight improvement in the 1990's; the debt/asset ratio was 16.4% in 1990 and 15.8% in 1999 (USDA National Agricultural Statistics Service, 2001). Although the profitability in farming appears to have improved from the 1980's, the price

fluctuations for many commodities including pork and grains continue to cause financial hardship for many farmers.

Fatal Injuries in the United States

The National Safety Council (NSC) (2000) reported an average of 810 agricultural fatalities annually during 1992-99 based on the Census of Fatal Occupational Injuries (CFOI). About 48% occurred in crop production, 22% in livestock production, 20% in agricultural services, 2% in forestry, and 9% in fishing, hunting and trapping. The fatality rate remained unchanged during the 1990's. The number of deaths in agriculture was 770 in 1999, and the fatality rate was 22.5 fatalities per 100,000 workers; six times higher than the average rate for all industries (3.8/100,000). Only mining (23.1/100,000) had a higher fatality rate than agriculture. In 2000, agriculture had the highest fatality rate (22.5/100,000) as the rate in mining (21.2/100,000) reduced, but the rate in agriculture did not (National Safety Council, 2001). The United States agricultural fatality rate was twice as high as the rate in Canadian agriculture (11.6/100,000) Pickett et al., 1999a) and three times as high as in Finnish agriculture (6.5/100,000) (Farmers Social Insurance Institution, 1992).

In 1980-89, the NIOSH National Traumatic Occupational Fatalities (NTOF) system reported 22.9 deaths per 100,000 workers in agriculture. African-Americans had the highest rate (26.4/100,000). Workers other than white or African-Americans had the lowest rate (18.9/100,000) (Myers and Hard, 1995). Medical examiner data from New Mexico in 1980-91 showed that the agricultural fatality rates were highest in the American Indian population. Males were at higher risk than females. Males over 65 years of age had the highest rate (60.5/100,000) (Crandall et al., 1997).

The farming population is older than most working populations; the mean age of the farm owner/operators was 54 years in the 1997 Census. The elderly farmers have a high rate of tractor overturns (Donham et al., 1997). A Canadian study suggests that children are specifically at risk from run-overs when bystanders or extra riders on tractors and farm equipment (Canadian Agricultural Injury Surveillance Program, 1998).

The tractor is the primary cause of farm fatalities. The National Safety Council (2000) reported 317 tractor-related deaths in 1998; 52% were overturns, 24% run-overs, 5% power take-off (PTO) related, and 20% from other causes. The tractor fatality rate was 8.2 deaths per 100,000 tractors. The number of tractors was about 4.8 million in 1993; 62% of them did not have Rollover Protective Structures (ROPS) (Myers and Snyder, 1995). Since 1985-86, nearly all new tractors have been equipped with ROPS by manufacturer agreement. Older non-ROPS tractors are often used for chores such as mowing, loading, transporting materials, and supplying power for PTO-driven machinery. They will be a significant injury hazard in the coming decades unless effective ROPS retrofit programs are implemented.

Two sources were found showing a decrease in fatality rates. In Iowa, the Department of Public Health SPRAINS data show a decreasing trend in farm fatalities in the 1990's (Donham, 2000). Nationally, the childhood fatalities reduced from 300 annually in 1978-83 to 104 annually in 1990-93. The number of exposed children also reduced, and the fatality rate reduction was 39% (Rivara, 1985; Rivara, 1997).

Tractor-related hazards and preventive methods were described in the 1997 Tractor Risk Abatement and Control policy workshop report (Donham et al., 1997). ROPS has proven very effective in Sweden to prevent fatalities (Springfeldt, 1993).

Other fatality hazards include: skid-steer loaders (Parker et al., 1996), electrocution and drowning (Adekoya and Myers, 1999), suffocation in flowing grain (Wahl et al., 1996), manure gasses (Madery et al., 1993), bulls (Casey et al., 1997), roadway collisions (Gerberich et al., 1996), and large round bales (Wahl et al., 1998). These and many other hazards have been discussed in the preventive literature including the National Agricultural Safety Database (NIOSH, 2001). Information from NIOSH Fatality Assessment and Control Evaluation (FACE) investigation reports has helped identify specific causes and preventive measures for many hazards (Pratt and Hard, 1998).

Non-fatal Injuries in the United States

Non-fatal injuries are not as well documented as fatalities in US agriculture. The Bureau of Labor Statistics (BLS) conducts a Survey of Occupational Injuries and Illnesses on about 176,000 industry establishments. Farms with fewer than 11 employees are excluded. In 2000, the injury rate estimates per 100 full-time employed agricultural workers were 6.8 for agriculture overall, 7.3 for agricultural production, 6.5 for agricultural services, 8.4 for forestry, and 6.5 for fishing, hunting, and trapping. The data on non-fatal injuries show a decreasing trend in the 1990's (Bureau of Labor Statistics, 2002). NSC reported 150,000 disabling injuries in agriculture in 1999 (4.5 injuries per 100 workers) (National Safety Council, 2000). NIOSH estimated 195,825 lost-time injuries in 1995; 6.8 lost-time injuries per 100 full time workers (Myers, 2001). Some surveys have reported higher injury rates in agriculture, and variation exists due to different data collection methods and definitions of agriculture and injury. Depending on the data source, reported injury rates vary from 0.5 to 16.6 per 100 person years (McCurdy and Carroll, 2000).

A Minnesota study showed a 5.8% annual injury rate (Lee et al., 1996). An Ontario survey reported a similar overall rate, with an elevated rate for males 31-40 years of age (12.2%). Spouses (1.7%) and children (2.0%) had lower rates (Pickett et al., 1995). New York dairy farmers had an injury rate of 16.6% (Pratt et al., 1992). Machinery and animals are major causes of non-fatal injuries. In Iowa, animals caused approximately 20% of the hospitalized injuries (Harlan, 2000). Although cows greatly outnumber bulls on dairy farms, bulls account for 25% of animal-related injuries in New York (Casey et al., 1997). Milking and trimming hooves were the most hazardous tasks in dairy farming in one study (Boyle et al., 1997).

Injury rates were 2.9 times higher in African-American farm workers compared to Caucasian and African-American owners in Mississippi and Alabama. Part-time farming, prior injury, and fair/poor condition of machinery were associated with high injury rates (McGwin et al., 2000). Fatal injury rates were 2.5 times higher among African-American farmers than among Caucasian farmers in North Carolina (Richardson et al., 1997). Older farmers over 55 years of age had an injury rate of 9.03% (Browning, 1998). California farm workers reported 29 injuries per 100 workers and 20% of workers had multiple injuries during the past year (Osorio, 1998). Workers' compensation in California showed a rate of 10.5 injuries per 100 full-time employee equivalents (FTE). The rate was highest for stock farm and feed-yard workers (19.7/100) and lowest for berry farm workers (4.4/100). The rate decreased steadily from 15/100 FTE in 1989 to 10.5/100 FTE in 1994. The author suggested increased OSHA enforcement as one possible reason for the decrease (Villarejo, 1998).

Agricultural Population in Finland

The analytical part of this study was based on Finnish farmers' workers' compensation insurance data. Therefore, the characteristics of the Finnish agriculture and farm population are of specific interest in this study. The Farmers Social Insurance Institution had an estimated 137,002 insured self-employed farmers mid-year in 1996 (Saarimäki, 2000). Another estimate of the agricultural labor force was 122,000 workers, consisting of 90,000 farmers (33,000 of them were women), 10,000 family members (4,000 of them were women), and 22,000 permanent employees (10,000 of them were women) (Finfood, 1997). The average farm size in 1999 consisted of 25.6 hectares (1 hectare = 2.5 acres) of arable land and 52.1 hectares of forest. The most common types of production in Finland have traditionally been dairy, beef, swine, poultry, and crop production. The primary crops are hay, forage, barley, oats, wheat, rye, rapeseed, potato, and sugar beet. Production is highly mechanized with 1 tractor per 11 hectares of arable land. About 6% of the arable land is in organic production (Finfood, 2001). Forestry has an important role on most farms. A family or an estate owns 99% of the farms. Approximately half of the farmers farm full-time. The income is often augmented by off-farm employment. While the farm size has rapidly increased, due to national and European Union regulations, industrialized production has not progressed to the extent it has in North America. Joining the European Union on January 1, 1995 had dramatic effects on agriculture. Most producer prices dropped "overnight" by 1/3 or more. Several types of subsidies came to replace lost earnings; however, they are being phased out, and this has caused difficult adjustments for farmers (Siren, 1999). Strong emphasis has been placed on environmental stewardship including restrictions on the handling of pesticides, fertilizers, and animal waste. Finland is the world's most northern nation with self-sufficient agriculture. The growing season is 180 days in the south and 110 days in northern Finland. Compared to North America, Finnish agriculture and climate are most similar to the eastern Canadian provinces and the northeastern states of the US.

Agricultural Injuries in Finland

Farmers Social Insurance Institution (Mela) administers the farmers' workers' compensation insurance (MATA) and provides statistical information on injuries and occupational diseases. Statistical year books were published in 1982-92 in Finnish and Swedish and for 1991-92 in English (Siitonen and Pätiälä, 1993). The year end number of farms in Finland was 105,581 in 1992 and the number of insured farm operators and family members was 199,418. Since 1992, the number of farms has declined dramatically to about 68,000 in 2001 and continues to decline. In 1987-92, the average fatality rate was 6.5 fatalities /100,000 workers (Farmers Social Insurance Institution, 1992). The average incidence rates for 1983-2001 were 7.3 injuries/100 workers and 0.46 occupational diseases/100 workers (Farmers Social Insurance Institution, 2002).

Besides MATA statistics, various studies have addressed injuries and risk factors for injuries. A Kuopio Regional Institute of Occupational Health study found that personal risk factors for farm injury included middle-age, male gender, smoking, overweight, and reduced physical condition. Prior to the injury, the injured persons had more minor injuries, double the number of health center visits, and triple the likelihood of seeking psychological care (Penttinen and Valonen, 1995). Another study found that dairy farms have a higher injury risk than crop farms, and the injury risk increases with the size of the dairy operation but decreases in largest categories (Virtanen et al., 1999).

Comparison of Injury Rates in Selected Countries

Comparison of injury rates between countries requires careful consideration of the climate, production, and other factors. While rates may not be easily comparable they can provide useful background for pointing out obvious differences. The fatal agricultural injury rate in the United States is about twice as high as in Canada and about three times as high as in Finland. The use of rollover protective structures on tractors is one important reason for differences in the fatality rate.

Table 1 shows some examples of published injury rates from the United States, Finland, Canada, and New Zealand. NIOSH has published injury estimates as part of the Traumatic Injury Surveillance of Farmers (TISF). The estimated non-fatal lost-time injury rate in 1995 was 6.8 injuries/200,000 hours worked (equivalent to 100 full-time worker years) (Myers, 2001). Other surveys have documented injury rates up to 18/100 workers (Thu, 1998) and even as high as 29/100 (Osorio, 1998). A survey in Ontario, Canada, concluded that 8.4 of 100 workers were injured during the past year; the rate was 13.1/100 in men and 3.8/100 in women (Health Canada, 1998). The fatalities in Canada have been reported by the Canadian Agricultural Injury Surveillance Program. The fatality rate was 11.6/100,000 workers during 1990-95 (Brison et al., 1997).

Work-related Illness

Respiratory Disease

Merchant et al. (2000) presented a summary of respiratory diseases, which have been shown to be associated with agricultural work exposures. The exposures included dust from grain, cotton, flax, hemp, tobacco, coffee, tea, herbal tea, castor bean, soybean, spices, and pollens; microbes including fungi and bacteria; animal dander, proteins, insects, mites, and weevils; as well as chemicals including ammonia, hydrogen sulfide, oxides of nitrogen, fumigants, fungicides, herbicides, insecticides, and rodenticides. The respiratory diseases associated with these exposures included: asthma, rhinitis, chronic bronchitis, airway obstruction, febrile syndromes (mill fever, grain fever, mycotoxicosis, organic dust toxic syndrome (ODTS), silo unloader's syndrome), hypersensitivity pneumonitis (farmer's lung, maple bark stripper's lung), and pulmonary edema.

Research suggests that livestock farmers experience high rates of lung disease. Thorne et al. (1995) summarized rates of respiratory symptoms in swine producers including asthma-like syndrome (11%), occupational asthma and chronic inflammation (20%), chronic bronchitis (25%), irritant rhinitis and pharyngitis (22%), and ODTS (33%). Reynolds et al. (1993) found an association between respiratory disease and exposures to turkey barn environment, including a decrease in lung function during a workday, and increasing respiratory disease with more years worked in the turkey-growing industry.

A survey of Ohio cash grain farmers in 1993 found the following prevalences of respiratory symptoms: 9.4% for chronic cough, 10.8% for chronic phlegm, 16.2% for dyspnea, and 8.1% for non-cold wheeze. Occupational factors associated with increased prevalence included cab tractor operation (cough); time spent farming (phlegm); having livestock other than cattle, cows, and calves (dyspnea); acres of corn for silage or green chop (cough); acres of alfalfa hay (non-cold wheeze); and personal involvement with pesticides (cough) (Wilkins et al., 1999). In Iowa, flu-like symptoms (22%), dyspnea (21%), and phlegm (15%) were most often reported symptoms. Presence of animal

confinements, vertical silos, and applying pesticides to livestock were significant risk factors (Sprince et al., 2000).

The long-term mortality from nonmalignant respiratory diseases was elevated (Relative Risk (RR) = 3.27, 95% Confidence Interval (95%CI): 2.1, 4.9) in California agricultural workers who filed workers' compensation claims between 1946 and 1975 compared to other occupations (Beaumont et al., 1995). NIOSH reported 51 fatalities in 1996 from hypersensitivity pneumonitis, some of which may be agricultural work-related (National Institute for Occupational Safety and Health, 2000).

Work exposure factors in farming and other dusty occupations have been found to enhance the risk for chronic bronchitis from 2- to 3-fold for farmers. In combination with smoking the risk increases to up to 6-fold (Melbostad et al., 1997). A multicenter case-control study of clinically and histologically diagnosed idiopathic pulmonary fibrosis (IPF), based on 248 cases and 491 controls was conducted between January 1989 and July 1993. Occupational risk factors adjusted for age and smoking included farming (Odds Ratio (OR)=1.6, 95%CI: 1.0, 2.5); livestock (OR=2.7, 95%CI: 1.3, 5.5); and vegetable dust/animal dust (OR=4.7, 95%CI: 2.1, 10.4) (Baumgartner et al., 2000).

Various studies including Schwartz et al. (1995) have indicated that the concentration of endotoxin in the bioaerosol is particularly important in the development of grain dust-induced lung disease. Dust from cows is the most important inducer of occupational allergic diseases in Finnish dairy farming accounting for 40% of the occupational asthma cases (Virtanen et al., 1996). Dose-response relationships have been identified, and new threshold limit values have been suggested for organic dust in animal confinements (total dust 2.4 mg/m^3, respirable dust 0.23 mg/m^3, endotoxin 800 endotoxin units/m^3, and ammonia 7 ppm) (Reynolds et al., 1996; Donham and Cumro, 1999). Ambient air quality standards for emissions from concentrated animal feeding operations (CAFO) have been adopted in many states, and a recent report summarizes the air quality issues and recommends standards for the state of Iowa (Merchant and Ross, 2002).

Cancer

In most studies, farmers have been found to experience lower rates of cancer, especially smoking-related cancers, compared to the general population. NIOSH reported a 0.89 Proportional Mortality Ratio (PMR) for farmers when compared to other industries in 1984-95. Especially lung cancer (0.81) was lower in agriculture. Certain cancers, including skin cancer (1.22) were elevated in agriculture (National Institute for Occupational Safety and Health, 2000).

Similar findings have been made elsewhere; a Finnish cohort study found an 18% decrease in overall cancer risk for farmers, and increased risk for cancers of lip (Standardized Incidence Ratio (SIR) = 1.51, 95%CI:1.35, 1.66), and Hodgkin's disease (SIR=1.35, 95%CI: 1.08, 1.68) (Pukkala and Notkola, 1997). A Swedish cohort study found a 20% decrease overall, with increased risk for lip cancer and multiple myeloma (Wiklund and Dich, 1995). Other studies have shown increased risks for cancers of the lip, stomach, brain, prostate, connective tissues, and the lymphatic and hematopoietic system among farmers (Blair et al, 1993; Brown et al., 1990; Cerhan et al., 1998; Blair and Zahm, 1991; Buxton et al., 1999). Blair et al. (1992) summarized 28 cancer studies and found lower rates of all cancers combined, and most other cancers except

Hodgkin's disease, multiple myeloma, leukemia, skin melanomas, and cancers of the lip, stomach, and prostate.

Several studies have found an association between pesticide exposures and multiple myeloma, leukemia, and non-Hodgkin's lymphoma (Zahm et al., 1992; Hoar et al., 1986; Zahm et al, 1990; Boffetta et al., 1989; Morrison et al., 1992). Since 1992, the US EPA worker protection standard requires that pesticide applicators must be trained and certified or licensed. This requirement changed pesticide application procedures, and many farmers started using contractors instead of applying pesticides themselves. This change in exposures may have an effect on future cancers. The Agricultural Health Study is a large prospective study designed to follow a cohort of about 90,000 applicators in Iowa and North Carolina for at least 20 years (Alavanja et al., 1996). This study will provide further information about the cancer risk of pesticide applicators compared to other populations, as well as various risk factors for cancer.

Noise Induced Hearing Loss

Several studies have found an increased prevalence of noise-induced hearing loss among farmers and farm family members (Plakke and Dare, 1992; May et al., 1990; Thelin et al., 1983; Crutchfield and Sparks, 1991). Hearing loss is common among older farmers, and also among younger farmers and teen-aged farm children (Ejercio et al., 1989; Broste et al., 1989). Beckett et al. (2000) found that 72% of farmers in a study of New York farmers had high frequency hearing loss. Factors associated with hearing loss included age, male gender, hunting, and use of grain dryers. In Ohio, self-reported noise sources included: non-cab tractors (nearly all farmers), chain saws (80%), combines (70%), off-farm work (33%), hunting (51%), and motor cycling (21%) (Wilkins et al., 1999).

While most studies have reported high prevalence of hearing loss in agriculture, the Iowa Keokuk County Rural Health Study results indicated no significant difference between those who had farming history and rural citizens who had not farmed. Hearing loss was found in 50% of females and 86% of males with farm history. Respectively, 50% of females and 80% of males without farm history had hearing loss. In young males the prevalence of hearing loss was 47% (Mudipalli et al., 2000).

Skin Disorders

Agriculture had the highest rate of skin disease (17.2/10,000 workers) of any occupation according to 1998 BLS data (National Safety Council, 2000). In Finland, 19% of all occupational diseases were skin disorders in 1999. Agriculture had the highest rate of skin disorders (12/10,000 workers) (Karjalainen et al., 2001). One Finnish study found a one-year prevalence of self-reported hand and forearm dermatoses of 16% for women and 7% for men (Susitaival et al., 1994).

A cross-sectional survey of California grape, citrus, and tomato workers showed a prevalence of 2% for contact dermatitis and 13% for lichenified hand dermatitis. Grape workers were more likely to report rashes in the last 12 months than were tomato workers or citrus workers (Gamsky et al., 1992). In California, plants (52.1%), chemical exposures (20.4%), and food products (12.5%) were the most common causes of 2,722 workers' compensation claims for lost-work-time skin conditions reported between 1978 and 1983 (O'Malley and Mathias, 1988). In Iowa, 9.6% of men and 14.4% of women reported dermatitis during one year. A history of allergy and exposure to petroleum

products were significant risk factors (Park et al., 2001a). Other studies have reported risk factors for skin disorders, including pesticides, chemicals, medications, fruit, flowers, and animals (Kanerva and Susitaival, 1996; Susitaival et al., 1995).

Zoonotic Diseases

Zoonotic diseases are relatively rarely reported in the farm population, however these illnesses may often be undetected. Among zoonotic infections transmitted from farm animals to humans are anthrax, brucellosis, erysiplea, tularemia, salmonella, staphylococcal dermatitis, and hantavirus (Armstrong and Post, 1989; Cosentini and Blasi, 1996). In a Missouri study, nine workers (8%) exposed to leptospirosis infected swine herd had positive serologic testing. Risk factors included smoking (OR = 14.4, 95%CI: 1.4, 137.7) and drinking beverages while working with infected pigs (OR = 5.1, 95%CI: 1.04, 24.3). Washing hands after work was protective (OR = 0.2, 95%CI: 0.03, 0.81) (Campagnolo et al., 2000).

A study from England reported prevalences of antibodies to Q-fever (29.2%), toxoplasma (50.2%), lyme disease (0.2%), leptospira (0.2%), brucella (0.7%), hantavirus (seroprevalence 4.7%), orthopox virus (0.7%), parapox virus (4.5%), Bartonella spp. (2.0%), Ehrlichia Chaffeensis (0.2%), human granulocytic ehrlichiosis agent (2.0%), and Echinococcus Granulosis (1.5%) (Thomas et al., 1999). In a Finnish study, 4% of farmers reported zoonotic infections, most commonly ringworm (1.3%) and milkers nodule (0.7%) (Susitaival, 1996).

Mental Health

Farming has an elevated rate of suicide in the US (Relative Risk=1.11) (National Institute for Occupational Safety and Health, 2000). However, a Canadian study found that the farmers' suicide rates were lower than the general population (Pickett et al., 1999b). A study in Ohio showed that cash grain farmers had higher rates of depressive symptoms than the national comparison group. Using the Center for Epidemiologic Studies Depression Scale, 8% of the farmers screened positive for depressive symptoms (Elliott et al., 1995). A similar study in Colorado reported a 7.9% rate for males and 11.1% for females (Stallones et al., 1995). In Iowa, 12.1% of farmers had depressive symptoms. Legal problems, not married status, sentimental value loss, substantial income decline, and decline in general health were significant risk factors (Scarth et al., 1997). Iowa farmers were 1.7 times more likely to have had depressive symptoms than Colorado farmers (Scarth et al., 2000).

Research suggests that economic stress on farmers leads to increases in stress-related medical conditions and injuries (Kidd et al., 1996; Thu et al., 1997). Mental health conditions; such as interpersonal distress within family, anxiety, and depression, increase during periods of economic stress. Paraprofessionals, who are farm residents themselves and who have experienced and recovered from tragedies, have been successful in providing outreach and support during the farm crisis of the 1980's (Barrett, 1987; Rosmann, 1994; Hannan, 1998).

Cumulative Trauma

The 1998 BLS data showed 4.4 cases of cumulative trauma per 10,000 farm workers. This was the second highest reported rate of illness after skin disorders (National Safety Council, 2000). In California, evaluation of 357 farms representing over

2000 workers (89% were hispanic male) showed a high prevalence of musculoskeletal problems including lower back (24%), upper back (19%), and wrist problems (18%). Farm family focus groups in Ohio identified lifting, forking, shoveling, sitting in twisted position looking back at equipment on tractor, and looking down at combine header as risk factors (Bartels et al., 2000). In a survey among Swedish dairy farmers 82% of men and 86% of women reported some muskuloskeletal symptoms in the past year (Gustafsson et al., 1994). Another Swedish study using the Ovako Posture Analysis System (OWAS) found unacceptable working postures 38% of the time when milking in stanchion barns and 10% when milking in parlors (Lundqvist et al., 1997). An Australian study showed that 57% of dairy farmers experienced back trouble related to their work (Lower et al., 1996). A Colorado study found a 43% back pain prevalence in dairy farming. The prevalence was 27% for field crop farmers and 25% for livestock farmers other than dairy (Xiang et al., 1999). In Iowa, 31% of farmers reported having daily back pain for a week or more during the past year compared to 18.5% in the general population (Park et al., 2001b).

Conclusions

The fatality risk is high in US agriculture; about twice as high as the risk in Canadian agriculture, and about three times as high as the risk in Finnish agriculture. The non-fatal injury data are not fully comparable, but similar rates (about 7%) were found in workers' compensation data in different countries. Surveys often report higher incidence rates than workers' compensation sources. Information on occupational diseases is limited due to lacking workers' compensation insurance for self-employed farmers in most jurisdictions. However, a body of literature describes work-related symptoms in agriculture. While these studies are useful for understanding occupational risk factors, they are not able to provide comparable rates due to varying methods and definitions. Very little information was found on lost time and cost of agricultural injuries and illnesses. Preventive measures, including engineering, enforcement, education, and incentives have been developed, however, very few well-conducted evaluations of these interventions were found in the literature.

Overall in the United States, fatalities are relatively well known, but the non-fatal injuries and work-related illnesses are not due to lacking insurance and surveillance programs for self-employed farmers. Defining the population at risk in agriculture also remains a challenge. The analytical part of this study examined data resources from Finland where all farmers are covered by workers' compensation since 1982. The population is well defined and injury and occupational disease information, including costs and lost time, is available for about two decades. This study focused on three gap areas in the literature: costs, lost time, and intervention effectiveness. Both injuries and occupational diseases were included to provide a broader perspective on work-related health conditions.

CHAPTER 3

COST OF INJURIES AND OCCUPATIONAL DISEASES IN AGRICULTURE IN FINLAND

Summary

Background: Although agriculture is one of the most hazardous industries, the costs of agricultural injuries and illnesses are not well known.

Objectives: This study aimed to characterize compensated agricultural injury and illness costs in Finnish agriculture and to identify risk factors associated with claim costs.

Methods: The annual costs to the workers' compensation insurance system were quantified from 1982 to 1999. Claims occurring in 1996 (N=10,922) were used for assessing long-term cost characteristics and risk factors. The *t*-test, chi-square test, analysis of variance, linear regression, and logistic regression were used in the analyses.

Results: The total insurance cost in 1996 was €23.5 million Euros (2.5% of the insured farm income), consisting of medical (16%), lost-time per diem (37%), accident pension (23%), survivors' pension (3%), impairment allowance (7%), rehabilitation (6%), and other costs (9%). The mean costs of 1996 claims with/without permanent pensions were: all claims €1743/€1349, injuries €1340/€1099, and occupational diseases €6636/€4380. Only 0.6% of the claims led to permanent pension, but the present value of the permanent pensions was 23% of the total costs. Women's claims had a higher risk of becoming permanent pensions compared to men (RR=1.8, 95%CI: 1.1-2.9), and occupational diseases had a higher risk of becoming permanent pensions compared to injuries (RR=6.9, 95%CI: 4.2-11.4). The most costly health outcomes included pulmonary diseases, amputations, dermatitis, and bone fractures. Work activities associated with high costs included grain handling; feeding dairy and beef animals; milking; racing, riding, and training horses; and commuting. High-cost causes included biological and organic dusts; large animals; scaffoldings; ladders; stairs; roofs; wagons; saws, wood splitters, and chippers; and power take-offs. Occupational diseases; slips and falls; falls from elevation; struck by or run over by machines; and pushed or run over by animals were high cost incident types.

Introduction

Although agriculture is considered one of the most hazardous industries, very little is known about the cost of agricultural injuries. Farmers lack workers' compensation in many jurisdictions, and no other surveillance system collects cost information. Health insurance may cover medical costs, but often it is not determined whether the injuries are work-related. Private insurers may not publish cost data as they consider them proprietary information. Available data suggest that occupational injuries place a significant burden on the economy. In the United States, work-injury costs were estimated at 1.3% (National Safety Council, 2000) to 1.8% (Leigh et al., 1997) of the gross domestic product (GDP) in 1999 (U.S. Census Bureau, 2000). The economic losses from occupational injuries and illnesses rival those from cancer and heart diseases in the United States (Leigh et al., 1997). Leigh et al., (2002) estimated the agricultural injury costs at $4.573 Billion, which is 2.8% of the value of farm sales, and 15.0% of the net cash returns in the US in 1992 (Census of Agriculture, 1992).

This study focuses on agricultural injury and occupational disease costs in Finland, where agriculture produced 1.5% of the GDP and comprised 6% of the labor force in 1996. The total injury and occupational disease costs were 0.7% of the gross national farm income and 2.2% of the net farm income (Finfood, 1997; Farmers Social Insurance Institution, 2002).

It is in the interest of farmers, family members, insurers, and society as a whole to reduce injuries and injury costs. Current lack of cost information limits risk assessment efforts, and agricultural health and safety policy decisions are often made with little knowledge of the magnitude of the problem. Accurate cost information would be valuable for sizing and targeting research and prevention efforts.

Since 1982, Finnish farmers have had a mandatory employment accident insurance program that covers all farmers and provides various types of compensation. The system is well established and well utilized by farmers. Large databases, detailed coding systems, and various quality control procedures provide accurate data for research. This study aimed to characterize claim costs and to identify risk factors leading to high claim costs. The potential risk factors included demographic, income, and injury/illness circumstance variables. Univariable methods were used for examining the association between the claim cost and each potential risk factor. Multivariable methods were used for examining these associations while controlling for other factors.

Methods

Two primary methods were used to examine the injury and illness costs. Method 1 was a descriptive characterization of actual injury and illness costs to the insurance system over time. Annual compensated costs were constructed correcting for inflation and population decrease. This method shows the evolution of actual annual costs since the insurance system was implemented, and establishes the cost burden to the insured persons over time. It also provides a comparison for the analytical study, which included estimated future costs. Method 2 was an analytical study of injuries and illnesses, which occurred in 1996. Injury cost characteristics and potential risk factors were assessed from claims records using analysis of variance, linear regression, and logistic regression methods. Method 2 used actual costs up to the data extraction date and estimated future costs of permanent pensions.

Setting

In Finland, various social insurance programs provide protection for elderly, disabled, and injured farmers. National health insurance and old-age pension are available to all citizens, including farmers. An earnings-related pension program was introduced in 1970 (Farmers' pension act, 1969) and a workers' compensation insurance in 1982 (Farmers' accident insurance act, 1982). Farmers' Social Insurance Institution (Mela) administers both programs, which are mandatory for 18-64 year-old self-employed farmers, fishermen, and reindeer herders, as well as family members earning more than €2,532 Euros (in 2001) from the family enterprise. The premiums and some benefits are based on insured farm income, which is determined by Mela reflecting the value of the work conducted on the farm. The insured farm income is determined using arable land, forestland, animal production, taxable income, and personal adjustment, and it is divided in most cases equally between the spouses or owners. The income is adjusted annually by a specific cost-of-living and wage index for social insurance

programs in Finland (The Central Pension Security Institute, 2001). The insured farm income provides a more stable basis for social insurance programs than taxable income, which may fluctuate widely from year to year.

Data

This study was conducted based on a research agreement between The University of Iowa and Mela. An international institutional review board clearance for human subjects research was obtained through The University of Iowa and the US Centers for Disease Control and Prevention. The descriptive study of annual insurance costs (Method 1) was conducted using aggregate data. These data were collected from Mela's annual insurance administration statistics. The analytical study of 1996 injuries and occupational diseases (Method 2) was conducted using claims data. The main dataset consisted of all injuries and occupational diseases, which occurred in 1996 (N=10,922). No personal identifiers were included in the data.

A compensable *injury* is defined as a sudden unexpected forceful event with an external cause, which results in bodily damage or an ailment, and which occurs in the course of agricultural work (Farmers Social Insurance Institution, 1998). Compensable *occupational diseases* are defined by legislation as ailments that are probably predominantly due to specific physical, chemical, or biological factors associated with work (Occupational disease act, 1988). The data were extracted from the claims database on August 1, 2000, and compensated costs up to that point were included. The present value of permanent pensions as determined by MATA was also available. All costs were converted from the Finnish currency, Markka (FIM) into Euros (EUR). The Markka is permanently tied to the Euro (€1 EUR = 5.95 FIM). Starting 1/1/2002, the Euro has been the official currency of Finland. As of 4/5/02, €1 EUR = $0.878 USD.

The variables used in the analytical study are briefly described in Table 2. The Appendix presents the complete list of codes and frequencies for nine variables. Total cost was the primary outcome variable, and cost sub-categories including medical costs, lost-time per diem, and pensions, were secondary outcomes of interest.

The distribution of cost variables was skewed, and therefore natural log-transformed costs were used as outcomes. As an example, distribution indicators for the actual total costs included: mean = €1743, median = €471, coefficient of variation = 525, standard deviation = 9156, skewness = 20.4, and kurtosis = 621. Respectively, the indicators for natural log-transformed total costs were: mean = 6.24, median = 6.16, coefficient of variation = 21, standard deviation = 1.35, skewness = 0.068, and kurtosis = 2.2. After log-transformation the outcome variables had a near normal distribution enabling the use of general linear models without loss of precision. The advantages of log-transformation have been summarized by Manning and Mullahy (2001). In general, using no transformation for skewed outcome leads to loss of precision and biased estimates. However, transformation can lead to fairly complex re-transformation of model estimates. The "smearing" estimation is one technique for re-transformation (Duan, 1983). The smearing transformation is not necessary if the error term is log-normally distributed. Simple parametric retransformation procedure is outlined by Kennedy (1981), and was used in this study. Due to the relatively large number of variables and multiple models tested, this study primarily reported non-adjusted costs for factors found significantly associated with high costs, rather than complete lists of estimates.

The compensated costs up to the data extraction on August 1, 2000 were included for all cases. Those cases with continuing costs beyond August 1 2000 were identified for separate analysis. The potential risk factors included demographic, income, and incident/exposure characteristics.

Statistical Methods

Injury and occupational disease rates were constructed based on the number of claims and the insured mid-year population in 1996. The rates among men and women were compared using the chi-square test. The *descriptive study* of *annual insurance costs* (Method 1) was conducted using aggregate data from insurance administration statistics. All costs from 1982 to 1999 were compiled, and actual costs were adjusted for inflation using the cost-of-living and wage index (TEL index), which is a standard method in Finnish social insurance programs. Annual costs per insured person were calculated using the index-adjusted annual costs and mid-year populations. The purposes of this method were to describe the evolution in the costs over time as the insurance system matures, as well as establishing the cost burden for insured persons. This method enables comparison of actual costs and estimated costs in the second method.

The *analytical study of cost characteristics and risk factors* (Method 2) was conducted using 1996 claims data. This year was selected balancing issues related to the insurance system maturity, follow-up time after the incident, changes in agriculture, and insurance policy changes. The *mean costs per claim* were calculated for total costs and cost sub categories. The mean costs for dichotomous variables, gender and injury/illness code, were compared using the *t*-test. The analysis of variance (ANOVA), linear regression, and logistic regression were used for measuring the associations between potential risk factors and outcomes.

First, we conducted univariable analyses examining the overall association between each potential risk factor and the log-transformed total costs excluding permanent pensions. The categorical risk factor variables; work activity, cause, nature of incident, type of injury/illness, part of body, and incident month; were assessed using the GLM analysis of variance for unbalanced data. The overall association was assessed and the contribution of each category to the model was examined. The GLM Dunnett procedure was used for identifying highest cost categories. This procedure performs Dunnett's two-tailed *t*-tests, testing if the mean costs in any category are significantly different than in the specified reference category. This method adjusts the significance level for multiple comparisons (SAS Institute Inc., 1987). The reference category for each variable was the category with a frequency of N>250 nearest to median costs. The continuous risk factor variables; age, farm income, employment income, business income, and the personal claim rate; were assessed using linear regression.

Secondly, multivariable methods were used for identifying risk factors for costs while controlling for other factors. The GLM procedure was used for fitting models for five log-transformed cost outcomes: 1) total costs; 2) total costs excluding permanent pensions, 3) medical costs, 4) lost-time per diems, and 5) paid pensions up to Aug 1, 2000. The potential risk factors were: age, gender, personal claim rate, farm income, employment income, business income, injury/occupational disease code, work activity, cause, nature of incident, type of injury/illness, part of body, and incident month. The full model, including all risk factor variables, was fitted for each outcome, and the significance level of each risk factor was examined. Specific models were developed for

work activity, cause, and nature of incident. High cost categories were identified using the Dunnett's *t*-test while controlling for a limited number factors: age, gender, farm income, employment income, and business income.

Thirdly, multiple logistic regression was used to determine which risk factors contributed to claims becoming pension cases. Models for three outcomes were fitted: 1) any pension paid, 2) pension paid beyond August 1, 2000, and 3) permanent pension cases. The potential risk factor variables were the same as in the GLM models, and the stepwise procedure was used for building the models.

Several variables in these data have very detailed coding and categories were combined to avoid over fitting the models. Small categories were joined with other categories with a related topic area and similar mean costs. Three variables; work activity, cause, and nature of incident were of specific interest in this study as they are directly applicable to prevention. The coding of these variables was kept relatively specific. Categories with a frequency of 20 or less were combined (with certain exceptions). For other variables, categories with 30 or less observations were combined. Only a limited number of variables were included in the multivariable models to keep the models parsimonious. The ICD 10 code and some other variables were excluded.

Results

Injury and Occupational Disease Rates

The frequencies and rates of injuries and occupational diseases in 1996 were calculated and the results are presented in Table 3. The injury rate was 9.07/100 for men, 4.80/100 for women, and 7.37/100 for both. The occupational disease rate was 0.51/100 for men, 0.75/100 for women, and 0.61/100 for both. The relative risk of an injury was 1.89 times higher for men compared to women (95% CI: 1.81-1.97). The relative risk of an occupational disease for men was 0.68 times the risk for women (95% CI: 0.60-0.78). Especially farmer's lung, asthma, dermatitis, and epicondylitis rates were higher in women.

Method 1: Annual Insurance Costs

The compensated annual insurance costs in 1982-1999 were calculated and converted to 1999 value in Euros using the annual cost-of-living and wage index. The annual costs per insured person were then calculated using the mid-year populations. Figure 1 shows the annual insurance costs for 1982-1999. The total annual index adjusted cost burden per insured person increased from €75 in 1983 to €215 in 1999. The increase was rapid in the 1980's and especially the pension costs increased. The costs appear to have stabilized in the early and mid 1990's. The annual insurance cost burden consist of paid benefits to new cases, as well as old cases from previous years, which continue to require medical care, rehabilitation, or pension. The annual insurance costs may vary based on changes in the population, incidence rate, claim severity, accumulation of long-term disability cases, health care costs, and many other factors. This study described the actual costs but did not draw statistical inference from the changes or analyze contributing factors to cost changes over time.

During 1996, the compensated insurance costs were €23.5 Million, consisting of medical cost (16%), lost-time per diem (37%), accident pension (23%), survivors' pension (3%), impairment allowance (7%), rehabilitation excluding lost time during

rehabilitation (6%), and other costs (9%). The cost of pension does not include the present value of permanent pensions, only actual paid pensions during each year.

Method 2: Long-term Cost of 1996 Claims

All injuries and occupational diseases, which occurred in 1996, were included in this analysis. The claims data were extracted on August 1, 2000, and all compensated costs up to that point were included. The total and mean costs were calculated for injuries and occupational diseases, and the results are shown in Table 4. The total costs for 1996 cases were €19 Million. The mean costs with/without permanent pensions were as follows: all claims €1743/€1349, injuries €1340/€1099, and occupational diseases €6636/€4380. Occupational diseases were about four times as costly as injuries when permanent pensions were excluded and five times as costly when the permanent pensions were included. The number of injuries was about twelve times higher than the number of occupational diseases, but the total cost for injuries (€13.5 Million) was only two and a half times as high as the cost for occupational diseases (€5.5 Million). Lost-time per diem was the largest cost sub-category (44%), followed by present value of permanent pensions (23%) and paid pensions up to August 1, 2000 (17%). All pensions combined were 40% of the total costs. Medical care was 12% of the total costs using Method 2.

Table 4 presents the costs using both Method 1 (€23.5 Million) and Method 2 (€19 Million). Method 2 does not include administrative costs, impairment allowance, and some costs beyond August 1, 2000, which explains part of the difference in total costs. Differences were found also in the cost sub-categories. Pensions were much greater in Method 2 (40% versus 26%). The permanent pensions were 23% of the total costs in Method 2, indicating that a small number of permanent disability cases (66 out of 10,922 cases; or 0.6%) is responsible for almost a quarter of the total costs. Permanent pension cases consisted of 42 injuries and 24 occupational diseases.

Risk Factors for Injury and Illness Costs

Univariable Analysis

Type of Production

The type of production coding consists of seven agricultural production categories: animal production, crop production, other farm work, forest work, on-farm construction work, reindeer herding, and fishing. The type of production had a significant association with log-transformed total costs (excluding permanent pensions), but explained less than 1% of the cost variation (ANOVA, $p<0.0001$, R-Square=0.007). The claim costs were higher than average in animal production and crop production, and lower than average in all other categories. Table 5 shows the injury and illness costs by type of production. The table also includes the numbers and percentages of farms in 1996 by type of production (Finfood, 1998). Although accurate comparable rates cannot be established from these data, it appears that animal production comprises about half of the claim costs and also about half of the farms. In crop production, the total costs appear to be much lower than the share of farms. In forest production, costs appear to be higher than the share of forestry farms. It should be noted that crop production farms are often part time operations, and some forestry production occurs on nearly all Finnish farms.

Work Activity

The work activity coding consists of 150 categories, which was reduced to 76 by combining small categories. Dairy farming is common in Finland, and work activities related to dairy and beef animal care had the highest total costs. No data on working hours are available at the same detail level as represented in the work activity classification; therefore, rates cannot be established. Most occupational diseases occurred in animal production work.

The work activity had a significant association with total costs (ANOVA, $p<0.0001$, R-Square=0.036). The mean costs were compared using the Dunnett's *t*-test procedure ($p<0.05$). Farm building maintenance was used as the reference category (N=262, mean cost €1036). Of the 76 work activities, following had significantly higher costs than the reference category: handling and drying crops in storage (Relative Risk (RR)=1.8); feeding dairy and beef animals (RR=2.3); cleaning and brushing dairy animals (RR=3.9); milking and handling milk (RR=1.4); racing, riding, and training horses (RR=2.6); and commuting (RR=1.5). Table 6 lists the work activities associated with high claim costs.

Cause

The cause coding consists of 108 categories, which was reduced to 75 by combining small categories. The cause had a significant association with total claim costs (ANOVA, $p<0.0001$, R-Square=0.078). The Dunnett's *t*-test was used for comparing the mean costs. Dairy and beef animals was used as the reference category for comparisons (N=1761, mean cost €1192). The following categories had significantly higher costs that the reference category: circular saws, sawmills, wood splitters and chippers (RR=1.4); stairs (RR=1.6); scaffolding and unattached ladders (RR=1.5); and biological causes (primarily moulds and mites) (RR=6.8). Table 7 shows the causes associated with high claim costs.

Nature of Incident

These data had 28 nature of incident categories, which was reduced to 24 by combining small categories. Nature of incident had a significant association with total costs (ANOVA, $p<0.0001$, R-Square=0.11). The Dunnett's *t*-test was performed using kicked or stepped on by an animal as the reference category (N=698, mean cost €1005). The costs were higher in the following categories when compared to the reference category: falling from elevation when lifting, moving, or carrying a load (RR=2.3); falling from elevation without a load (RR=1.9); falling from elevation when the platform or structure falls or fails (RR=1.8); falling, sliding, or tumbling machines or equipment (RR=1.7); and occupational diseases (RR=3.5). Table 8 shows the nature of incident categories associated with high claim costs.

ICD10 Code

A total of 470 different ICD10 health outcome codes were used in these data. The categories were reduced to 44 by combining small categories. The ICD10 code had a significant association with total costs (ANOVA, $p<0.0001$, R-Square=0.28). The Dunnett's *t*-test was used for comparing costs using dislocation, sprain, or strain of joints or ligaments at the ankle and foot level as reference. The outcomes with higher mean costs than the reference category were: asthma; rhinitis; hypersensitivity pneumonitis;

dermatitis; various fractures; hand and wrist injuries; shoulder sprain and dislocation; knee dislocation, sprain, or strain; and epicondylitis. Table 9 shows the outcomes associated with high claim costs.

Type of Injury or Illness

The type of injury or illness coding consisted of 13 categories, which were reduced to 11 by combining small categories. This variable is similar to the ICD10 coding, but uses fewer categories. The type of injury or illness had a significant association with total costs (ANOVA, $p<0.0001$, R-Square=0.16). The Dunnett's *t*-test was performed comparing the mean costs using sprain or strain as the reference category. The categories with higher costs than the reference were: bone fractures; internal injury, illness, or concussion; amputation; skin disorder; and acute poisoning, electrocution, hearing loss, or other injury/illness. Table 10 shows the injury and illness costs and identifies those categories with higher costs than the reference category.

Other Factors

The mean costs (including permanent pensions) were higher for women (€2178) compared to men (€1576) (*t*-test, $p=0.002$), and the log-transformed costs were 6.31 and 6.21 respectively ($p=0.0002$). The mean costs were higher for occupational diseases (€6636) compared to injuries (€1349) (*t*-test, $p<0.0001$), and the log-transformed costs were 7.3 and 6.1 respectively ($p<0.0001$).

Part of the body had a significant association with total costs (ANOVA, $p<0.0001$, R-Square=0.16). Head, neck, upper limb from shoulder to wrist, hand, internal injury/illness, and multiple injuries had higher than average costs. Work circumstance was not a significant factor. Worker status had a significant association (ANOVA, $p<0.0001$, R-Square=0.02). Farm wives had higher cost claims than farmers, fishermen, reindeer herders, and paid family members. The incident month had a significant association with costs but explained less than 1% of the cost variation (ANOVA, $p<0.0001$, R-Square=0.006). The months with high cost claims were: February, March, May, November, and December.

The continuous variables were examined using linear regression. Age had only a weak association with log-transformed costs (REG, $p<0.0001$, R-Square=0.004), and older age was associated with higher costs. Personal claim rate also had a weak association with costs (REG, $p=0.0002$, R-Square=0.001)), and higher personal claim rate was associated with lower costs. All three types of income had a significant association with costs but explained only a small part of the cost variation (REG, $p<0.0001$, R-Square=0.007-0.03). Higher incomes were associated with higher costs. The multicollinearity between the continuous variables was low (largest condition index 12.9). There were no significant interactions between the continuous variables at the $p<0.0001$ level.

Multivariable Analysis of Risk Factors

Five multivariable GLM models were fitted examining to what extent the selected potential risk factor variables explained the variation in costs. The outcome variables were total costs, total costs excluding permanent pensions, medical costs, lost-time per diems, and paid pensions up to August 1, 2000. The potential risk factor variables were age, gender, farm income, employment income, business income, work activity, cause,

nature of incident, type of injury/illness, part of body, and incident month. Several variables were excluded; for instance ICD10, injury/occupational disease, type of production, and worker status were not used as other variables contain much of the same information in a more parsimonious fashion. The personal claim rate and work circumstance were not used as they contributed very little to the models.

The first model for log-transformed total costs explained 34% of the cost variation. All other variables were significant at the $p<0.0001$ level except gender ($p=0.002$), incident month ($p=0.003$), and work activity ($p=0.06$). The second model for log-transformed total costs excluding permanent pensions was very similar; it explained 34% of the variation in costs. All other explanatory factors were significant at the $p<0.0001$ level except gender ($p=0.002$), incident month ($p=0.002$), and work activity ($p=0.09$). The third model for the log-transformed medical costs explained 16% of the variation in costs. All other explanatory factors were significant at the $p<0.0001$ level except gender ($p=0.27$), incident month ($p=0.14$), work activity ($p=0.03$), farm income ($p=0.77$), and business income ($p=0.0002$). The fourth model for the log-transformed lost-time per diems explained 39% of the variation in costs. All other explanatory factors were significant at the $p<0.0001$ level except gender ($p=0.009$), incident month ($p=0.31$), work activity ($p=0.49$), and nature of incident ($p=0.0006$). The fifth model for the log-transformed pensions up to August 1, 2000 explained 45% of the variation in costs. All other explanatory factors were significant at the $p<0.0001$ level except age ($p=0.55$), farm income ($p=0.18$), business income ($p=0.02$), gender ($p=0.02$), and incident month ($p=0.40$).

The GLM models explained 16 to 45% of the cost variation. The medical costs were least predictable and the pensions and per diems were most predictable. The strongest contributing factors to the costs in these models were type of injury/illness, part of body, cause, nature of incident, age, employment income, business income, and farm income. Gender, work activity, and incident month were significant only in some models. Men had significantly higher costs than women, but after adjusting for other factors the effect of gender became much less significant.

Three GLM models were fitted to identify high cost categories in the main variables of interest, work activity, cause, and nature of incident. A limited number of potential confounders or modifying factors were used in these models including age, gender, farm income, employment income, and business income. The outcome variable was log-transformed total cost excluding permanent pensions. The Dunnett's t-test procedure was used for comparing the mean costs of all categories to the reference categories. The purpose of this analysis was to determine whether the categories identified in the univariable analysis prevailed as high cost categories after controlling for potential confounders or effect modifiers.

The model for work activity compared mean costs of all categories to the reference category (farm building maintenance) while adjusting for potential confounders. The model explained 11% ($p<0.001$) of the cost variation, and all factors in the model were significant ($p<0.0001$). The following categories had significantly higher costs than the reference category: feeding dairy and beef animals (RR=2.3); cleaning and brushing dairy animals (RR=4.1); milking and handling milk (RR=1.4); training, riding, and racing horses (RR=2.9); handling and drying crops in storage (RR=1.7); other forage and grain harvesting work (RR=2.2); transporting supplies and commodities to and from the farm (RR=1.6); and commuting (RR=1.5). This analysis identified the same

categories as the univariable analysis and two additional categories and the estimates when controlling for age, gender, and income, were fairly similar to the unadjusted estimates.

The model for cause compared all cause categories to the reference category (dairy and beef animals) while controlling for other factors. The model explained 15% of the cost variation, and all factors in the model were significant ($p<0.0001$). The categories with significantly higher costs than the reference category were: biological causes (primarily moulds and mites); stairs; scaffoldings and unattached ladders; and circular saws, sawmills, wood splitters, and chippers. These categories were the same as in univariable analysis and the risk estimates were very similar.

The model for nature of incident compared all categories to the reference category (kicked or stepped on by an animal) while controlling for potential confounders. The model explained 18% of the cost variation ($p<0.0001$), and all factors except gender ($p<0.05$) were significant at the $p<0.0001$ level. The categories with mean costs higher than the reference category were: occupational diseases; falls from elevation; falling, slipping, or tripping with or without a load; falling from elevation with or without a load; sliding or tumbling machines or equipment; struck by or run over by machines; and pushed, run over, or thrown by animals. These categories were the same as in the univariable analysis, and the risk estimates were very similar to unadjusted estimates.

Pension cases are rare but they represent a large proportion of costs. Risk factors for pension were examined at three levels using logistic regression. The models were built using the stepwise procedure; variables were included at $p<0.1$ level, and kept in the model at $p<0.05$ significance level. The first model had any pension paid (yes/no) as the outcome variable. Gender, employment income, cause, nature of incident, type of injury/illness and part of body were significant contributors for all pensions ($p<0.05$). The second model for pensions paid beyond August 1, 2000 (yes/no) found gender, farm income, employment income, business income, nature of incident, type of injury/illness, and part of body as significant contributing factors for long pensions. The third model for permanent pension (yes/no) found only age and type of injury/illness as contributing factors for permanent pensions.

The multivariable analyses showed that type of injury/illness and part of body were strongly associated with costs. Cause, nature of incident, age, and employment income were nearly as strongly associated. Farm income and business income were significant in several models. Gender, incident month, and work activity were significant only in some models. The multivariable comparison of the mean costs in work activity, cause, and nature of incident categories identified the same categories as the univariable analyses, plus some additional high cost categories. Overall, these analyses found several risk factors for costs, but the available variables were not very helpful in predicting the highest cost cases leading to permanent pension.

Discussion

Agriculture is a hazardous occupation worldwide. In Finland, the annual fatal injury rate in agriculture was 6.5/100,000 (Farmers Social Insurance Institution, 1992), less than the rate in United States agriculture (22.5/100,000) (National Safety Council, 2000) and Canadian agriculture (11.6/100,000) (Pickett et al., 1999a), but higher than the rate in other industries in Finland (2.6/100,000) (Statistics Finland, 1998). Several factors have likely contributed to the low fatality and injury rates in Finnish agriculture.

The rollover protective structures (ROPS) became mandatory on new tractors in 1969. The safety of machinery has been addressed by national and international standards. In 1985, occupational health services were made available to farmers, and about 34% of the farmers are currently members (Ministry of Health, 1984; Eskola, 2001). Education has been provided to farmers and professionals working with farmers (Rautiainen, 1994). Insurance premium bonuses have been offered for those having no claims, and those who are members of the occupational health service system (Rautiainen et al., 2001). A stand-in program is in place providing farm workers to help during disability, maternity, and annual vacation (for livestock farmers). These efforts have likely had an impact on the frequency and severity of agricultural injuries and illnesses and related costs.

In this study, the injury costs in agriculture were 0.7% of the national gross farm income, 2.2% of the net farm income, and 2.5% of Mela's specific insured farm income (Farmers Social Insurance Institution, 2001; Finfood, 2001). This is comparable to estimates in all industries in the US; 1.3% (National Safety Council, 2000) to 1.8% (Leigh et al., 1997) of the GDP (U.S. Census Bureau, 2000). Leigh et al. (2001) estimated the total injury costs in US agriculture in 1992 at $4.573 Billion, which is 2.8% of the value of farm sales, and 15.0% of the net cash returns (Census of Agriculture, 1992). This estimate appears considerably higher than our estimate in Finnish agriculture. The gross income based estimate was four times higher and the net income based estimate seven times higher. These data show that agricultural injury costs appear to be much higher in the United States compared to Finland. This finding is also reflected in the workers' compensation rates. The US workers' compensation premium rates were generally in the range of 1.3-4.1% of the payroll for most industries. Rates for agriculture were 2.8-16.9% for field crop farming, 4.2 –16.2% for cattle farming, 3.1-18.0% for orchards, and 2.4-17.8% for nurseries (Oregon Department of Consumer Business and Services, 2001). The total workers' compensation costs in Finnish agriculture were about 2.5% of the insured income (payroll). Several factors may contribute to the low workers' compensation costs in Finnish agriculture including successes in injury prevention efforts, low health care costs, and low insurance administration costs. Although the farm injury and illness costs are lower in Finnish agriculture compared to the examples from the United States and Canada, the costs are still a significant burden for Finnish agriculture, as the profitability has been low and nearly half of the gross farm income comes from subsidies (Siren, 1999). Savings from reduced injury and illness costs could make a small but significant contribution to improving the farm economy.

It is well recognized that workers' compensation insurance represents only part of injury and illness costs. Some cases fall outside compensation: for instance unclaimed eligible cases; cases of uninsured people; cases of illness that may be work-related but are not compensable occupational diseases by law; and eligible occupational diseases that are not properly diagnosed. Types of compensation are usually limited and may not cover all losses. In Finland, the state supports medical care, and charges to the workers' compensation insurance are below cost. The general health insurance absorbs part of the costs. A wide range of direct and indirect costs and social consequences could be involved in injury and illness cases. No attempt was made to quantify them beyond compensated costs.

Broader consequences of injuries and illnesses have been described in the literature. Dembe (2001) presented the social consequences of occupational injuries and

illnesses in the following categories. The first categorization was by affected individuals and groups: 1) Work environment: injured worker, coworkers, employer, management, office staff, safety and health officials; 2) Family and friends: worker's family, friends, colleagues, neighbors, and 3) Community; workers' compensation insurers, other insurers, health care providers, labor unions, other worker groups, employer groups, lawyers, regulators, and lawmakers. The second categorization was by societal role including: vocational, domestic, leisure, recreational, civic, political, religious, economical, educational, professional, biological, and sociocultural. The third categorization was by institutions and structures including: workplaces, hospitals/clinics, homes, neighbors, churches, schools, stores/markets, businesses, courts, prisons, and social care organizations. The fourth categorization was by: 1) vocational function: reduced wages, diminished productivity, unemployment, and retraining, 2) Psychological and behavioral responses: stress, depression, anger, stigmatization, isolation, violence, suicide, and unhealthy behaviors such as smoking and drug abuse, 3) Social effects: medical care utilization, household tasks, interpersonal communication, family relationships, sleep/sexual disruption, divorce, community involvement, and discrimination 4) Physical status and limitations: impairment, disability, pain, and effects on activities in daily living. The broader impacts are complex and difficult to trace and measure. The investigation of social consequences is complicated by the intricate reciprocal relationships among the determinants, effects, and modifiers of work-related disorders.

Several methods have been utilized for valuation of the broader economic consequences of injuries and illnesses. Weil summarized three methods: present value of future earnings, contingent valuation, and compensating wage differentials (Weil, 2001). The present value of future earnings method calculates the present value of the foregone earnings stream given assumptions about age, earnings growth, and discount rate. The contingent valuation method is a survey-based procedure eliciting willingness to pay for lowered risk of death (Acton, 1973; Jones-Lee et al., 1995; Hammitt and Graham, 1999; Hammitt, 2000). The compensating wage differentials method calculates differentials in wages attributable to small differences in risk, which are then used in calculating implied value of life (Viscusi, 2000; Kneiser and Leeth, 1991). Weil also summarized the alternative methods for valuation of the economic consequences of non-work disability. The three methods included measuring 1) changes in household income (Burkhauser and Daly, 1996), 2) changes in allocation of time devoted to household activities by the injured worker and members of the household (Miller, 1995), and 3) quality-adjustable-life years (QALY) (Miller et al., 1995).

This study was limited to the actual paid benefits and the estimated value of future permanent pensions. Some attempts have been made to estimate the broader consequences of agricultural injuries. An injury may lead to changes in the operation and profitability of a farm (Cole et al., 1997). Injuries during critical planting and harvest times could lead to significant crop losses. However, one Finnish study found that injuries during harvest time did not cause expected monetary losses as family members, friends, and neighbors stepped in and the harvest continued without delay in all but few cases (Malkki and Jussila, 1997). Further study is needed to identify and measure the complex changes in the management and sustainability of the farm in the long term.

An accident may cause an injury as well as property damage, and it has been suggested that property damage from injury events causes significant losses. The

Finnish farmers' workers' compensation covers certain personal items such as eyeglasses, but generally no property losses. An investigation linking 48 farm injury cases to property/casualty insurance data found that 41% of these cases had also property losses, but the damage was relatively small requiring only minor repair work (Seppänen, 1990). This study suggests that the indirect costs from property damage in injury events are not very significant, although more research is needed in this area.

Men had 1.89 times more injuries than women, but 0.68 times fewer occupational diseases than women. The division of work on farms likely has an effect on these differences. Men's working hours include more fieldwork compared to women (602 versus 72 hours/year), as well as hazardous tasks such as construction (107 versus 7 hours/year) and forest work (88 versus 3 hours/year). Men contribute much less to household work (80 versus 1022 hours/year), but slightly more to animal care duties (1092 versus 776 hours/year). The annual working hours on farms in 1996 were 2446 hours for men, 2169 hours for women, 524 hours for male family members, and 308 for female family members (Agricultural Economic Research Institute, 2000). Overall, the greater injury risk for men appears to be explained by the higher share of hazardous work tasks, but the higher risk of occupational diseases for women does not seem to be clearly explained by division of work duties on the farm. Women have more occupational diseases related to animal care work, but men appear to have slightly higher working hours in animal care.

A recent NIOSH report estimated that the injury rate was 6.8/200,000 hours (equivalent of 100 person years) in agriculture in the United States (Myers, 2001), which is similar to the injury rate in this study (7.4/100 person years). Men had 89% and women had 11% of the reported injuries in the US. In this study the respective proportions were 74% and 26% for injuries and 49% and 51% for occupational diseases. There appears to be a difference in women's injury rates between the two countries. This could be due to different data collection methods and/or actual differences in injury rates. It is possible that women on US farms work less on the farm and more off the farm, or that women's injuries are under-reported. Survey respondents are often male owner/operators, and their recall may be different for their own injuries and their spouse's injuries.

The index-adjusted total insurance costs per insured person increased almost three-fold in the past two decades. This is partly explained by the decreasing number of farmers and the accumulating number of permanent pensions in the insurance system as it matures. Other factors may include increased incomes and health care costs. Medical costs were 12% (method 2) or 16% (method 1) of all costs, which is comparable to costs reported in the US (16%) (National Safety Council, 2000). The lost-time compensation including per diems and pensions was 63% (method 1) or 84% (method 2), compared to 52% productivity losses in the US. These data consistently suggest that medical costs are only a small fraction and losses of time, earnings, and productivity are a much greater cost factor.

Age was expected to be significantly associated with costs, and significant associations were found with some cost types. Gender was a significant factor as females were at higher risk for costly occupational diseases. After adjusting for various risk factors, the effect of gender was greatly reduced. The insured farm income, employment income, and business income were associated with costs. Income determines the level of the lost-time per diems and pensions, and is therefore an

obvious factor. Certain dusty tasks in dairy-, beef-, and swine- production and grain handling were associated with high costs from asthma, rhinitis, and farmer's lung. Other high cost categories were horse training, riding, and racing. Injuries related to commuting and transporting goods also had high costs.

Causes associated with high cost claims included biological causes, dusts, stairs, scaffoldings, ladders, circular saws, sawmills, wood splitters and chippers, and slippery terrain. Biological causes (molds and mites) are primarily related to hypersensitivity pneumonitis (farmer's lung), which is common in Finnish dairy farming. About 100-300 new cases per year have been compensated in the 1980's and 90's by the MATA insurance. Organic dust (primarily animal dander, flour, and grain dust) leading to asthma and rhinitis is another important problem. Another major group of causes including scaffoldings, ladders, and stairs is associated with severe fall injuries. Horse-related injuries have increased with the popularity of horses on farms. Serious head injuries from kicks are included in this category. The power take-off shaft is a known hazard. Only eleven power take-off injuries were compensated, but they were among the highest cost cases, confirming the serious nature of these injuries (Luoma et al., 1985).

The most costly outcomes included internal injury, illness, and concussion; various bone fractures; amputations; skin diseases; and acute poisoning, electrocution, and hearing loss. The nature of incident categories with high costs included occupational diseases; being pushed or run over by animals; slips and falls; and being caught in, tangled, and crushed by machines or equipment. These data appear to differ from the common perception that machinery is responsible for the majority of serious injuries. This study suggests that animal and fall-related injuries and occupational diseases are more dominant in causing high cost claims.

The GLM multivariable analyses explained 16-45% of the variation in various types of costs. This indicates that a fairly significant random element exists in the claim costs. The medical costs and permanent pensions were least predictable, and the paid pensions and per diems were most predictable by the available variables. The most significant predictors of claim costs were type of injury/illness code, part of body, cause, nature of incident, income, and age. Generally, the same variables were identified as significant risk factors for pensions in the logistic regression models. The permanent pensions were rare and only age and type of injury/illness were significantly associated factors.

After controlling for other factors, many expected and some unexpected categories of work activity, cause, and nature of incident were found to be associated with costs. Commuting and transportation may reflect the hazardous nature of roadway travel. Circular saws, sawmills, wood splitters, and chippers; chainsaws and clearing saws; and PTO shafts were among expected severe injury causes. Falls caused high cost claims, as did caught in or crushed by a machine, electrocution, and explosion. The health outcomes showed several types of high cost conditions, including pulmonary disease, fractures, dislocations, shoulder and upper arm injuries, and amputations.

The mean injury cost was €1099 without permanent pensions and €1340 with permanent pensions. The respective costs were €4380 and €6636 for occupational diseases. These data indicate that permanent disabilities, although few in number (0.6%), greatly contribute to the total costs. The permanent pensions appeared to be less predictable than other costs in this study, partly due to their small number in the data.

Strengths and Weaknesses

The Finnish farmers' accident insurance data help provide baseline information on agricultural injury and illness costs. The data are comprehensive as nearly all farmers are insured. Claims are made in most cases that have compensable costs involved. A mail survey in 1986 found that about three out of four self-reported injuries requiring professional medical care were found in the claims data and out of unclaimed injuries, 80.7% caused no disability (Eskelinen et al., 1989). There are differences in the injury rates between regions ranging from 4 to 10/100 insured persons, but these differences appear to be explained by the intensity of livestock production (Mela, 2001).

The coding systems developed by Mela are very detailed offering precise information for prioritizing prevention. Significant efforts are made in the adjudication process to code each case completely, and various quality control methods are used to ensure accurate coding. No missing or obvious miscoded data were found in the entire dataset.

The claims data did not include personal identifiers. It is likely that some of the claims occurred to the same people. The insurance practice has shown that about one out of ten claims in one year are "repeat" claims to persons who already had another claim during that year. This has some effect on rate and relative risk calculations, and the interpretation of these measures. The number of injured/ill persons is likely about 10% lower than the number of claims (N=10,922). Multivariable analysis may be affected, as data from some persons may be repeated more than once. This violates the independence assumption. We were not able to assess the effect of "repeat" claims in this study.

This study is limited to compensated costs only. No attempt was made to estimate various indirect and social costs. A small part of eligible costs is likely excluded due to unclaimed cases and excluded (right censored) costs beyond August 1, 2000.

Conclusions

This study characterized claim costs and identified risk factors for costs. The total costs to the insurance system in 1996 were €23.5 Million, which is 2.5% of the insured farm income. The costs consisted of medical (16%), lost time per diem (37%), accident pension (23%), survivors' pension (3%), impairment allowance (7%), rehabilitation (6%), and other costs (9%). The long-term costs for injuries and illnesses occurring in 1996 were somewhat different. The total costs were lower (€19 Million), and the share of pensions was higher mainly due to including the present value of permanent pensions (23% of total costs). There were 66 permanent pension cases (0.6% of all cases), which represent about one quarter of all costs. The mean costs of 1996 claims were €1340 for injuries, €6636 for occupational diseases, and €1743 for all claims. Overall the costs were low: about 0.7% from the gross farm income compared the 2.8% estimate in the United States.

Multivariable analysis showed that type of injury/illness, part of body, cause, nature of incident, age, farm income, off-farm income, work activity, and age were associated with costs. The risk of permanent pension was 1.8 times higher for women compared to men, and 6.8 times higher for occupational diseases compared to injuries. Occupational diseases; slips, trips, and falls; falls from elevation; and animal-related

cases were most costly. Animal care, grain handling, transporting goods, and commuting were among high cost activities. High cost causes included biological and organic dusts, large animals, scaffoldings, ladders, stairs, wagons, saws, sawmills, wood splitters and chippers, power take-offs, and repetitive motion.

CHAPTER 4

LOST TIME FROM INJURIES AND OCCUPATIONAL DISEASES IN AGRICULTURE IN FINLAND

Summary

Background: Although injuries and illnesses are common in agriculture, the magnitude of lost time and contributing risk factors are not well known.

Objectives: This study aimed to characterize lost time from agricultural injuries and occupational diseases and to identify risk factors for length of disability.

Methods: All compensated injury and occupational disease claims in 1996 (N=10,922) from the Finnish farmers' workers' compensation insurance were included in this study. Analysis of variance, linear regression, logistic regression, *t*-test, and chi-square test were used for examining lost time characteristics and associated risk factor. The primary outcome was total lost time. Potential risk factors included demographic, income, and incident circumstance variables.

Results: The total lost time from 1996 injuries and occupational diseases was 1431 person years, which is 1.04% of the 137,002 person years in agriculture in 1996. About 51% of the lost time was from short-term disabilities within one year from the incident. About 21% was from temporary long-term disabilities, and 28% was from permanent disabilities. Occupational diseases comprised 8% of the cases and 29% of the lost time. The mean lost time was 37 days for injuries, 185 days for occupational diseases, and 48 days for all claims. The mean lost time was 62 days for women and 42 days for men. Disability time increased with age. Older persons had more fractures, amputations, and other serious conditions and they also had longer disability times from similar conditions as did younger persons. Work with dairy and beef animals and horses, commuting, transportation, grain and feed handling, and cutting trees were work activities associated with long disabilities. Circular saws, sawmills, wood chippers and splitters; biological causes; motorcycles, snowmobiles, and fishing vessels; power take-off shafts; stairs; ladders; scaffoldings; and slippery terrain were causes associated with long disabilities. Bone fractures, internal injuries, amputations, and skin disorders were health outcomes associated with long disabilities.

Conclusions: About 1% of the productive work time was lost due to injuries and occupational diseases. The risk of long disabilities increased with age. Women had longer disabilities than did men and occupational diseases had longer disabilities than did injuries. Priority areas for prevention include lung disease from organic and biological dusts, falls from elevation, injuries from large animals, and certain machinery-related injuries.

Introduction

Agriculture is a hazardous industry and high fatality rates have been reported in the literature (Myers and Hard, 1995; Canadian Agricultural Injury Surveillance Program, 1998; National Safety Council, 2001; McCurdy and Carroll, 2000; Rautiainen and Reynolds, 2002). Information on non-fatal injuries and work-related illnesses is not as readily available. Injury definitions differ between insurance, surveillance, and research programs, and rates are usually not comparable. The severity definitions also differ, if severity is defined at all. Consistent determination of lost time requires an established program such as workers' compensation insurance. Self-employed farmers lack workers' compensation in most jurisdictions, and only employed farm workers are usually covered. Therefore little information exists accurately describing the length of disability or time lost from injuries and illnesses in agriculture.

Since 1982, Finnish farmers have been covered by employment accident insurance known as MATA, which provides compensation for injuries and occupational diseases. Benefits include medical expenses, lost-time per diem, rehabilitation, impairment allowance, accident pension, survivors' pension, and death benefits. Health care providers assign disability time for farmers in the same way as they do for other workers. The lost time may range from no lost time at all to permanent disability. Along with cost, the length of disability provides a useful measure of severity and enables estimation of lost productive work time in the working population.

This study aimed to characterize lost time from injury and occupational disease claims, and to identify risk factors associated with lost time. Both injuries and occupational diseases were included, providing a broad spectrum of medical conditions caused by work. Univariable and multivariable methods were used to determine the association between lost time and demographic, income, and incident/exposure characteristics.

Methods

Setting

The farmers' employment accident insurance (MATA) (Farmers' accident insurance act, 1982) is part of the social insurance coverage available for all farmers in Finland. Other programs include national health insurance, old-age pension (Social Insurance Institution, 2002), earnings-related pension (Farmers' pension act, 1969), and occupational health services (Institute of Occupational Health and Ministry of Social Affairs, 2000). MATA covers all 18-64 year-old self-employed farmers, fishermen, and reindeer herders, as well as family members earning more than €2,532 EUR (in 2001) from the agricultural enterprise. The estimated midyear number of insured persons in 1996 was 137,002. A specific insured farm income is determined for each farm and insured person, reflecting the value of the work on the farm. The premiums and lost-time benefits are based on the insured farm income. Employed agricultural workers are not insured by MATA; therefore they were not included in this study.

Data

This study included all compensated injuries and occupational diseases, which occurred in 1996 (N=10,922). MATA defines an *injury* as a sudden unexpected forceful event with an external cause, which results in bodily damage or an ailment, and which occurs in the course of agricultural work (Farmers Social Insurance Institution, 1998).

Occupational diseases are specific illnesses defined by legislation, which are probably predominantly due to specific physical, chemical, or biological factors associated with work (Occupational disease act, 1988). The data were obtained on August 1, 2000 from the MATA claims database. They included the number of short-term disability days during one year after the incident. The income, paid pensions up to August 1, 2000, and present value of permanent pensions were used for estimating long-term disability time.

Outcome Variables

The two primary outcome measures were short-term disability time and long-term disability time. These measures were based on the structure of the insurance data. The short-term disability time was defined as the number of days when the injured person received lost-time per diem payments. Per diems are paid for each disability day up to one year from the incident. The long-term disability time was defined as compensated disability time beyond one year from the incident when the injured person received accident pension. The disability time was derived from two sources: actual paid pensions and the present value of permanent pensions. Lost time up to August 1, 2000 was calculated as follows: lost years = paid pensions / annual income at the time of the claim. The future lost time from permanent pension cases was estimated as follows: lost years = present value of permanent pensions / annual income at the time of the claim. There were 331 (3%) active temporary pension cases at the time of data extraction. The future disability time in these cases was excluded. Insurance experience indicates that this excluded time is relatively small compared to the time already compensated within 3-4 years from the incident for these cases.

Physicians assign the length of disability taking into consideration the physical condition and the working circumstances. In the least severe cases, no lost time is assigned and only medical and other direct expenses are compensated. In more severe cases, an initial disability period is assigned, and it can be extended as the medical condition requires. A per diem is paid for the disability days up to one year for cases with at least three days of disability after the incident day. If the disability continues longer than one year, the per diem is converted into disability pension, which may be temporary or permanent and full or partial.

Several indicator variables were constructed from the total lost time including any disability time (89%), one week (69%), two weeks (44%), one month (23%), three months (7%), and 1000 days (1.3%). Other indicators were constructed for long-term disability over one year (5.6%), active temporary pension on August 1, 2000 (3.0%), and permanent pension (0.6% of all cases). These variables were used in logistic regression and some classifications.

Risk Factor Variables

Age at the time of the injury/illness as well as *gender* were included as potential risk factors. *Personal claim rate* described the personal claims experience and was calculated as follows: personal claim rate = number of claims / years insured by MATA. *Insured farm income* was the personal farm income confirmed by the Farmers Social Insurance Institution reflecting the value of the person's work on the farm. *Employment income* was the personal income from off-farm employment. *Other business income* is the personal income from business other than farming. *Work activity* described the task during the injury/illness and has 150 categories. *Cause* was the primary factor leading to

the injury/illness classified in 108 categories. *Nature of incident* described the mechanism of injury/illness event in 28 categories. *ICD10* code was used for classifying the health outcome and 470 categories from over 10,000 possible categories were used in these data (World Health Organization, 2001). Type of injury/illness also described the health outcomes in 13 main categories. *Type of production* described the major types of production in seven categories. *Work circumstance* coding was used for own work, work for others, and commuting. *Worker status* described if the person was a male farmer, female farmer, family member, fisherman, or a reindeer herder. Incident month was included as a potential risk factor. Table 2 provides a summary description of the variables.

Statistical Methods

The mean length of disability was calculated for injuries and occupational diseases. The means for men and women were compared using the *t*-test. The mean length of disability was also calculated for injuries and occupational diseases, and the means were compared using the *t*-test. The rates of long-term disability were constructed for men and women as well as injuries and occupational diseases. The rates were compared using the chi-square test.

The analysis of variance (ANOVA), linear regression, and logistic regression procedures were used for measuring the associations between outcomes and potential risk factors (SAS Institute Inc., 1987). The distribution of total lost days was skewed (mean=48, median=13.0, standard deviation=285, skewness=18, kurtosis=430). Therefore natural log-transformed lost days (mean=2.63, median=2.64, standard deviation=1.33, skewness=0.18, kurtosis=1.4) were used as outcome in the linear models. About 11% of the cases had no compensated lost time, and one day was added to all lost days to enable log transformation. The advantages of log-transformation have been summarized by Manning and Mullahy (2001). Simple parametric retransformation procedure as outlined by Kennedy (1981) was used in this study. Due to the relatively large number of variables and multiple models tested, this study primarily reported non-adjusted lost time for factors found significantly associated with long disabilities, rather than complete lists of parameter estimates.

Univariable analyses were conducted examining the overall associations between risk factors and log-transformed total lost days. The dichotomous variables, gender and occupational disease/injury code, were assessed by comparing the mean lost days using the *t*-test. The categorical risk factor variables; type of production, work activity, cause, nature of incident, type of injury/illness, part of body, and incident month; were assessed using the ANOVA procedure. Categories with long disabilities were identified using the GLM Dunnett procedure. This procedure compares the means of each category to a specified reference category and adjusts the significance level ($p=0.05$) for multiple comparisons. The criteria for selecting the reference category was the nearest category to median costs with a frequency of $N>250$. The continuous risk factors; age, farm income, employment income, business income, and the personal claim rate; were assessed using linear regression.

Multivariable methods were used for measuring the associations between lost time and a combination of risk factors. Two GLM models were built using log-transformed short-term disability and total disability as outcomes. The potential risk factors were: age, gender, personal claim rate, farm income, employment income,

business income, work activity, cause, nature of incident, type of injury/illness, part of body, and incident month. The full model including all risk factor variables was fitted, and the contribution of each potential risk factor was examined. Several variables were excluded to avoid over fitting the models and using variables with similar information.

Logistic regression was used to determine which risk factors contributed to claims becoming long disability cases. The categories for long disability were at least 30 days (23%) and 1000 days (1.3%). Potential risk factor variables were the same as in the above GLM models, and the stepwise procedure was used for building the models ($p<0.10$ for inclusion, $p<0.05$ for keeping the variables in the model).

Results

Short-term Disability

A total of 727 person years of productive time was lost from short-term disabilities within one year after the injury or occupational disease incident. This is equal to 0.53% of the productive person years in Finnish agriculture in 1996. Most of the claims included some lost time; only 11% of injuries and 9% of occupational diseases had no compensated lost time at all. The majority of the disabilities lasted less than one month. The mean length of disability was 24.1 days for injuries (STD 42.6), 26.7 days for occupational diseases (STD 54.9), and 24.3 days for all claims (STD 43.6). There was no significant difference in length of short-term disability between injuries and occupational diseases (*t*-test, $p=0.10$). The distribution of cases by length of short-term disability is presented in Figure 2. This figure shows that the highest numbers of cases were in the one, two, and three-week categories, and the number of cases reduced logarithmically in longer disability categories. The 52-week category was elevated as many long-term disability cases are assigned one full year of disability time from the start, which continues as a disability pension thereafter.

Long-term Disability

Except for fatalities, long-term disability cases represent the most severe cases. Injuries became long-term disabilities in 2.2% of the cases, occupational diseases in 47% of the cases, and all claims in 5.6% of the cases. The number of long-term disability cases was 227 for injuries, 389 for occupational diseases, and 616 for both. Unless the disability is clearly permanent, the long-term disability pension is assigned for a certain period of time based on expected recovery. The pension can be full or partial, and new pension periods can be assigned as the condition requires. The effective compensated lost time is often a combination of several pension periods at different disability percentages. Estimating the lost time from the monetary value of the pensions and income accounts for any combination of pension periods. Long-term disability pension cases (excluding permanent pensions) had 0.48 years of effective compensated lost time on the average between one year from the incident and data extraction on August 1, 2000 (in about three years). This reflects the fact that most of the pensions are periodic and/or partial.

There were 66 permanent disabilities, 42 from injuries and 24 from occupational diseases. The total productive person years lost were 229 years for injuries, 177 years for occupational diseases, and 406 years for all cases. Table 11 summarized the percentages of claims leading to long-term disability.

The total lost person-years from long-term disabilities (temporary and permanent pensions) were 343 years for injuries, 361 years for occupational diseases, and 704 years for all pension cases. The lost time was 305 years for women and 399 years for men. Table 12 presents the lost person-years from occupational diseases and injuries for men and women. Table 11 shows the percentage of injuries and occupational diseases leading to long-term disability pension in three categories. The percentage of claims with any pension time was 47% for occupational diseases, 2.2% for injuries, and 5.6% for all claims. The percentages of long pensions beyond August 1, 2000 were 27% for occupational diseases, 1.7% for injuries, and 3.6% for all claims. The percentages of permanent pensions were 2.9% for occupational diseases, 0.4% for injuries, and 0.6% for all claims. These results indicate that occupational diseases lead to long-term disability and pension clearly more often than injuries do.

Short-term and Long-term Disability

The estimates of total person years lost were 1010 years for injuries, 421 years for occupational diseases, and 1431 years for all claims. The injuries comprised 71% and occupational diseases 29% of the lost time. The lost person years were 1.04% of the total productive person years in agriculture in 1996 (137,002 person years), assuming that all insured persons worked full time in agriculture. The lost time was 516 person years or 0.95% of the productive time for women and 915 person years or 1.11% of the productive time for men. The total lost time per claim was 185 days for occupational diseases and 37 days for injuries. For occupational diseases the mean lost days were 214 for women and 157 for men. For injuries the lost days were 38 and 36 respectively. Table 12 presents the lost years from occupational diseases and injuries for men and women.

Risk Factors for Length of Disability

Univariable Analysis of Risk Factors

Injury and Occupational Disease

Occupational diseases had longer disability times than injuries (185 days versus 37 days; t-test, $p<0.0001$). Most short-term disability cases were injuries (91.6%); only 8.4% were occupational diseases. A greater number of occupational diseases become long-term disability cases (389 versus 227 cases). Most long-term disabilities (63%) were occupational diseases.

Age

The mean age of the insured population was 45.4 years and the mean age of the persons with an injury or illness in 1996 was 45.2 years. The mean age was higher in injury cases (45.4 years) compared to occupational disease cases (42.7 years) (*t*-test, $p<0.0001$). The mean length of disability had a strong association with age. The length of disability increased slightly exponentially with age as presented in Figure 3 (lost days= $13.705\ e^{0.1813*Age}$, R-square = 0.997). When including the youngest and oldest age categories, which had relatively few cases, the association was: lost days = $8.1379\ e^{0.261*Age}$, R-square = 0.95. This association was further examined by stratified methods. There appears to be two reasons for the association between disability time and age. First, as presented in Table 13, older farmers appear to have serious conditions more frequently such as bone fractures, amputations, and internal injuries/illnesses. For

instance, the proportion of fractures was significantly greater in the age group 60-69 years (21 fractures / 934 cases) compared to 30-39 years (12 fractures / 2361 cases) (chi sq, $p<0.0001$). Secondly, as presented in Table 14, disability times for older people from the same conditions appear to be longer in most injury/illness categories. For instance, the mean lost time from fractures was longer in the age group 60-69 years of age (61 days) compared to 30-39 years of age (39 days) (*t*-test, $p<0.0001$).

Gender

The mean length of short-term disability was 41.3 days for women and 31.6 days for men (*t*-test, $p<0.0001$). The length of total disability was 62.2 days for women and 42.3 days for men (*t*-test, $p<0.0001$). Women have fewer injuries and less time lost from injury incidents, but more occupational diseases and time lost from occupational diseases as presented in Table 12.

Personal Claim Rate

The mean personal claim rate was 3.4 claims per 10 insurance years, and the rates were 3.6 for men and 2.9 for women. The association of lost time and personal claim rate does not appear to be linear. A polynomial trend line was fitted for the short-term disability time and the personal claim rate (Lost time = 1.2573 * personal claim rate^2 - 9.656 * personal claim rate + 35.264) (R-square = 0.87). Figure 4 shows the personal claim rate trend. The length of disability was higher for those persons with lowest and highest personal claim rates. This may indicate that farmers are reluctant to make their first claims unless the condition is severe. After being more familiar with the process, they may make claims more readily even for lesser injuries. In the other end of the spectrum, there may be persons with a history of frequent claims who have a higher risk for severe conditions.

Incident Month

Incident month had an association with log-transformed total lost days but explained less than 1% of the variation in lost time (ANOVA, $p<0.0001$, R-Square=0.005). The months with longer than average disabilities were February, March, May, September, November, and December. These months coincide with the winter months when the dairy work is done in confinement causing dust exposure and respiratory disease. Also the seeding and harvest months appear to be associated with longer disabilities. Many serious injuries occur during those peak work times.

Income

The insured farm income did not have a significant association with total lost time. Employment income from off-farm employment had a weak association (REG, $p<0.0001$, R-Square=0.01), as did off-farm business income (REG, $p<0.0001$, R-Square=0.002). Greater off-farm income levels were associated with longer disabilities. The larger farm income is usually connected with larger farm size, higher level of mechanization, and greater number of livestock. These factors are thought to introduce severe injury hazards, longer working hours, and longer exposure times. However, no significant association was observed between lost time and farm income. The association with off-farm employment and business income may suggest that off-farm work increases exposures for severe farm injury/illness hazards. Hurry, fatigue,

inexperience, and darkness when working late have been suggested as contributing factors.

Work Activity

There were 150 work activity categories, which were reduced to 76 by collapsing small categories. Work activity had an association with total lost time (ANOVA, $p<0.0001$, R-Square=0.04). Work activities with long disabilities were identified using the GLM Dunnett means comparison procedure. Moving feed from storage to animals was used as the reference category (N=699, mean lost days=31). The work activities with longer disabilities than the reference category were: feeding dairy and beef animals (RR=1.6); cleaning and brushing animals (RR=2.9); horse training, riding, and racing (RR=2.2); and commuting (RR=1.4). Additional significant long disability categories in the ANOVA model were: handling, preserving, and transporting feed grain; other grain and forage harvest work; handling and drying grain; preparation, mixing, and milling dairy feed; cutting trees for firewood; and transporting supplies and commodities to and from the farm. The categories with long disabilities are presented in Table 15.

Cause

There were 108 cause categories in these data, which were reduced to 75 by collapsing categories. Cause had an association with length of disability (ANOVA, $p<0.0001$, R-Square=0.08). The Dunnett's means comparison was conducted using uneven terrain as the reference category (N=505, mean lost days=27). The categories with disability times longer than the reference category were: circular saws, sawmills, wood chippers, and splitters (RR=1.4), and biological causes (RR=2.5). Additional categories with significantly longer disability times in the ANOVA model were: motorcycles, mopeds, cycles, snowmobiles, sleds, and fishing vessels; power take-offs; stairs; attached ladders; scaffoldings and unattached ladders; and slippery terrain. The categories with long disability times were presented in Table 16.

Nature of Incident

There were 28 incident type categories in these data, which were reduced to 24 by collapsing small categories. Nature of incident had an association with total lost time (ANOVA, $p<0.0001$, R-Square=0.11). The Dunnett's means comparison was performed using falling, slipping, or tripping when lifting or carrying a load as the reference category (N=1199, mean lost days=34). The categories with longer disabilities than the reference category were: falling from elevation when lifting, carrying, or moving a load (RR=1.5); falling from elevation when the structure falls or fails (RR=1.3); and occupational diseases (RR=1.8). Additional categories with long disability times in the ANOVA model were: falling from elevation without a load, and jumping or coming down from elevation. The nature of incident categories with long disabilities are presented in Table 17.

ICD10 Code

There were 470 categories in these data, which were reduced to 44 by collapsing small categories. The ICD10 code had the strongest association with total lost time (ANOVA, $p<0.0001$, R-square=0.35). The Dunnett's means comparison was conducted using superficial injury of wrist and hand as the reference category. The outcomes with longer disabilities than the reference category were: zoonosis; rhinitis; asthma;

hypersensitivity pneumonitis (farmer's lung); dermatitis; epicondylitis; contusion of thorax; rib fracture; contusion of lower back and pelvis; injury of shoulder and arm; various fractures; sprains, strains, and other injuries of hand and wrist; knee dislocation, sprain, or strain; contusion of foot; wound of ankle and foot; and ankle and foot dislocation, sprain, and strain. The categories with long disability times were presented in Table 18.

Type of Injury or Illness

The type of injury/illness had a significant association with disability time (ANOVA, $p<0.0001$, R-square=0.15). This coding is similar to ICD10 but there are only 13 injury/illness categories, which were reduced to 11 by collapsing small categories. Sprain and strain was used as the reference category and outcomes with longer disabilities were: fractures; internal injury, illness, and concussion; amputation; skin disorder; and acute poisoning, electrocution, hearing loss, and other injury/illness. The categories with long disability times were presented in Table 18.

Other Factors

Part of body had a strong association with disability time ($p<0.0001$, R-Square=0.22). Using lower limb from hip to ankle as the reference category the parts of body associated with longer disabilities than the reference category were: upper limb from shoulder to wrist, internal injury and illness, and other/multiple injury. Insurance years were associated in a similar fashion as age; those who were older and had been insured longer had more serious claims. Work circumstance had only a weak association and commuting was associated with increased disability time. Type of production was associated and animal production, fishing, and reindeer herding had long disabilities. Worker status had a weak association and female farmers and reindeer herders had longer disability times than male farmers.

Multivariable Analysis of Risk Factors

The first model used general linear models (GLM) procedure for measuring the associations between disability time and potential risk factors while controlling for other factors. The analysis used log-transformed total lost time as outcome and age, gender, incident month, farm income, employment income, business income, work activity, cause, nature of incident, type of injury/illness, and part of body as potential risk factors. The model was significant ($p<0.0001$, R-Square=0.36), and all risk factor variables except farm income ($p=0.83$) and work activity ($p=0.07$) were significantly associated with disability time ($p<0.05$). Older age and greater employment income and business income were associated with longer disabilities. Women had longer disabilities than did men. Claims in winter months, May, and August had longest disabilities. Cause was significant and circular saws, sawmills, wood splitters, and chippers; stairs; biological causes; and scaffoldings and unattached ladders were high disability time categories using the Dunnett's means comparison. Nature of incident was significant and falling from elevation, falling when the structure falls or fails, and occupational diseases were long disability categories. Fractures, internal injuries and illnesses, amputations, and skin disorders were long disability outcomes. Upper limb from shoulder to wrist, internal injury/illness, and other/multiple injury were body parts associated with long disabilities. Overall the strongest risk factors for total lost time by F-value from largest to the smallest

were: part of body, type of injury/illness, age, employment income, business income, gender, nature of incident, cause, injury month, work activity, and farm income. The type of injury/illness, and part of body describe aspects of the medical condition and they have the strongest association with length of disability. Smaller models were also fitted for identifying work activity, cause, and nature of incident categories with long disabilities without adjustment for health outcome. In general, the same categories were significant in the smaller models as in the bigger model with health outcome variables included.

The second model used log-transformed lost time excluding permanent pensions as outcome. The same risk factor variables were included and the full model was fitted. The model was very similar ($p<0.0001$, R-Square=0.37), and all risk factors except farm income and work activity were significantly associated with the disability time.

The third model used log-transformed lost time estimated from permanent pensions as outcome and the same potential risk factors. The model was significant ($p<0.0001$, R-Square=0.16), and all other variables were significant except all three types of income and incident month.

The fourth model examined risk factors for long disabilities using logistic regression. The outcome variable was more than 30-day disability (yes/no). About 23% of the cases had over 30 days of lost time. The potential risk factor variables were age, gender, injury/occupational disease code, farm income, employment income (yes/no), business income (yes/no), personal claim rate, work activity, cause, nature of incident, type of injury/illness, part of body, worker status, and incident month. A stepwise procedure was used and the significance levels were $p<0.1$ for inclusion and $p<0.05$ for keeping the variables in the model. The significant risk factors were: type of injury/illness, part of body, employment income, cause, age, nature of incident, and incident month. The causes with long disabilities included: cars, trucks, and vans; circular saws, sawmills, wood splitters and chippers; stairs; slippery terrain; stacks, heaps, boxes, and ground forage storages; dirt particles, projectiles, and dusts; plants, trees, falling trees, stumps; biological causes; dairy and beef animals; swine; horses; and breaking ice and soft terrain. This analysis identified some additional categories not identified in the other analyses. For other variables, the long disability categories had already been identified in previous models.

Another logistic regression model was fitted using over one year disability (yes/no) as the outcome. About 1.3% of the cases had more than one year of effective lost time. The same potential risk factors were included and the stepwise procedure was used with the same inclusion criteria. Only part of body and type of injury/illness were significant in this model.

Discussion

Agriculture is a hazardous industry. In Finland, the 1987-91 average annual fatal injury rate was 6.5/100,000 in agriculture (Farmers Social Insurance Institution, 1992) and 2.6/100,000 in other industries (Statistics Finland, 1998). In the US, the 1999 fatality rate was 22.5/100,000 in agriculture and 3.8/100,000 in other industries (National Safety Council, 2000).

This study assessed lost time from workers' compensation records, and the results showed that in Finnish agriculture about 1.04% of the productive work time is lost due to injuries and occupational diseases. Several issues must be considered when interpreting this result. For self-employed farmers, the concept of lost time is not as clear

as it is for employees. In an employment situation sick days are directly measurable. For self-employed farmers, the actual lost work time is not easily measurable. Farmers have a tendency to continue working even with severe injuries. Some tasks, such as milking and feeding animals, must be done regularly regardless of injuries. When injured, farmers may modify their work tasks, and still be somewhat productive on the farm. On the other hand, great losses may occur if the disability compromises the management of the farm, or delays seeding, planting, or harvest. Lost opportunities due to disability may have great long-term effects.

This study used compensated disability time as a measure for lost time. The physicians treating the patients use their judgment in determining the length of disability. The physical condition and the person's work duties on the farm are considered. Lost-time per diems and pensions are paid for the duration of disability, but it is not known whether this accurately describes the actual lost time for the injured farmers. Even with this uncertainty, the compensated length of disability provides a useful consistent measure, as physicians follow general workers' compensation principles and assign the disability time in the same manner for farmers as workers in other industries.

Various risk factors for injuries have been identified in the Finnish farming population, including male gender, middle age, overweight, reduced physical condition, smoking, and history of previous injuries, illnesses, and conditions requiring psychological care (Penttinen and Valonen, 1995). Another study found that dairy and swine farms are at higher risk for injuries than other farms, and full-time farmers had a higher risk than part-time farmers. The injury risk on dairy farms increased from the smallest to the mid-size dairies, and decreased in the largest categories (Virtanen et al., 1999). A recent study found that the Swedish-speaking persons had fewer claims than the Finnish-speaking persons (RR: 0.80, 95%CI: 0.73, 0.88), which may indicate differences in the working conditions or cultural differences in applying for compensation. This study also found that the injury rate was higher (9.1/100) for full time farmers (>75% of income from farming) compared to all farmers (6.3/100) (Virtanen et al., 2002).

In the present study, 8% of the claims were occupational diseases but they represented 28% of the total lost time. On the average, occupational diseases are clearly more severe than injuries. The total lost time per claim was 185 days for occupational diseases and 37 days for injuries when both short-term and long-term disability time were included.

Age was associated with length of disability. A trend was found where the short-term disability increased slightly exponentially with increased age. Older persons had more serious injuries and took longer to recover from similar conditions as did younger persons. This finding emphasizes the need for prevention of injuries in older persons, as well as retirement programs.

Gender was associated with claim rates. The injury rate was higher for men, but the occupational disease rate was lower for men compared to women. The high occupational disease rates in women appear unexpected. Traditionally women worked more in the animal care, which is a source of respiratory diseases, dermatitis, and cumulative trauma. However, currently the work roles have become more even. Women had greater disability times from injuries and occupational diseases. This is also somewhat unexpected, as in many studies men have been found to have more injuries and more serious injuries (Myers 2001; Pickett, 1999).

The personal claim rate was a unique variable in this study. It describes the personal claims experience measured by number of claims during the time being insured. The personal claim rate was significantly associated with short-term disability time. Those persons with the lowest and highest personal claim rates had longer disabilities as described by a 2nd order polynomial model. This result may suggest that once the insured people are familiar with the claim process, they may seek compensation more readily. Those with the highest personal claims rates may have a history of previous conditions, and due to their poorer health, they may be at higher risk of new serious conditions.

The insured farm income had only a weak association with the length of short-term disability. Higher off-farm income was associated with increased disability time. In most multivariable models there was no association between farm income and total lost time. This is somewhat unexpected as farm income reflects the size of the farm and the amount of work done on the farm. Often larger farms have more machinery, livestock, and other injury hazards, but based on most models, farm income was not a significant factor.

Machinery is often reported as the cause of most severe injuries (Canadian Agricultural Injury Surveillance Program, 1998; Gerberich et al., 1996; National Safety Council, 2001). Tractor injuries are common and Suutarinen (1992; 1995), among others, has addressed issues related to tractor injuries. This study found some severe machinery-related causes including power take offs and saws, sawmills, wood splitters, and chippers. However, other causes than machinery were more prominent including stairs, ladders, scaffoldings, roofs, and slippery terrain, which cause slips and falls or falls from elevation. Dusts, molds, and mites causing respiratory disease were equally or more hazardous than machinery in causing long disabilities. This is an important finding for prevention, which often concentrates on machinery and leaves out slips and falls, falls from elevation, biological causes, and dusts.

The strongest risk factors for both short-term and total disability time were: part of body, type of injury/illness, age, employment income, business income, gender, nature of incident, personal claim rate, cause, age, and gender. These variables explained 35% of the variation in short-term disability time. Farm income, personal claim rate, and work activity were not significant in the multivariable model. This R-square value indicates that disability time is highly variable or that the variables available in this study explained only about one third of the variation in disability time. Replacing the type of injury/illness and part of body codes with the ICD10 code improved the model fit to 39% when using 44 ICD categories or to 48% when using all 470 categories; however, these models were not examined in this study.

Strengths and Weaknesses

The Finnish agricultural injury and occupational disease data are very comprehensive. Workers' compensation insurance is mandatory for all farmers, and the percentage of unclaimed injuries is estimated at less than 25% (Eskelinen et al, 1989). The short-term disability data are quite accurate, as physicians assign the disability time according to general workers' compensation principles. The injured persons have an appeal process to seek correction to the adjudication decisions. Quality control for data is extensive and no missing or obviously miscoded data were found. The risk factor variables included farm and off-farm income, which are rarely available for research. The

ICD10 coding as well as specific coding developed by Mela for work activity, cause, nature of incident, and other circumstances provide very specific information for prevention. The data included injuries and occupational diseases and enabled comparison of lost time from these two major outcomes. Published information on agricultural occupational diseases is very limited, and this study makes a contribution to understanding the magnitude of the occupational disease problem in relation to injuries.

The weaknesses of this study include the estimation of long-term disability time. The lost time up to data extraction was derived from paid pensions, which provide a reasonably accurate measure of compensated lost time. Disability time beyond data extraction date was excluded (right censored) in 313 (3%) cases. Based on insurance experience this loss was likely not very significant as these cases were not permanent disabilities and they likely had only limited lost time in the future. A major portion of the total lost time is from permanent pensions. The estimation of lost time from the present value of permanent pensions is complex and has limitations. The present value of permanent pension is assigned based on the degree of disability, age, life expectancy, income at the time of the incident, and discounting. The future pension has a cap of 85% up to the age 65, and 60% thereafter. The discounting factor may cause under estimation of lost time. On the other hand, using pension time beyond normal retirement age may over estimate the lost time. Due to these limitations, the long-term-disability time should be interpreted with caution.

The claims data did not include personal identifiers. It is likely that some of the claims occurred to people who already had a previous claim during that year. Insurance practice has shown that about one in ten claims in one year is a "repeat" claim by persons who already had another claim that year. This has to be recognized when interpreting injury rates. The rates represent "injuries", rather than "injured persons" per population. The multivariable analyses may be affected by including more than one claim from the same person, as this is a violation of the independence assumption in regression methods. We were not able to measure the effect of the "repeat" cases without personal identifiers. It is assumed that the variability in the data is relatively similar among repeatedly injured persons and other injured persons.

Conclusions

This study concluded that 1.04% of productive time was lost from injuries and occupational diseases. Injuries caused more short-term disability and occupational diseases more long-term disability. Men were at higher risk for short-term disability from injuries, and women were at higher risk for long-term disability from occupational diseases. Age had an exponential effect on disability time. Several specific work activities, causes, incident types, health outcomes, and other characteristics were identified, which are applicable for targeting prevention.

CHAPTER 5

INSURANCE PREMIUM BONUS AS A PREVENTIVE MEASURE IN AGRICULTURE IN FINLAND

Summary

This study aimed to determine whether the no-claims bonus, implemented on July 1, 1997 in the Finnish farmers' workers' compensation insurance, had a preventive effect on injuries. This bonus reduces premiums by 10% for each claim-free year up to a 50% reduction in five consecutive claim-free years. An interrupted time series analysis was conducted measuring whether the trend in the injury rate changed after the bonus was implemented. Monthly injury rate from 1990-2000, changes in the insurance policy, and economic indicators were included in the analysis. The results showed injury claims reduced by about 10% after the intervention while controlling for other contributing factors. Further analysis was conducted to determine whether this reduction occurred in minor injuries only, indicating under-reporting. Stratified analyses showed that minor injuries below €50 Euros reduced by 25%, and moderately severe categories from €100-800 or up to 30 days of disability reduced 12-20%. Some severe injury categories increased. The mean length of disability increased from 25 to 29 days ($p<0.0001$), and the mean compensation cost increased from €1190 to €1339 ($p=0.005$). Overall, the results showed a significant reduction in the injury rate. The reduction occurred in minor and moderately severe injuries. Minor injuries did not reduce as much as expected, and moderately severe injuries reduced more than expected. Shifting of claims to other types of insurance was not observed. This indicates that the bonus may have some preventive effect, assuming that the farmers have a fairly good understanding of the value of the bonus and seek compensation when it is financially feasible for them.

Introduction

Agriculture has been recognized as a hazardous occupation worldwide. The nature of hazards varies by region, climate, and type of production. Mechanization of agriculture has created serious injury hazards. Handling of animals, heavy labor, long working hours, and exposure to chemicals, dust, noise, and the weather are major hazards as well. Besides farmers and farm workers, children are also exposed to farm hazards (Myers, 1998a; Myers 2001; McCurdy and Carroll, 2000).

Preventive efforts have been initiated at various levels from international organizations to individual farms. The International Labour Organization (2001), the International Organization for Standardization (2001), and other organizations have produced conventions, directives, standards, guidelines, and general information on health and safety. National laws, standards, and preventive programs have also been established to address hazards in agriculture (29 CFR 1910:267; United States Environmental Protection Agency, 2001; United States Department of Agriculture, 2001; NIOSH, 2002; USDA, 2001). The level of activities and the type of programs vary in different countries and jurisdictions.

Injury prevention continues to be a challenge in agriculture, and there are very few examples of successful interventions (DeRoo and Rautiainen, 2000). The "three E's"

(engineering, education, and enforcement) are common approaches, but they have limited application in agriculture. Engineering is effective, but requires capital investments and time. Education is well accepted; however, participation is often low, and education may not lead to safe behaviors. Enforcement is effective but difficult to implement and unpopular among farmers (Murphy, 1992). Comprehensive occupational health services have been introduced in Scandinavian countries (Husman et al., 1990; Höglund, 1989; Landbrukshelsen, 2000). Incentive-based programs have been developed recently, including insurance rebates (Abend and Halman, 1998), grants (Lundqvist, 1996; Stone and Saacke, 1998), loans, discounts, and vouchers for safety products (Reinhart, 1997). Insurance rebate or bonus programs have received special attention (Jaspersen et al., 1999; Thu et al, 1998). If proven effective, insurance bonus systems may have universal importance, as they are relatively inexpensive and easy to implement. They reward success and motivate efforts towards effective injury prevention.

This study aims to evaluate the effectiveness of a financial incentive intervention, the no-claims bonus implemented on June 1, 1997 in the Finnish farmers' employment accident insurance program, known as MATA insurance. MATA is compulsory for all self-employed farmers in Finland. It is similar to workers' compensation provided for employed workers in other industries. MATA provides a unique opportunity for research, as the program is nationwide, mandatory, well-established, and well-utilized. Farmers Social Insurance Institution administers the program and maintains registries of injuries and insured persons, which enable accurate measurement of changes in the population and injuries over time. A quasi-experimental study using the interrupted time series method was conducted to measure changes in the injury rate before and after the intervention. The main question was whether this intervention had a preventive effect on injuries.

Methods

Setting

Finland is the world's most northern nation with self-sufficient agriculture. Compared to North America, Finnish agriculture and climate are most similar to the eastern Canadian provinces and the northeastern states of the US. The growing season is 180 days in southern and 110 days in northern Finland. The average Finnish farm in 1999 consisted of 25.6 hectares of arable land and 52.1 hectares of forest (1 ha = 2.5 acres). The main commodities are dairy, beef, swine, poultry, and field crops including hay, forage, barley, oats, wheat, rye, rapeseed, potato, and sugar beet. Production is highly mechanized with 1 tractor per 11 hectares of arable land. About 6% of the arable land is in organic production (Finfood, 2001). Forestry has an important role on most farms. A family or an estate owns 99% of the farms. The number of farms has decreased rapidly and the farm size has increased. Farming is a part-time activity for an increasing number of farmers. About half of the farms receive 75% or more of their income from farming (Virtanen et al., 2002). Due to national and European Union regulations, industrialized production has not progressed to the extent it has in North America. Joining the European Union on January 1, 1995 had dramatic effects on agriculture. Most producer prices dropped "overnight" by 1/3 or more. Several types of subsidies were initiated to replace lost earnings. Many of them have been phased out, and this has caused difficult adjustments for farmers (Siren, 1999). Strong emphasis has

been placed on environmental stewardship including restrictions on the use of pesticides, fertilizers, and animal waste.

Cohort

The cohort in this study consisted of Finnish farmers, fishermen, and reindeer herders who are insured by the Finnish farmers' employment accident insurance, MATA. All self-employed farmers on farms with at least 2 hectares of agricultural land are covered. This minimum farm size changed to 5 hectares on January 1, 1994. Self-employed fishermen and reindeer herders are covered as well. Family members are insured if their annual salary from the family holding is at least €2,433 Euros (€1 EUR = $0.878 USD on 4/5/02). Employed workers in agriculture, forestry, and fishing are excluded from MATA, but they are covered by other workers' compensation programs. In some cases the mandatory insurance requirement can be waived if the holding is small and adequate insurance coverage exists from other sources. Voluntary MATA coverage can be purchased on holdings where mandatory requirements do not apply. The proportions of voluntarily insured persons and those whose mandatory insurance has been waived are small. In this study, the insured persons are referred to as farmers, recognizing that about 2.7% of them were actually paid family members, 1.1% were fishermen, and 1.3% were reindeer herders. In 1998, 61% of the insured persons were men and 39% were women. Figure 5 shows the number of insured persons during this study period. End-of-year populations were used in this figure, and estimated mid-year and monthly populations were used in rate calculations and the time series analysis.

Data

Data were acquired for this study from the Finnish Farmers Social Insurance Institution in the summer of 2000 based on a research agreement between The University of Iowa and Farmers Social Insurance Institution. An international institutional review board clearance was obtained through the US Centers for Disease Control and Prevention and The University of Iowa. The data had no personal identifiers.

Typically a claim is made in person at the local agent's office. Physicians assign the disability time. The injury characteristics are coded in detail and missing information is verified by calling the doctor, agent, injured person, or other source as necessary. False information is subject to legal consequences. Various quality control procedures are in place, and data entry errors are effectively controlled in the adjudication process. MATA staff members are trained in coding the injury circumstances using ICD10 (World Health Organization, 1993) and other coding systems, which takes a significant portion of their time in claims adjudication.

The first dataset used in this study consisted of 1996-98 claims records including 29,599 cases. These data were used for analyzing crude and stratified rates before and after the intervention. The intervention was implemented on July 1, 1997. Data from 1997 were excluded and the calendar years immediately before and after the intervention year were used for analysis. The second dataset consisted of 1990-2000 claims including 125,931 cases. After exclusion of back injuries (10,151 cases) and occupational diseases (8,356 cases), 107,424 injuries were available. The third dataset was constructed for the time series analysis. Monthly injury frequency and rate, as well as monthly observations for various other variables from January 1990 to March 2000 (123 months) were constructed. Several experts at Farmers Social Insurance Institution,

the Finnish Agricultural Economic Research Institute, and other institutions were interviewed to identify important variables.

Hypotheses

This study had two main hypotheses:

1. The injury rate reduced after the intervention, and
2. The injury rate reduced at all levels of severity and not only in minor injuries.

The first hypothesis was tested using crude rate comparison and the interrupted time series method. The second hypothesis was tested using stratified methods examining the injury rates at various levels of severity. The mean length of disability and the mean compensation cost before and after the intervention were also examined.

Interrupted Time Series Analysis

Outcome Variables. The monthly number of injuries was used in the interrupted time series analysis as outcome. A compensable injury is described in MATA as a sudden unexpected forceful event with an external cause, which results in bodily damage or an ailment, and which occurs in the course of agricultural work. Self-inflicted injuries are excluded. Injuries from deliberate actions by a third party are included if there is a causal connection to the victim's work. Roadway injuries are included if they occur while conducting farm-related work (Farmers Social Insurance Institution, 1998). Besides injuries, MATA compensates occupational diseases; however, they were excluded from this study. Cumulative trauma, such as epicondylitis and tenosynovitis, are classified as occupational diseases, and were thus excluded. Back injuries were also excluded due to changes in insurance policies, which altered the rate of compensated back injuries during this study period. These exclusions provided the most homogenous outcome for the analyses. A monthly injury rate (injuries per 1000 persons) was calculated for the interrupted time series analysis.

Explanatory Variables. The no-claims bonus was implemented on July 1, 1997. Insured persons who do not have compensated claims during the previous year receive a 10% reduction in their premiums. Each claim-free year thereafter adds 10% to this bonus up to the 50% level in five consecutive claim-free years. Each compensated claim reduces the bonus by 10%, but the 0% level is never exceeded (Farmers Social Insurance Institution, 2001). The bonus system provides an incentive for farmers to make safety improvements and attempt to avoid injuries. Rather than mandating or educating, this incentive leaves it up to the farmers to reduce their injuries the best way they can. An indicator variable was used for the intervention in the interrupted time series analysis.

Several temporal indicator variables were used to mark significant changes in the insurance policy and agriculture as listed in Table 20. These time-indicator variables should be interpreted with caution, recognizing that they represent points in time. The listed events potentially had an effect on the injury rate, but other changes in the society at the same times may have some effect as well.

Several continuous variables were included in the monthly data. The average *national net farm income* was included. The annual figures were used for each month of the year. The *Producer Price Index* was also included. The annual index figures were used for each month of the year. The monthly numbers of farm foreclosures with 0, 1,

and 2-year lag times were examined as economic stress indicators, but they were not used, as they did not significantly contribute to any model.

Stratified Analysis

Under-reporting of injuries was of specific interest in this study. Stratified methods were developed to address the extent of a potential reporting bias. The basic assumption was that the farmers optimize their finances when considering whether it is beneficial to make a claim or absorb the injury costs themselves. The MATA bonus is similar to a bonus that has been used in the auto insurance, and consumers including farmers are very familiar with that bonus system. The value of the bonus provides a theoretical break-even point whether it is beneficial for the consumer to make a claim. This value can be estimated for each insured person based on his/her annual insurance premium and the current bonus level. Generally, the greatest bonus loss occurs when the current bonus is 10% and it changes to 0%. During each of the following five years the bonus then remains 10% less than it would be without the injury claim. This five-year loss equals approximately 50% of one annual premium payment, and is referred to in this paper as the "bonus value". Farmers may not be able to accurately estimate their own bonus value; they may over- or under-estimate it to some degree. The under-reporting could therefore be gradual from minor to more serious injuries. Stratified methods addressed the changes at different severity levels. MATA insurance data provide two important variables for severity: length of disability and compensation cost. These variables are correlated, but they reflect different aspects of severity and may deviate in some cases. The first stratified analysis was based on the length of disability. The second analysis was based on the claim cost. The third analysis was based on the compensation cost and the personal bonus value. The premium and the bonus value were determined for each injured person. A "feasibility ratio" was calculated for each person as follows: feasibility ratio = compensation amount / personal bonus value. The feasibility ratios in 1996 and 1998 were compared in categories from <1 to 10 times the bonus value. This analysis included 62% of the claims and allowed analysis of the changes in reporting minor and moderately severe cases.

Statistical Methods

A combination of statistical methods was used to determine the preventive effect of the bonus system. Two methods were used to test hypothesis 1. The overall difference in injury rates in 1996 and 1998, the years immediately before and after the intervention year, was evaluated using the chi-square test. The changes in the injury rate over time from January 1990 to March 2000 were analyzed using the interrupted time series method (ARIMA). This method was first developed by Box and Jenkins (Box and Jenkins, 1979) and utilizes the AutoRegressive Integrated Moving-Average (ARIMA) procedure. The interrupted time series analysis accounts for seasonal variability, and allows measuring trend changes from intervention while adjusting for other factors entered into the model. The ARIMA and interrupted time series models have been further discussed by authors including SAS Institute Inc. (1997), McDowall et al. (1980), Marmoll Jirovec (1986), Jensen (1990), and Crabtree et al. (1990).

Two methods were used to test hypothesis 2. The mean length of disability and the mean compensation cost in 1996 and 1998 were compared using the *t*-test.

Stratified analysis was conducted comparing injury rates in 1996 and 1998 at various levels of severity using the chi-square test.

Results

Crude Injury Rate Analysis

The first analysis compared injury rates in 1996 and 1998, the years immediately before and after the intervention. The chi-square test results are summarized in Table 21. The analysis showed that the injury rate reduced by 7.6% for women, 10.5% for men, and 9.3% for both. All reductions were statistically significant ($p<0.001$).

Interrupted Time Series Analysis

Changes in injuries from January 1990 to March 2000 were analyzed using the interrupted time series method. The outcome variables were monthly injury count and rate. The explanatory variables included insurance policy change indicators, economic indicators, and the indicator for the intervention. ARIMA and seasonal ARIMA models were fitted for each outcome variable using combinations of explanatory variables. The three ARIMA parameters, p (number of autoregressive structures in the model), d (number of times differencing is done in the model), and q (number of moving average structures in the model) were set by examining the model fit, prediction error distributions, autocorrelations, partial autocorrelations, and white noise tests. The best-fitting models for the injury count and the injury rate are shown in Table 22.
Model 1 using the number of injuries as outcome showed a fairly high level of fit ($R^2=0.84$), and several of the anticipated explanatory factors were highly significant ($p<0.0001$). The model parameters were: Step:Jan1991 + Step: Jan1994 + Step:Jul1997 + Farm Income + ARIMA(1,0,0)(1,1,0)s No Intercept.
Model 2 using monthly injury rate as outcome showed a slightly lower level of fit ($R^2=0.68$), and the same explanatory factors were significantly associated with the injury rate. The model parameters were: Step:Jan1991 + Step:Jan1994 + Step:Jul1997 + Farm Income + ARIMA(0,0,1)(1,1,1)s No Intercept. The no-claims bonus was a significant explanatory variable in both models. Therefore it can be concluded that the bonus did have a significant effect on the injury time series while adjusting for the identified explanatory variables. The injury number decreased by 106 monthly, which is about 13.5% decrease from the average level in previous two years. The injury rate decreased by 0.51, which is about 8.9% decrease from the previous two year level. These models show an average of about 11% reduction after the intervention. Several other variables helped explain the variability, besides the bonus. The change in the minimum farm size (January 1994) decreased injuries by 196 per month and the short-term illness compensation (January 1991) increased injuries by 177 per month. Figures 6 and 7 show the monthly injury numbers and rates from the ARIMA analysis.

Overall Injury Severity Analysis

Changes in the overall severity were measured by comparing the mean length of disability and compensation cost in 1996 and 98 using the two sample t-test. The mean length of disability increased from 25 to 29 days ($p<0.0001$), and the mean compensation cost increased from €1190 to €1339 ($p=0.005$). These amounts were adjusted by the cost-of-living and wage index, which increased 3.7% from 1996 to 1998. The paid benefits up to August 1, 2000 were included. The present value of permanent

accident pensions was excluded. These two analyses showed that changes occurred in the length of disability as well as in compensation cost. The compensated injuries were more severe in 1998 compared to 1996. This indicates that minor injuries reduced more than severe injuries.

Stratified Injury Severity Analysis

Stratified analysis was used to address the potential under-reporting. The basic assumption was that the reporting bias would have a strong effect on minor injury claims near and below the bonus value. More costly injury claims should not be significantly affected. The mean bonus value was first determined to understand at what severity level the under-reporting might likely occur. Table 23 shows the mean farm income, premium, and the bonus value using the "worst-case scenario", where the bonus value is equal to 50% of one annual premium payment. As Table 23 indicates, the mean value of the lost bonus is low, €59 in 1996, €62 in 1998, and €60 on the average. This is due to the relatively low injury rate, low injury cost, and governmental support for the insurance program. Only about 1/3 of the total insurance cost is covered by premiums, and 2/3 of the cost is covered by governmental support. Based on this analysis, it would be expected that claims below €60 should reduce strongly, and claims clearly over €60 should not be significantly affected, assuming that farmers understand the value of their bonus and optimize their finances when considering the feasibility of making the claim.

Stratified Analysis by Claim Cost

The first stratified analysis compared injury claim costs before and after the intervention in categories where the cost was doubled at each cut-point. The percentage of injuries in the two lowest categories (<€25 and €25-49), below the average €60 bonus value is quite low, only about 5% of all injuries. Figure 8 shows the distribution of injury rates in each cost category in 1996 and 1998. The <€25 injuries reduced significantly (22%, $p=0.02$) as did the €25-49 injuries (26%, $p=0.002$), but the €50-99 injuries did not change. Moderately severe injuries in categories from €100-800 injuries reduced significantly (12-20%, $p<0.0001$). Increases were found in the €6400–25600 categories (33-53%, $p<0.05$). The changes appear to be somewhat gradual from <€25 up to €800. It was expected that the minor injuries below the mean bonus value would decrease strongly, but only about 25% reduction was observed. In most of these cases, the farmers took a net loss by making the small claim and losing their bonus. Moderately severe injuries should not have been affected, but the rates decreased in categories up to €800, which is more than ten times the mean bonus value. This result indicates that either there was a reduction in the true injury rate, and/or that a great number of farmers took a net loss by not making feasible claims. Interestingly rates in two severe categories increased.

Stratified Analysis by Length of Disability

The second stratified analysis compared injuries before and after the intervention at various length of disability levels. The relation between the length of disability and the claim cost was examined. The two measures are highly correlated ($r=0.71$, $p<0.0001$). The mean costs were calculated at different levels of disability time, and the results are presented in Table 24. The mean cost was clearly higher than the mean bonus value (€60) in all categories, even the zero lost days category. Therefore, the length of

disability may not be a very sensitive measure for assessing the under-reporting of minor injuries; however, it provides useful information about the characteristics of injury severity changes.

The injury rates in 1996 and 1998 by length of disability were examined, and the distribution of rates is presented in Figure 9. The chi-square tests showed that the injury rates decreased significantly in most of the minor and moderate injury categories up to 30 days of disability. The reductions were similar in the four minor injury categories. The rates increased in two severe injury categories (121-240 and 241-360 days). The fatalities reduced from 13 to 6 but this decrease was not statistically significant (p=0.17).

Bonus Category Analysis

A personal bonus value was calculated for each injured person. A feasibility ratio was then calculated by dividing the claim cost by the personal bonus value. The claims below the bonus value (feasibility ratio <1) are not financially feasible after the bonus system was implement. The injured person took a net loss by making the claim and losing the bonus. The claims with feasibility ratio >1 are feasible, and no reductions should be observed in these categories, assuming the injury rates were unchanged.

Figure 10 shows the distribution of the injury rates in 1996 and 1998 in feasibility ratio categories. There was a significant reduction in the first category where the compensation was less than the value of the lost bonus. However, a greater reduction than 25% was expected as most of these injured persons likely took a loss by making the claim and losing their bonus. In the second category where the compensation was between one and two times the bonus value there was no difference. Significant reductions were observed in almost all other categories even up to ten times the bonus value. This suggests that either the injury rate reduced or that a great number of farmers over estimated the value of the bonus. It would clearly not be financially feasible to leave an injury unclaimed when the value of the claim is as much as ten times greater than the lost bonus.

Discussion

Bonuses, adjusted premiums, or experience rating for various groups have been used in the insurance industry including life insurance, auto insurance, and workers' compensation. Life insurance rates are typically different for smokers and non-smokers. Other risk factors such as flying private airplanes, mountain climbing, or other hazardous sports have been used for adjusting premium rates. Auto insurance bonus systems based on personal claims experience are common in Europe, including Finland. These bonus systems have lately been under scrutiny to evaluate whether they limit competition. However, recent European Union decisions indicate that bonus systems will be allowed, but they cannot be required by national laws (Kuparinen, 2001). In the US, automobile insurance premiums may be adjusted by demographic and behavior factors, such as age and driving record (Deloitte and Touche, 1996). Experience rating has been used in workers' compensation premiums for sectors of industry, and in some cases individual companies, divisions, or departments (Workplace Safety and Insurance Board, Ontario, 2001; Ison, 1998; Oregon Department of Consumer Business and Service, 2001). In MATA insurance, this rate differentiation was taken to the individual level. All insured farmers and family members may receive a bonus up to 50% based on their own claims experience (Farmers Social Insurance Institution, 2001).

Adjusted premiums have been primarily market-driven and competitive in nature. They enable designing insurance products for low-risk groups at lower premium rates. Price has a strong influence on consumer behavior, and the bonuses may have some preventive effect as people strive towards being able to qualify for lower rates. On the other hand, reporting of minor injuries may decrease as policyholders want to maintain their low premiums.

The results from this study showed that the injury claims reduced. Both the crude rate analysis and the interrupted time series analysis showed about 10% reduction after the bonus was implemented. This was an expected result of the bonus system. It was also expected that minor injuries below and slightly above the bonus value would reduce strongly, but the actual reduction was less than 30%. The moderately severe injuries up to €800 or 30 disability days reduced more than expected. There were unexpected increases in the injury rate in some severe injury categories. The fatalities decreased by half, but this reduction was not statistically significant. The mean length of disability increased from 25 to 29 days, and the mean compensation amount increased from €1190 to €1339.

The results confirmed the first hypothesis. The injury rate clearly reduced after the intervention. The second hypothesis was not confirmed. The injury reduction did not occur across all levels of severity, but was concentrated in the minor and moderate severity categories, and some severe categories actually increased. The results suggest that part of the reduction in claims is due to under-reporting of minor injuries, but it does not appear to explain the entire injury rate reduction. Part of the reduction is due to lower reporting of minor injuries, but a larger part occurred in the moderate severity categories where the under-reporting should have no effect. This was evident in the stratified analysis where the compensation cost was compared to the personal bonus value. There were reductions in most categories up to 10 times the bonus value. In such cases farmers took a significant loss when leaving an injury unclaimed, and it is unlikely that most farmers would take such losses. One possible explanation is that Finnish consumers are used to auto insurance bonuses. The value of those bonuses is higher than the MATA bonus and this may result in overestimation of the MATA bonus.

The increases in some severe injury categories would require further study. The bonus system does not appear to have a plausible connection as a causal factor. It is possible that the rapid changes in agriculture may have an effect. The farm size, level of mechanization, working hours, and off-farm employment increased in the 1990's. The number of dairy producers decreased. Some studies have suggested that there is an association between stress and serious injuries (Thu et al., 1997). The stress level has certainly been very high among Finnish farmers through the 1990's, although it is not clear whether it changed after the bonus system was implemented. One reason could be that the mean age of the injured persons was higher in 1998 (46.2 years) than in 1996 (45.5 years). There is a correlation between age and length of disability in this study population ($r=0.11$, $p<0.0001$), as well as age and compensation cost ($r=0.03$, $p=<0.0001$). At an older age, injuries tend to be more expensive and take a longer time to recover. The costs were adjusted by cost-of-living and wage index, which increased the 1998 actual costs about 3.7% in relation to 1996 costs. There has been a three-fold increase in total injury costs per insured person during the two decades of MATA insurance after index adjustment. The injury costs have historically increased faster than the rate of inflation. Some of these factors may have contributed to the cost increases.

However, the stratified analysis by length of disability showed similar results as costs, and it appears likely that the severity of injuries actually increased from 1996 to 1998.

Claims data from two other insurance systems administered by the Farmers Social Insurance Institution were examined to determine whether there was evidence of claims shifting from MATA to other insurances. No shifting of claims was observed. The four-year average MATA injury and occupational disease rate reduced from 8.9% (1993-1996) to 7.4% (1998-2001), which is a 16.7% decrease. The four-year average leisure injury rate increased from 1.0% to 1.2% (18.1% increase) after the intervention. The four-year average short-term illness insurance claim rate reduced from 20.0% to 16.2% (19.1% decrease). These data showed that while the MATA claim rate reduced, there was no indication of claims shifting to other insurances. Shifting to leisure insurance would not be expected as work injuries are not compensable under that policy. Shifting to the short-term illness insurance would be possible but the short-term illness rate also decreased suggesting no shifting likely occurred. The national health insurance data were not available, but it would be expected that the shifting would occur mostly in the short-term illness insurance.

Conclusions

The results of this study indicate that the insurance bonus system reduced injury claims by about 10%. The stratified analysis by severity indicated that the reduction occurred in minor injuries and in moderately severity categories as well. The reduction in minor injuries below the value of the bonus was less than expected, and the reduction in moderately severe injuries was greater than expected. No shifting to other insurances was observed. Therefore, the reduction in the injury rate may be explained partly by under-reporting of minor injuries and partly by preventive effect in moderately severe injuries. Increases were observed in some severe injury categories, which would require further examination.

Generalizeability

When assessing the generalizeability of these data, the type of climate, production, and social insurance systems must be considered. Finnish farms are relatively small: 25.6 hectares of arable land and 52.1 hectares of forest. Dairy production and mixed farming are common. The main crops are limited by the growing season to hay, forage, barley, oats, wheat, rye, rapeseed, potatoes, and sugar beets. Production is highly mechanized, but the machinery is generally smaller compared to North American agriculture. About 6% of arable land is in organic production. Most farms have some forestry production. Off-farm employment is becoming increasingly important, and about half of the farms receive over 75% of their income from farming (Virtanen et al., 2002). Agriculture is regulated by European Union and National regulations and subsidies are an important part of farm income (Siren, 1999). Farmers have various social insurance programs including national health insurance, old-age pension, work-related pension, and occupational health services.

This study is most generalizeable in Scandinavia and northern Europe. The eastern Canadian provinces and the northern and northeastern states of the US have similar climate and production. Some of the injury and illness characteristics in workers' compensation insurance data are universal, such as a small percentage of cases being responsible for most of the lost time and cost. The effect of age is also likely universal,

as well as the severity of cases using standard classification methods such as the ICD10 code.

Strengths and Weaknesses

The Finnish farmers' accident insurance system is comprehensive as the insurance is mandatory for all farmers. The insurance has been in place since 1982, and claims records as well as records of insured persons are available since that time. Accurate analyses of injury rates over time are possible from these data. The proportion of unclaimed injuries is low, likely less than one-fourth of all eligible injuries (Eskelinen et al., 1989). The coding systems are very detailed describing the injury characteristics and circumstances. The data are very complete; no missing data were found in this study.

The claims data did not include personal identifiers. It is likely that some of the claims occurred to the same people. The insurance practice has shown that about 10% of claims in one year are "repeat" claims to persons who already had another claim during that year. This has to be recognized in interpreting injury rates. The rates are literally "injuries", rather than "injured persons" per population.

Cost analysis included paid benefits up to August 1, 2000. The present value of permanent pensions was excluded. From 1996 injuries, 66 led to permanent pension.

The study included self-employed farmers, fishermen, and reindeer herders. The fishermen and reindeer herders may have different exposures and claim-reporting characteristics, but differences between these populations were not examined in this study.

Much of the documentation and citations in this study were in the Finnish language and are not readily available for English readers. The first author translated the variable names, terms, definitions, and citations as necessary.

CHAPTER 6

CONCLUSIONS

Literature showed that the fatality rate is high in US agriculture; about twice as high as the rate in Canadian agriculture and about three times as high as the rate in Finnish agriculture. The non-fatal injury data are not comparable. Definitions and data collection methods vary and published injury rates range from 0.5 to 29/100 workers. Information on occupational diseases is limited due to lacking workers' compensation for self-employed farmers in most jurisdictions. Little information was found on cost, lost time, and intervention effectiveness.

This study characterized injury and occupational disease costs and identified risk factors for costs. The total costs in 1996 were €23.5 Million consisting of medical (16%), lost time per diem (37%), accident pension (23%), survivors' pension (3%), impairment allowance (7%), rehabilitation (6%), and other costs (9%). The total costs were 0.7% of the gross farm income, which is low compared to 2.8% estimated in the US. The mean cost of 1996 claims was €1743. Occupational diseases were about five times more costly than injuries on the average. Only 0.6% of the claims were permanent pensions, but they represented nearly one quarter of the costs. The risk of permanent pension was 1.8 times greater for women compared to men, and 6.8 times greater for occupational diseases compared to injuries.

About 1% of productive time was lost from injuries and occupational diseases. The average lost time was 37 days for injuries and 185 days for occupational diseases. Men were at greater risk for short-term disability from injuries, and women were at greater risk for long-term disability from occupational diseases. Disability time increased with age. Older persons had more fractures, amputations, and other severe conditions, and older persons took longer to recover from similar conditions as did younger persons.

Most severe claims in terms of cost and lost time were related to large animals, organic dust, and various hazards in the working environment rather than machinery, which is commonly considered responsible for most serious injuries. Slips and falls, falls from elevation, pushed or run over by animals or machinery, and occupational diseases were associated with high costs and long disabilities. Women were at greater risk of occupational diseases, especially respiratory diseases and dermatitis. This is interesting as the traditional working roles have changed and both men and women participate relatively equally in animal care, which is the source of most occupational diseases.

The studies of costs and lost time identified important priority areas for prevention. More efforts should be directed to the prevention of respiratory disease from biological and organic dusts when working in animal confinements. Dermatitis and cumulative trauma from repetitive motion are also priorities in animal production work. Injuries from large animals are frequent and severe and animal handling facilities should be designed to avoid these injuries. Falls from scaffoldings, ladders, stairs, and wagons caused severe injuries. Proper permanent stairs or ladders should be used instead of temporary ladders in places where the ladders are used frequently. Better scaffolding, proper guardrails, and fall protection should be used in on-farm construction work. Riding on hay and grain wagons is a hazardous practice and should be avoided. Injuries from saws, sawmills, wood splitters, wood chippers, and power take-offs are caused by

poorly designed or poorly guarded machinery. Improving machinery guarding remains an important priority for reducing injuries.

This study found that the insurance bonus system reduced injury claims by about 10%. The four year average injury and occupational disease rate reduced as much as 17% after the intervention year (1997). The reduction occurred in minor injuries and in moderately severe categories as well. The reduction in minor injuries below the bonus value was less than expected, and the reduction in moderately severe injuries was greater than expected. The reduction in the injury rate may be explained partly by under-reporting of minor injuries, but part of the reduction may be due to preventive effect. No shifting of claims to other insurances was observed.

This study indicates that a financial incentive is effective in reducing claims. Based on this experience, insurers could use similar incentives more widely. Fewer claims, whether caused by under-reporting or true preventive effect, would reduce administration costs and offer competitive advantages to insurers. The bonus did not constitute a major barrier for farmers to receive compensation for legitimate claims as the value of the bonus was only about €60 on the average. This study supports a more active role for the insurance industry in prevention. Further research and development is needed to design and test incentive programs encouraging safe behaviors and safety improvements on the farm.

FIGURES

Figure 1. Finnish Farmers' Employment Accident Insurance System Costs per Insured Person, 1982-1999; Adjusted to 1999 Value in EUR by Cost of Living and Wage Index

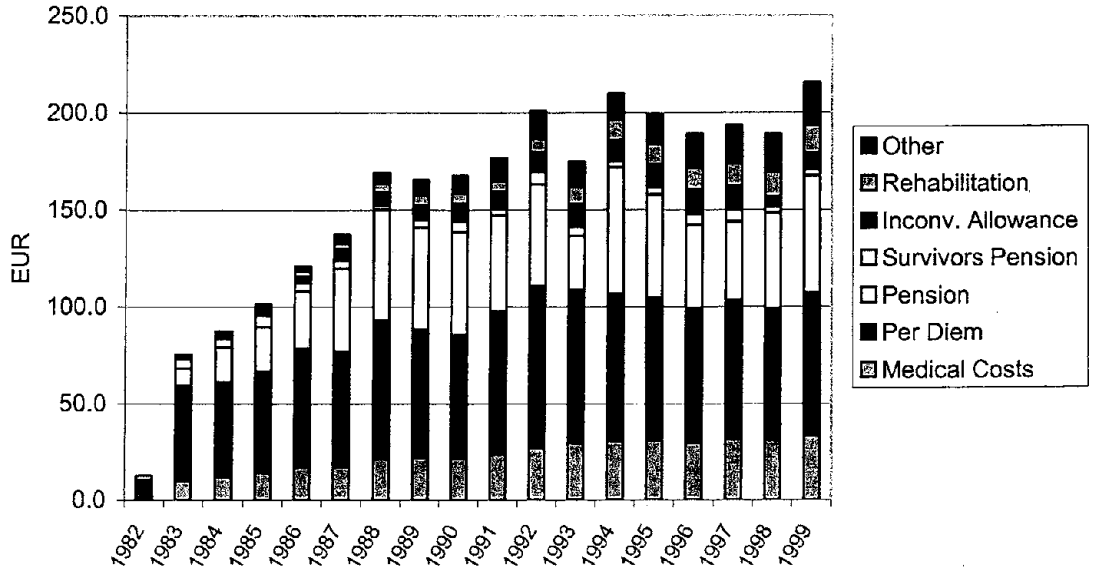


Figure 2. Short-Term Disability (<=1 Year); Distribution of Claims by Length of Disability (Number of Claims per Week) N=10922

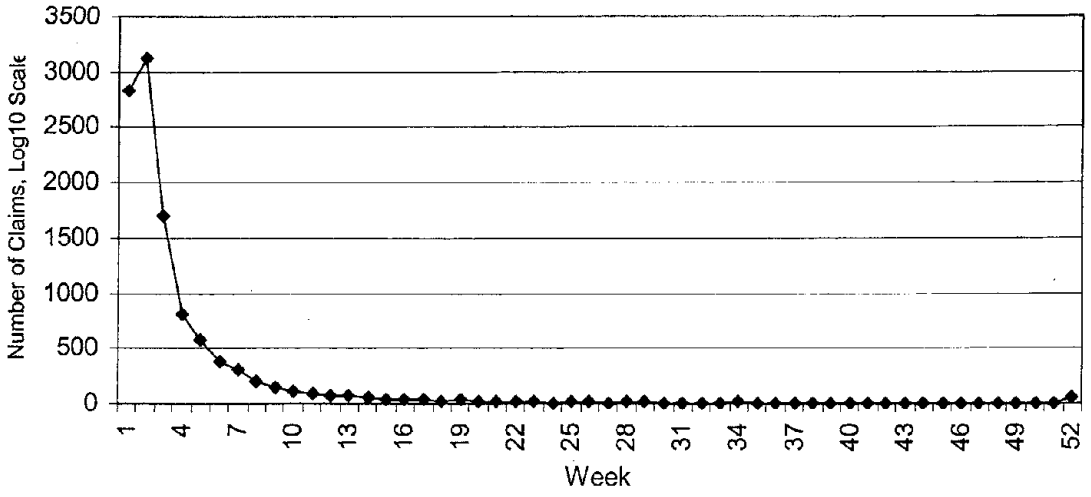


Figure 3. Mean Short-term Disability Time by Age Group; Exponential Trend

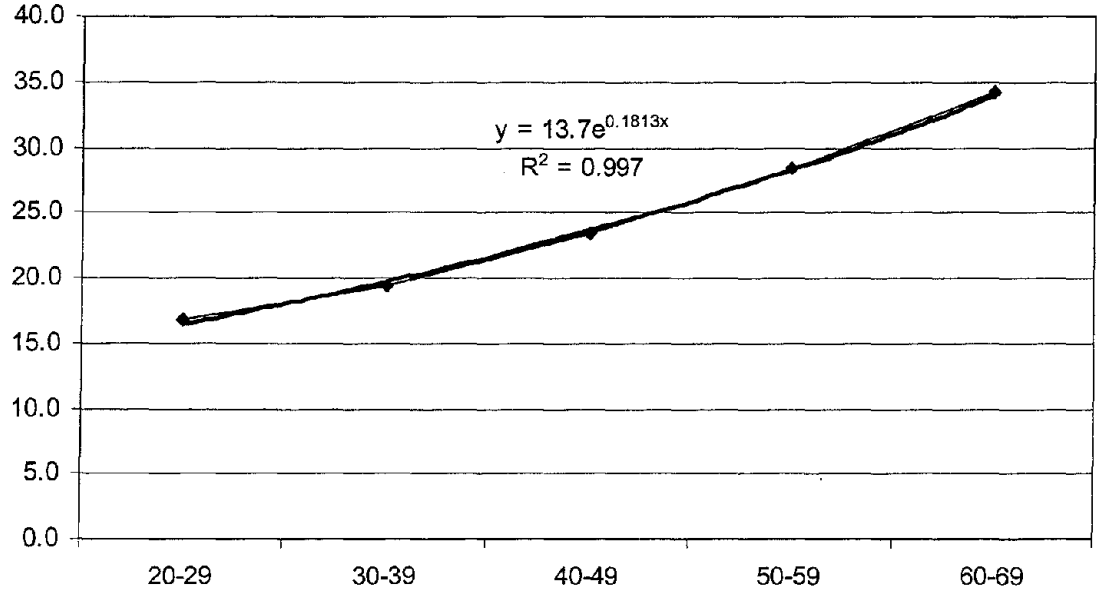


Figure 4. Mean Length of Disability by Personal Claim Rate; Polynomial (2'nd order) Trend

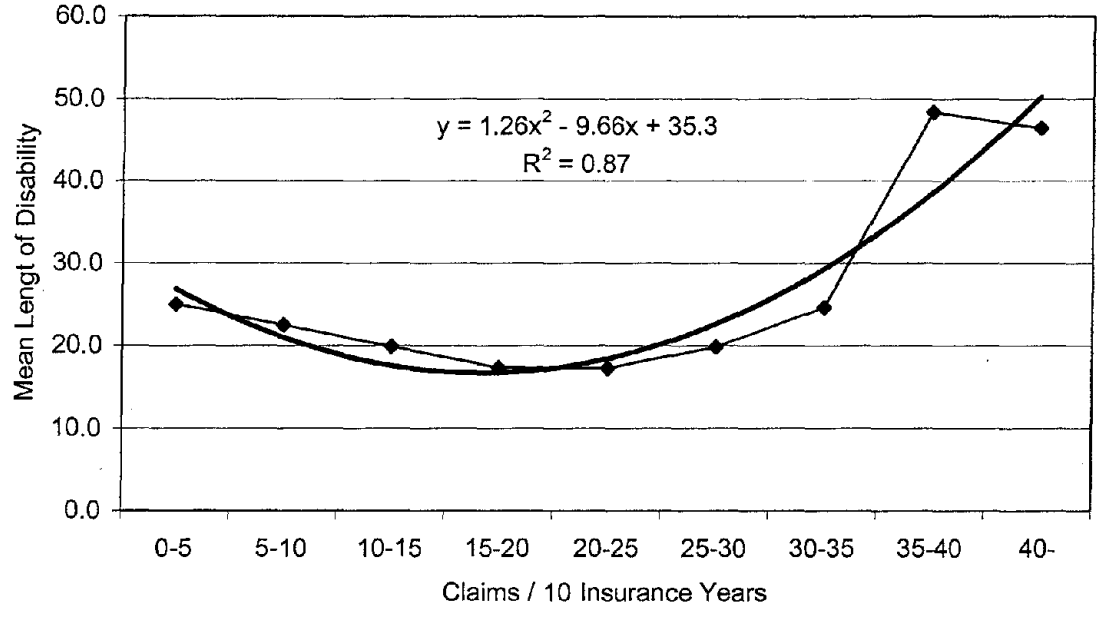


Figure 5. Number of Insured Farmers and Family Members in Finland, 1990-1999

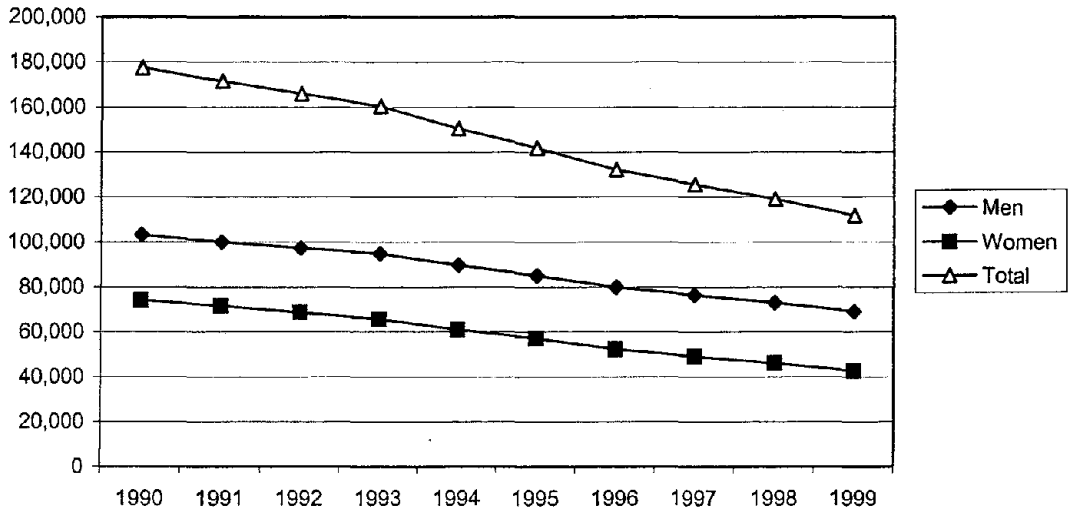


Figure 6. ARIMA Model Predictions for Monthly Number of Injuries; Model Parameters: Step:Jan1991 + Step:Jan1994 + Step:Jul1997 + Farm Income + ARIMA(1,0,0)(1,1,0)s NoInt

Figure 7. ARIMA Model Predictions for Monthly Injury Rate; Model Parameters: Step:Jan1991 + Step:Jan1994 + Step:Jul1997 + Farm Income + ARIMA(0,0,1)(1,1,1)s NoInt

Figure 8. Injury Rate in 1996 and 1998 by Claim Cost

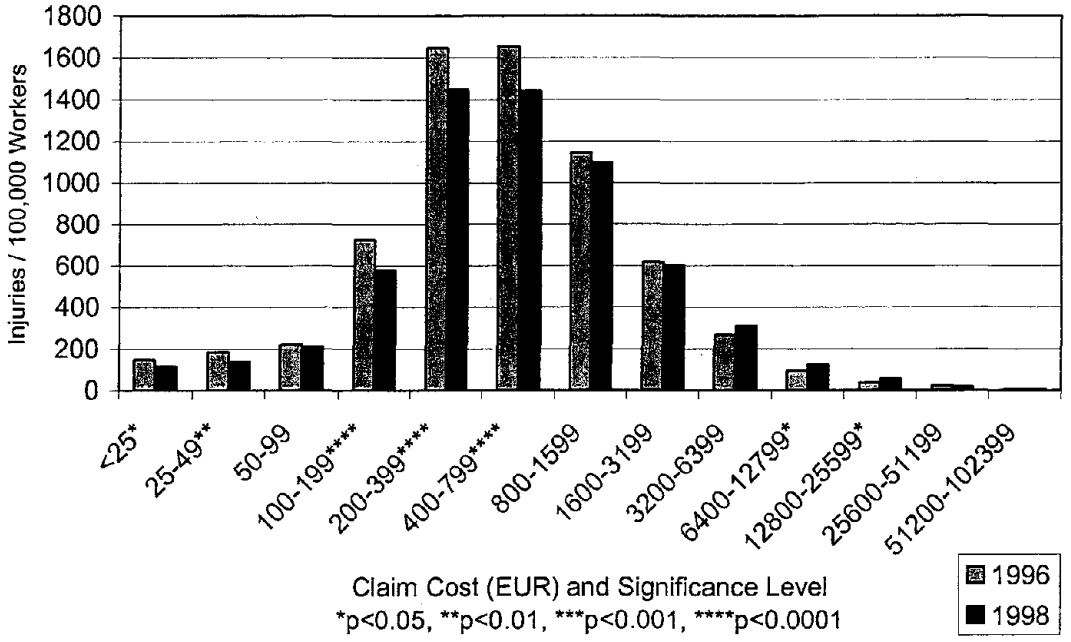


Figure 9. Injury Rate in 1996 and 1998 by Length of Disability

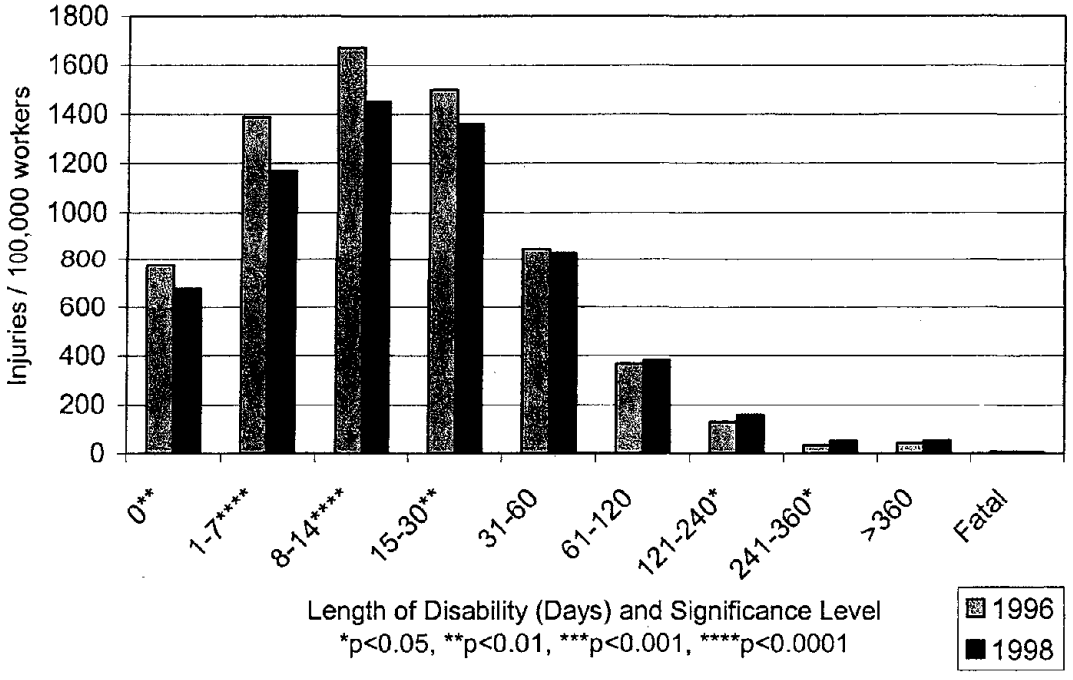
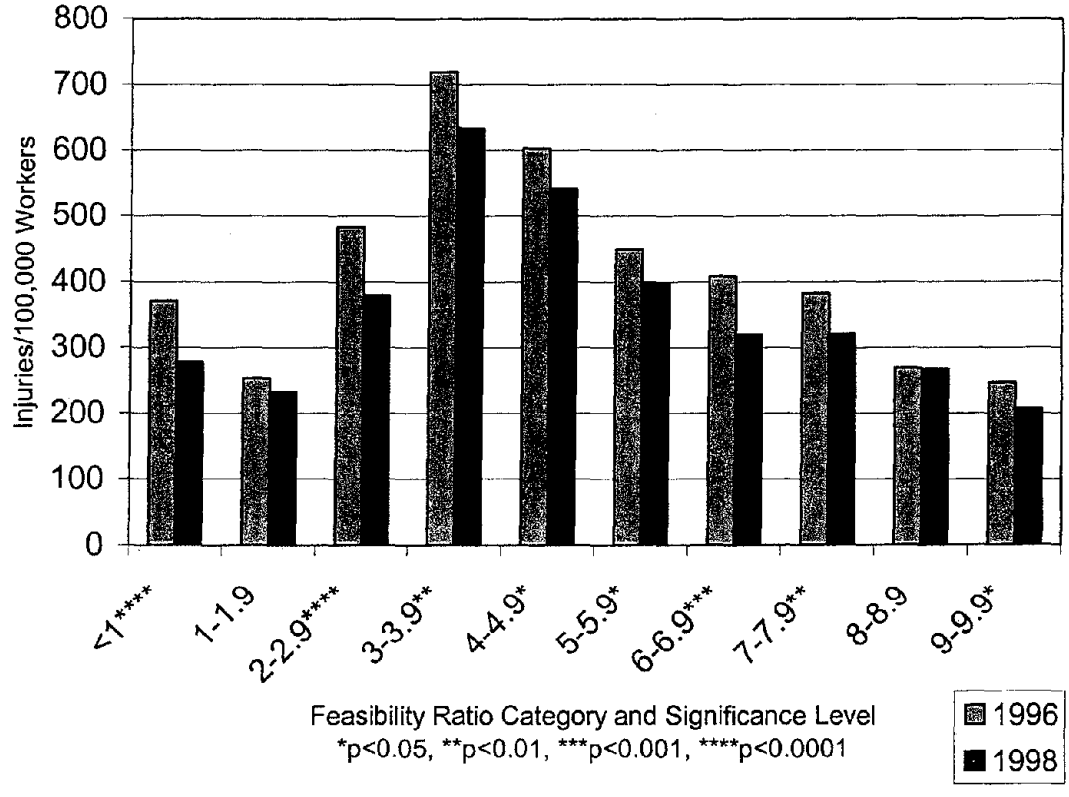


Figure 10. Injury Rate by Feasibility Ratio Category in 1996 and 1998



TABLES

Table 1. Examples of Agricultural Injury and Illness Rates

Country and Source. [-] indicates data is not available	Year	Fatalities	Hospitalized injuries	Lost time/ disabling injuries	All occup. injuries	Occup. diseases
Rate Denominator		*100,000*	*100*	*100*	*100*	*100*
USA, NSC[1]	1999	22.6	-	3.4	7.3	0.54
USA, NIOSH[2]	1995	-	-	6.8	-	-
Iowa, SPRAINS[3]	1994	26	0.8	-	-	-
Canada, CAISP[4, 5]	1990-95	11.6	0.19	-	-	-
New Zealand[6]	1986-91	9	0.27	-	28.5	-
Finland[7]	1987-99	7.5	-	-	-	-
Finland[8]	1983-01	-	-	-	7.3	0.46

Sources:

1. National Safety Council. Injury Facts. 2001 Edition. Itasca, IL.
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5. Brison RJ. Hospitalized farm injuries in Canada, 1990-96. A report from the Canadian Agricultural Injury Surveillance Program. March 1999.
6. Marshall SW, Clarke J, Langley JD, Cryer PC, 1996. Agricultural Injuries in New Zealand.
7. Eskola E. Agricultural Fatalities in Finland 1987-2000. Farmer Social Insurance Institution, Finland. 2000. Unpublished communication.
8. [Farmers Social Insurance Institution, Finland. 2002. MATA injury and illness time series 1.7.1982-31.12.2001. (In Finnish) Espoo, Finland. http://www.hci.fi/mela/tilastot.nsf/Aikasarjat?OpenView&Start=1&Count=30&Expand=4#4

Table 2. Variable Descriptions

Variable Name	Data Type	Description
Outcomes		
Total cost	Continuous	All benefits paid up to 8/1/2000. Present value of permanent pensions is included (EUR).
Total cost excluding permanent pensions	Continuous	All benefits paid up to 8/1/2000. Present value of permanent pensions is excluded (EUR).
Medical Cost	Continuous	Compensated medical expenses, medications, transportation (EUR).
Lost-time per diem	Continuous	Payment for lost workdays up to one year, 1 lost day payment = 1/360th of farm income, paid for each day of the week (EUR).
Rehabilitation	Continuous	Rehabilitation expenses, excluding lost time (EUR)
Paid pension	Continuous	Paid pension, beginning one year from the incident to 8/1/2000 (EUR)
Permanent pension	Continuous	Permanent pension, full or partial (EUR)
Pension case	Dichotomous	Pension case types: 1) any pension paid, 2) pension paid beyond Aug 1, 2000, and 3) permanent pension Y/N
Risk Factors		
Age	Continuous	Age in years
Gender	Dichotomous	Male or female
Occup. disease/injury	Dichotomous	Injury or occupational disease
Personal claim rate	Continuous	Personal claims experience (includes accepted and rejected claims); claim number/years insured*10
Farm income	Continuous	Insured farm income; determined by Farmers Social Insurance Institution for each farm and insured person
Employment income	Continuous	Employment income from off-farm employment
Business income	Continuous	Business income from non-farm business
Part of body	Discrete	Injured part of body, 13 categories
Work activity	Categorical	Work activity during incident or exposure, 150/76 (original/after combining) categories
Cause	Categorical	Primary cause, agent, or exposure of injury/illness, 108/75 categories
Nature of incident	Categorical	Nature of incident; for example fall, struck by, caught in, occupational disease etc., 28/24 categories
Type of injury/illness	Categorical	Type of injury/illness; fracture, sprain, cut, etc., 13/11 categories
ICD10 code	Categorical	ICD10 code, 473/44 categories
Worker status	Categorical	Farmer, farm wife, family member, pensioner etc., 21/7 categories
Incident month	Categorical	Calendar month of the incident, 12 categories

Table 3. Injury and Occupational Disease Incident Rates in 1996; Relative Risk for Men Compared to Women

	Injuries			Occupational Diseases			All Claims
	Women	Men	Total	Women	Men	Total	Total
Population	54626	82376	137002	54626	82376	137002	137002
Incidents	2620	7472	10092	409	421	830	10922
Incident Rate	4.8	9.07	7.37	0.75	0.51	0.61	7.97
Relative Risk		1.89			0.68		1.73
95% CI		1.81-1.97			0.60-0.78		1.66-1.80
p-value		<0.0001			<0.0001		<0.0001

Table 4. Number of Claims, Mean Cost per Claim, Total Cost, and Percentage of Total Cost in Sub-categories

	Occupational Diseases			Injuries			Total	Total
	Women	Men	All	Women	Men	All	Method 2	Method 1
Number of Claims	*409*	*421*	*830*	*2620*	*7472*	*10092*	*10922*	*N/A*
Mean Total Cost per Claim, EUR	*3805*	*3443*	*3621*	*1728*	*1539*	*1588*	*1743*	*N/A*
Total Cost, Million EUR	*1.6*	*1.4*	*3.0*	*4.5*	*11.5*	*16.0*	*19.0*	*23.5*
Percentage of Total Cost								
Medical Care %	6	6	6	12	14	13	12	16
Per Diem %	18	23	20	45	50	48	44	37
Rehabilitation %	3	4	3	5	4	5	4	6
Impairment allowance %								7
Paid Pension %	8	8	8	17	19	18	17	23
Survivors' Pension %	1	0	0	0	0	0	0	3
Permanent Pension %	64	60	62	21	13	15	23	N/A
All Pensions Combined %	*73*	*68*	*71*	*38*	*32*	*34*	*40*	*26*
All Pensions and Per Diems Combined %	*91*	*91*	*91*	*82*	*82*	*82*	*83*	*63*
Other Costs %								9
Total %	100	100	100	100	100	100	100	100

Note: Method 1 includes all paid benefits and administrative costs during the calendar year 1996. This method includes benefits to cases, which occurred in 1996, as well as long-term disability cases from previous years. Method 2 includes costs for cases, which occurred during 1996. Payments up to data extraction on August 1, 2000 are included. The present value of permanent pensions is included. Administrative costs and impairment allowances are excluded.

Table 5. Cost by Type of Production; Count of Injury and Occupational Disease (OD) Claims, Mean Claim Cost, Total Cost, Number of Farms, and Ranking by Mean and Total Costs

	Number of Claims			Mean Claim Cost			Total Cost		Number of Farms		Ranking by Cost	
Type of Production	**OD**	**Injury**	**All**	**OD**	**Injury**	**All**	**Sum**	**%**	**Farms**	**%**	**Mean**	**Sum**
Animal Production	572	4632	5204	5681	1033	1544	8034976	54.5	46576	49.5	1	1
Crop Production	114	1662	1776	2182	1292	1350	2397600	16.3	41064	43.6	2	2
Other Farm Work	40	2069	2109	719	1056	1050	2214450	15.0	5231	5.6	6	3
Forest Work	67	812	879	1048	1101	1097	964263	6.5	1243	1.3	4	4
Construction Work	30	737	767	1087	1229	1224	938808	6.4		0.0	3	5
Reindeer Herding	2	93	95	1135	1058	1060	100700	0.7		0.0	5	6
Fishing	4	85	89	664	915	904	80456	0.5		0.0	7	7
Grand Total	**830**	**10092**	**10922**	**4380**	**1099**	**1349**	**14733778**	**100**	**94114**	**100**		

Table 6. Work Activities Associated with High Claim Costs; Claim Count, Cost, and Ranking by Total and Mean Cost

		N of Claims			Cost		Rank by	
Code	**Work Activity** (Significance (p<0.05) 1=Univariable ANOVA, 2=Univariable Dunnett, 3=Multivariable (small model) ANOVA, 4=Multivariable (small model) Dunnett, 5=Multivariable (large model) Dunnett)	OD	Inj	All	Sum	Avg	Sum	Avg
217	Dairy and beef work, Cleaning, brushing animals (1,2,3,4,5)	71	29	100	470643	4706	4	1
245	Horse work, Racing, riding, training (1,2,3,4,5)		41	41	187491	4573	12	2
160	Grain harvesting, handling, preserving, transporting feed grain; Forage harvesting; Other forage harvesting work; Other grain harvesting work (1,3,4,5)	3	20	23	84395	3669	18	3
213	Dairy and beef work, Feeding dairy and beef animals (1,2,3,4,5)	159	284	443	1334901	3013	1	4
243	Horse work, Transporting and moving animals (1,3)		72	72	176351	2449	13	5
133	Forage harvesting, Transporting forage to storage (3)	1	17	18	43560	2420	21	6
231	Swine work, Preparation of swine feed, feeding (1,3,5)	19	77	96	228614	2381	9	7
173	Potato, root crop work, Potato harvesting and transport to storage (1,3,5)	5	44	49	114339	2333	16	8
113	Tillage, seeding, crop protection, Seeding, planting (1)	1	52	53	123112	2323	15	9
164	Grain harvesting, handling, drying, cash crops in storage (1,2,3,4,5)	13	174	187	421085	2252	6	10
412	Farm building construction, Farm building renovation and adding on (3)	5	100	105	223041	2124	10	11
229	Dairy and beef work, Other dairy work (1,3,5)	59	156	215	421177	1959	5	12
240	Horse work, feeding horses; Removal of horse manure, bedding, cleanup; Other horse work (3)	1	31	32	54715	1710	19	13
223	Milking and handling milk (1,2,3,4,5)	95	650	745	1265648	1699	2	14
146	Hay harvesting, Transporting hay from field to storage (3)	9	110	119	201591	1694	11	15
820	Commuting (1,2,3,4,5)	11	404	415	642392	1548	3	16
830	Pesticide related work (1)	2	32	34	50315	1480	20	17
300	Timber felling, preparation, Preparation of felling trees; Felling trees (3)	20	139	159	230291	1448	8	18
211	Dairy and beef work, Preparation, mixing, milling dairy feed (1,3,5)	12	61	73	101167	1386	17	19
522	Transporting supplies and commodities to and from farm (1,3,4,5)	2	114	116	159796	1378	14	20
225	Dairy and beef work, artificial insemination, breeding, delivering, care of sick animals (1,3)	19	259	278	376696	1355	7	21

Table 7. Causes Associated with High Claim Costs; Claim Count, Cost, and Ranking by Total and Mean Costs

		Count			Cost		Rank by	
Code	**Cause** (Significance (p<0.05) 1=Univariable ANOVA, 2=Univariable Dunnett, 3=Multivariable (small model) ANOVA, 4=Multivariable (small model) Dunnett, 5=Multivariable (large model) Dunnett)	OD	Inj	Tot	Sum	Avg	Sum	Avg
154	PTO shafts (1,3)		11	11	95894	8718	14	1
600	Biological cause (1,2,3,4,5)	196	1	197	1386357	7037	1	2
332	Dirt particles, projectiles, dusts (3,5)	164	165	329	1232654	3747	2	3
142	Rakes, windrowers, balers, forage harvesters (1)		29	29	94690	3265	15	4
311	Roofs (1,3)		47	47	132581	2821	12	5
223	Horses (1,3)		130	130	309058	2377	7	6
306	Floor openings, feed drop openings (1,3)		48	48	114038	2376	13	7
312	Scaffoldings, unattached ladders (1,2,3,4,5)		214	214	416277	1945	4	8
910	Family members; Other persons; Dirt masses; Fishing equipment; Explosive gasses; Rubbing against clothing, boots, surface, excluding machine or handtool; Unusual pressure (1,3)	107	166	273	523337	1917	3	9
301	Stairs (1,2,3,4,5)		136	136	248602	1828	9	10
156	Circular saws, sawmills, splitters, chippers (1,2,3,4,5)	1	173	174	309803	1780	6	11
333	Plants, trees, falling trees, stumps (3)		149	149	254283	1707	8	12
302	Attached ladders (1,3)		29	29	45085	1555	18	13
323	Breaking ice, soft terrain (3)		32	32	48653	1520	17	14
326	Loads of grain, hay, straw, logs, wood (1,3)		105	105	157724	1502	11	15
122	Trailers, wagons (1,3)		214	214	309900	1448	5	16
153	Front- and back-end loaders, back hoes, loaders, compressors, tractor driven pumps (3)		49	49	70372	1436	16	17
112	Tractor steps (1,3)		128	128	178904	1398	10	18

Table 8. Nature of Incident Categories Associated with High Claim Costs; Claim Count, Cost, and Ranking by Total and Mean Costs

		Count			Cost		Rank by	
Code	**Nature of Incident** (Significance (p<0.05) 1=Univariable ANOVA, 2=Univariable Dunnett, 3=Multivariable (small model) ANOVA, 4=Multivariable (small model) Dunnett, 5=Multivariable (large model) Dunnett)	OD	Inj	Tot	Sum	Avg	Sum	Avg
92	Occupational diseases (1,2,3,4,5)	823		823	3599982	4374	1	1
21	Falling from elevation when lifting or moving a carrying a load (1,2,3,4,5)		143	143	463023	3238	4	2
55	Caught in, tangled, crushed by machine or equipment (1,3)		100	100	228223	2282	7	3
22	Falling from elevation without a load (1,2,3,4,5)		322	322	614079	1907	3	4
23	Falling from elevation when the platform, structure falls or fails (1,2,3,4,5)		229	229	425113	1856	5	5
57	Struck by, run over by motor vehicle (1,3)		44	44	75404	1714	8	6
32	Falling, sliding, tumbling machines or equipment (1,2,3,4,5)		170	170	285732	1681	6	7
72	Tossed, run over, thrown by animals (1,3,4,5)		515	515	706887	1373	2	8

Table 9. ICD10 Categories Associated with High Claim Costs; Claim Count, Mean Claim Cost, Cost, and Ranking by Total and Mean Costs

		Count			Cost		Rank by	
Code	**ICD10 Code** (Significant at p<0.05, univariable ANOVA and univariable Dunnett)	OD	Inj	Tot	Sum	Avg	Sum	Avg
J4	Asthma J45-J459	146		146	1767511	12106	1	1
J6x	Hypersensitivity pneumonitis J668-J680	53	1	54	469487	8694	9	2
S82	Fracture of lower leg including ankle S82-S829		109	109	603208	5534	5	3
J3x	Rhinitis J159-J303	135	1	136	586509	4313	7	4
L23	Contact dermatitis L23-L238	97		97	404723	4172	10	5
S62	Injury of hand and wrist S62-S628		408	408	917423	2249	4	6
S4	Injury of shoulder and upper arm S40-S499		724	724	1584500	2189	2	7
S5	Injury of elbow and forearm S50-S59		278	278	600584	2160	6	8
S66x	Injury of had and wrist S64-S669	2	141	143	276134	1931	12	9
S83	Dislocation, sprain and strain of joints and ligaments of knee S83-S836		603	603	1037360	1720	3	10
S92	Fracture of foot except ankle S92-S929		306	306	508565	1662	8	11
M7	Epicondylitis, bursitis, rotator cuff syndrome M70-M796	120	63	183	285703	1561	11	12
	Grand Total	830	10092	10922	14730479	1349		

Table 10. Type of Injury and Illness, Claim Count, Cost, and Ranking by Total and Mean Costs

		Count			Cost		Rank By	
Code	Type of Injury/illness, Significance	OD	Inj	Tot	Sum	Avg	Sum	Avg
3	Internal injury, illness, concussion 1,2,3,4	291	107	398	2152600	5409	4	1
4	Amputation 1,2,3,4		39	39	135805	3482	8	2
15	Acute poisoning; Electrocution; Hearing loss; Other injury 1,2	254	124	378	1200545	3176	5	3
9	Skin disease 1,2,3,4	193	2	195	524741	2691	7	4
1	Bone fracture 1,2,3,4		1499	1499	3350020	2235	2	5
99	Sprain, strain	90	3642	3732	4070702	1091	1	6
7	Bruise, crush		2714	2714	2229307	821	3	7
8	Burn		179	179	126884	709	9	8
5	Cut		1442	1443	861220	597	6	9
6	Rubbing, material in eye, splinter, minor skin injury	1	344	345	78655	228	10	10
	Grand Total	830	10092	10922	14730479	1349		

Table 11. Number of Injuries and Occupational Diseases by Gender; Percentage of Cases by Lost Time Category

	Occupational Disease			Injury			Grand
	Women	Men	Total	Women	Men	Total	Total
Number of Claims	*409*	*421*	*830*	*2620*	*7472*	*10092*	*10922*
Population	*54626*	*82376*	*137002*	*54626*	*82376*	*137002*	*137002*
Incident rate	*0.75*	*0.51*	*0.61*	*4.80*	*9.07*	*7.37*	*7.97*
Claims with no lost time %	8	11	9	9	11	11	11
Claims with some lost time %	92	89	91	91	89	89	89
Short-term disability <1 year %	75	72	74	91	89	89	88
Long-term disability >1 year %	51	43	47	2.3	2.2	2.2	5.6
Disability beyond 8/1/2000 %	31.5	23.5	27.5	1.9	1.6	1.7	3.6
Permanent disability %	3.18	2.61	2.89	0.53	0.37	0.42	0.60
Total %	100	100	100	100	100	100	100

Table 12. Lost Time from Short-term (<=1 Year) and Long-term (>1 Year) Disabilities for 1996 Claims

	Occupational Disease			Injury			Grand
	Women	Men	Total	Women	Men	Total	Total
Number of claims	*409*	*421*	*830*	*2620*	*7472*	*10092*	*10922*
Population, person years	*54626*	*82376*	*137002*	*54626*	*82376*	*137002*	*137002*
Years lost							
Short-term disability	35	25	61	176	491	667	727
Long-term disab. >1y up to 8/1/2000	103	81	184	29	86	114	298
Permanent disability	102	75	177	71	157	229	406
Total	240	181	422	276	734	1010	1431
Years lost/Person years, %							
Short-term disability	0.06	0.03	0.04	0.32	0.60	0.49	0.53
Long-term disab. >1y up to 8/1/2000	0.19	0.10	0.13	0.05	0.10	0.08	0.22
Permanent disability	0.19	0.09	0.13	0.13	0.19	0.17	0.30
Total	0.44	0.22	0.31	0.51	0.89	0.74	1.04
Days Lost/Case	*214*	*157*	*185*	*38*	*36*	*37*	*48*

Table 13. Percentage of Claims by Type of Injury/Illness and Age

PERCENTAGE OF CASES [-] indicates no cases in class	**Age**							
Type of Injury/Illness	**10-19**	**20-29**	**30-39**	**40-49**	**50-59**	**60-69**	**70-80**	**Total**
Bone fracture	8	12	12	13	14	21	27	14
Sprain, strain	20	31	37	36	34	27	18	34
Internal injury, illness, concussion	0	5	4	4	3	3	7	4
Amputation	4	1	0	0	0	1	2	0
Cut	24	15	14	12	13	14	16	13
Rubbing, material in eye, splinter, skin injury	6	4	3	4	3	2	-	3
Bruise, crush	27	22	22	25	28	28	27	25
Burn	4	3	2	1	1	2	-	2
Skin disease	-	3	2	2	2	1	-	2
Acute poisoning	-	-	0	0	0	-	-	0
Electrocution	-	-	-	-	0	0	-	0
Hearing loss	-	-	0	0	0	0	-	0
Other injury	6	5	4	3	3	2	2	3
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Number of Cases	**49**	**747**	**2631**	**3503**	**3014**	**934**	**44**	**10922**

Table 14. Mean Short-term (<=1 year) Disability Days by Type of Injury/Illness and Age

MEAN DISABILITY DAYS [-] indicates no cases in class	**Age**							
Type of Injury/Illness	**10-19**	**20-29**	**30-39**	**40-49**	**50-59**	**60-69**	**70-80**	**Total**
Bone fracture	33	40	39	44	60	61	105	50
Sprain, strain	7	13	20	24	27	34	31	24
Internal injury, illness, concussion		23	23	32	48	50	3	34
Amputation	21	72	38	51	88	83	365	70
Cut	7	16	14	13	16	19	14	15
Rubbing, material in eye, splinter, skin injury	1	1	2	4	3	7	-	3
Bruise, crush	6	12	14	18	20	24	23	18
Burn	4	11	21	17	26	13	-	19
Skin disease	-	8	16	15	28	27	-	18
Acute poisoning	-	-	0	0	3	-	-	2
Electrocution	-	-	-	-	125	3	-	64
Hearing loss	-	-	0	0	0	0	-	0
Other injury	4	9	16	26	27	18	153	22
Total	**9**	**17**	**19**	**23**	**28**	**34**	**55**	**24**
Number of Cases	**49**	**747**	**2631**	**3503**	**3014**	**934**	**44**	**10922**

Table 15. Work Activities Associated with Long Disabilities; Claim Count, Lost Time, and Rank by Total and Mean Lost Time

		N of Claims			Lost days		Rank by	
Code	**Work Activity** (Significance p<0.05, 1=univariable ANOVA, 2=univariable Dunnett, 3=multivariable ANOVA, 4=multivariable Dunnett, 5=multivariable logistic 30 days)	OD	Inj	All	Sum	Avg	Sum	Avg
245	Animal husbandry, Horse work, Racing, riding, training (1,2,3,4,5)		41	41	16531	403	4	1
133	Crop production, Forage harvesting, Transporting forage to storage (1)	1	17	18	3113	173	13	2
162	Crop production, Grain harvesting, Transporting grain to storage (3)	1	37	38	5690	150	10	3
243	Animal husbandry, Horse work, Transporting and moving animals (3)		72	72	10670	148	7	4
217	Animal husbandry, Dairy and beef work, Cleaning, brushing animals (1,2,3,4)	71	29	100	13444	134	5	5
213	Animal husbandry, Dairy and beef work, Feeding dairy and beef animals (1,2,4)	159	284	443	50977	115	2	6
160	Crop production, Grain harvesting, Handling, preserving, transporting feed grain; Crop production, Forage harvesting, Other forage harvesting work; Grain harvesting, Other grain harvesting work (1)	3	20	23	2308	100	14	7
412	Construction work, Farm building construction, Farm building renovation and adding on (3)	5	100	105	10360	99	8	8
173	Crop production, Potato, root crop work, Potato harvesting and transport to storage (3,5)	5	44	49	4718	96	11	9
316	Forestry work, Timber felling, preparation, Cutting trees for firewood (1)	4	37	41	3653	89	12	10
223	Animal husbandry, Dairy and beef work, Milking and handling milk (3)	95	650	745	54867	74	1	11
820	Commuting (1,2,3)	11	404	415	27844	67	3	12
164	Crop production, Grain harvesting, Handling, drying, cash crops in storage (1)	13	174	187	12107	65	6	13
300	Forestry work, Timber felling, preparation, Preparation of felling trees; Felling trees (5)	20	139	159	9043	57	9	14
	Total	830	10092	10922	522314	48		

Table 16. Causes Associated with Long Disabilities; Claim Count, Lost Time and Rank by Total and Mean Lost Time

		N of Claims			Lost days		Rank by	
Code	**Cause** (Significance p<0.05, 1=univariable ANOVA, 2=uivariable Dunnett, 3=multivariable ANOVA, 4=multivariable Dunnett 5=multivariable logistic 30 days, 6=multivariable logistic 90 days)	OD	Inj	All	Sum	Avg	Sum	Avg
154	PTO shafts (1,3,6)		11	11	5238	476	10	1
600	Biological cause (1,2,3,4,5,6)	196	1	197	74250	377	1	2
311	Roofs (3,6)		47	47	9178	195	8	3
332	Dirt particles, projectiles, dusts (3,5)	164	165	329	44388	135	2	4
223	Horses (5,6)		130	130	16347	126	3	5
301	Stairs (1,3,4,5,6)		136	136	12352	91	5	6
110	Tractor, moving off course, overturn; Tractor, normal movement (6)		32	32	2717	85	12	7
319	Other structures (3,5)		90	90	7490	83	9	8
142	Rakes, windrowers, balers, forage harvesters (3,6)		29	29	2197	76	13	9
156	Circular saws, sawmills, splitters, chippers (1,2,3,4,5,6)	1	173	174	12061	69	6	10
333	Plants, trees, falling trees, stumps (3,5,6)		149	149	10177	68	7	11
312	Scaffoldings, unattached ladders (1,4)		214	214	12641	59	4	12
307	Manure grooves (3)		104	104	5144	49	11	13
	Total	830	10092	10922	522314	48		

Table 17. Natures of Incident Categories Associated with Long Disabilities; Claim Count, Lost Time, and Rank by Total and Mean Lost Time

		N of Claims			Lost days		Rank by	
Code	**Nature of Incident** (Significance p<0.05, 1=univariable ANOVA, 2=univariable Dunnett 3=multivariable ANOVA, 4=multivariable Dunnett, 5=multivariable logistic 30 days, 6=multivariable logistic 90 days, 7=multivariable logistic 365 days, 8=multivariable logistic ICD 30 days)	OD	Inj	All	Sum	Avg	Sum	Avg
92	Occupational diseases (1,2,3,4,5)	821	2	823	151952	185	1	1
21	Falling from elevation when lifting or moving a carrying a load (1,2,3,4,5,6,7,8)		143	143	24875	174	2	2
23	Falling from elevation when the platform, structure falls or fails (1,2,3,4,5,6,7,8)		229	229	22528	98	3	3
22	Falling from elevation without a load (1,3,4,6,7,8)		322	322	22425	70	4	4
24	Jumping or coming down from elevation (1,6,8)		146	146	9156	63	5	5
32	Falling, sliding, tumbling machines or equipment (6,8)		170	170	8857	52	6	6
	Total	830	10092	10922	522314	48		

Table 18. ICD10 Codes Associated with Long Disabilities. Claim Count, Lost Time, and Rank by Total and Mean Lost Time

		N of Claims			Lost days		Rank by	
Code	**ICD10 Code** (Significance p<0.05, 1=univariable ANOVA, 2=univariable Dunnett, 5=multivariable logistic ICD 30 days, 6=multivariable logistic ICD 90 days, 7=multivariable logistic ICD 365 days)	**OD**	**Inj**	**All**	**Sum**	**Avg**	**Sum**	**Avg**
J3x	Rhinitis J30-J303 (1,2,5,6)	135	1	136	20383	150	8	4
J4	Asthma J45-J459 (1,2,5,6,7)	146		146	89648	614	1	1
J6x	Hypersensitivity pneumoitis J668-J92 (1,2,5,6,7)	53	1	54	21730	402	6	2
L23	Allergic contact dermatitis L23-L238 (1,2,5,6,7)	97		97	10770	111	9	6
M7	Soft tissue disorder related to use, overuse, and pressure M70-M796 (1,2,5,6)	120	63	183	8980	49	11	13
S1	Throat, neck, cervical spine injury S100-S18 (5)		87	87	8418.6	97	12	7
S4	Shoulder and upper arm injury (1,2,5,6,7)		724	724	55322	76	2	8
S5	Forearm and elbow injury S50-S59 (1,2,5,6,7)		278	278	20834	75	7	9
S62	Wrist and hand injury S62-S628(1,2,5,6)		408	408	29780	73	4	11
S66x	Wrist and hand injury S64-S669 (1,2,5,6)	2	141	143	10559	74	10	10
S82	Fracture of lower leg including ankle S82-S829 (1,2,5,6,7)		109	109	24089	221	5	3
S83	Dislocation, sprain, and strain of joints and ligaments of knee S82-S829 (1,2,5,6,7)		603	603	39859	66	3	12
S99x	Ankle and foot injury S961-S999 (5,7)		11	11	1475.4	134	13	5
	Total	830	10092	10922	522314	48		

Table 19. Injury/Illness Types Associated with Long Disabilities. Claim Count, Lost Time, and Rank by Total and Mean Lost Time

		N of Claims			Lost days		Rank by	
Code	**Type of Injury/Illness** (Significance p<0.05, 1=univariable ANOVA, 2=univariable Dunnett 3=multivariable ANOVA, 4=multivariable Dunnett, 5=multivariable logistic 30 days. 6=multivariable logistic 90 days, 7=multivariable logistic 365 days)	OD	Inj	All	Sum	Avg	Sum	Avg
3	Internal injury, illness, concussion 1,2,3,4	291	107	398	114653	288	3	1
4	Amputation 1,2,3,4,5,6,7		39	39	7130	183	8	2
15	Acute poisoning; Electrocution; Hearing loss; Other injury 1,2	254	124	378	48993	130	5	3
1	Bone fracture 1,2,3,4,5,6,7		1499	1499	117044	78	2	4
9	Skin disease 1,2,3,4	193	2	195	13610	70	7	5
99	Sprain, strain	90	3642	3732	121353	33	1	6
7	Bruise, crush		2714	2714	69062	25	4	7
8	Burn		179	179	3774	21	9	8
5	Cut	1	1442	1443	25126	17	6	9
6	Rubbing, material in eye, splinter, minor skin injury	1	344	345	1570	5	10	10
	Total	830	10092	10922	522314	48		

Table 20. Interrupted Time Series Variables

Variable	Data Type	Date	Effect	Description
Outcomes Variables				
Injury frequency	Continuous			Monthly number of injuries
Injury rate	Continuous			Monthly rate of injuries, Injuries/1000 persons
Explanatory Variables				
Short-term illness 1	Indicator	1-Jul-91	Abrupt, permanent	A new short-term illness compensation policy was introduced. Applications increased and some (especially back) short term-illness claims were compensated as injuries. Permanent effect.
Short-term illness 2	Indicator	1-Jul-91 to 1-Jan-94	Abrupt, temporary	A new short-term illness compensation policy was introduced. Applications increased and some short term-illness claims (especially back) were compensated as injuries. Temporary effect.
Minimum farm size	Indicator	1-Jan-94	Abrupt, permanent	Minimum farm size was changed from 2 hectares to 5 hectares. The number of insured small farms was reduced.
European Union	Indicator	1-Jan-95	Abrupt, permanent	Finland joined the European Union. Producer prices reduced, new subsidies and regulations were introduced.
No-Claims Bonus	Indicator	1-Jul-97	Abrupt, permanent	No-Claims Bonus was implemented. Each claim-free year reduces premiums by 10%.
Occupational Health Bonus	Indicator	1-Jan-00	Abrupt, permanent	Members of the Occupational Health Service received a 20% bonus from their MATA premiums. 34% of the farmers were members.
Month	Continuous			Consecutive month after January 1990, total 123 months
Population	Continuous			Estimated monthly population.
Farm income	Continuous			National annual farm income. Annual figure was used for each month of the year.
Producer Price Index	Continuous			Agricultural producer price index. Annual figure was used for each month of the year

Table 21. Injury Rates in 1996 and 1998 Excluding Back Injuries

	Women		Men		Total	
	1996	1998	1996	1998	1996	1998
Population	54,626	47,613	82,376	74,701	137,002	122,314
Injuries	2,438	1,963	6,834	5,546	9,272	7,509
Injury Rate (injuries/100 persons)	4.5	4.1	8.3	7.4	6.8	6.1
Injury Rate Reduction %		7.6		10.5		9.3
Chi-square p-value for difference		0.0007		<0.0001		<0.0001

Table 22. Interrupted Time Series Analysis Results

Model I. Outcome Variable: Monthly Number of Injuries		
R-square = 0.84		
Model Parameter	Estimate	Prob>|T|
Seasonal Moving Average, Lag 12	0.85	<0.0001
Autoregressive, Lag 1	0.36	<0.0001
No Claims Bonus	-106.1	0.0006
National Farm Income	80.2	<0.0001
Change in Minimum Farm Size	-196.2	<0.0001
New Short-term Illness Policy	177.6	<0.0001
Model 2. Outcome Variable: Monthly Rate of Injuries		
R-square = 0.68		
Model Parameter	Estimate	Prob>|T|
Moving Average, Lag 1	-0.296	0.0008
Seasonal Moving Average, Lag 12	0.865	<0.0001
Seasonal Autoregressive, Lag 12	-0.109	0.38
No Claims Bonus	-0.51	0.001
New Short Term Illness Policy	0.828	0.0001
Change in Minimum Farm Size	-0.29	0.01
National Farm Income	0.15	0.03

Table 23. Mean Annual Farm Income, MATA Premium, and Bonus Value in 1996 and 1998 (EUR)

	Women		Men		Women and Men	
	1996	1998	1996	1998	1996	1998
Mean Farm Income	8,386	8,894	10,272	10,885	9,525	10,114
Mean MATA Premium	108	113	126	132	119	125
Mean Bonus Value	54	56	63	66	59	62

Table 24. Number of Injuries and Mean Injury Cost (EUR) by Length of Disability

	1996		1998	
Length of Disability (Days)	Number of Injuries	Mean Cost EUR	Number of Injuries	Mean Cost EUR
0	1,059	259	831	245
1-7	1,903	244	1,426	258
8-14	2,293	429	1,776	454
15-30	2,056	832	1,666	885
31-60	1,165	1,654	1,018	1,802
61-120	503	3,644	464	3,495
121-240	175	6,628	193	7,077
241-360	46	13,967	63	12,123
>360	59	27,894	66	24,519
Fatality	13		6	
Total	9,272	1,190	7,509	1,339

APPENDIX

INJURY AND OCCUPATIONAL DISEASE CLAIMS;

COUNT, LOST DAYS, AND COSTS

Table 25. Work Activity Codes, Claim Count, Lost Days, and Costs

		Claim	Lost Days		Cost EUR	
Code	Work Activity	Count	Sum	Avg	Sum	Avg
111	Crop production, Tillage, seeding, crop protection, Plowing, tillage, harrowing	78	2196	28	79462	1019
112	Crop production, Tillage, seeding, crop protection, Lime, fertilizer, manure transportation and application	71	1426	20	53761	757
113	Crop production, Tillage, seeding, crop protection, Seeding, planting	53	2911	55	123112	2323
114	Crop production, Tillage, seeding, crop protection, Pesticide, herbicide, fungicide handling and application	24	785	33	37537	1564
115	Crop production, Tillage, seeding, crop protection, Connecting and disconnecting implements	54	2383	44	96656	1790
128	Crop production, Tillage, seeding, crop protection, Commuting related to cereal crop production	18	442	25	15587	866
129	Crop production, Tillage, seeding, crop protection, Other cereal crop production work	23	713	31	29999	1304
131	Crop production, Forage harvesting, Mowing, forage harvesting, acid application in the field	47	963	20	43853	933
132	Crop production, Forage harvesting, Connecting and disconnecting implements	48	848	18	30760	641
133	Crop production, Forage harvesting, Transporting forage to storage	18	1397	78	43560	2420
134	Crop production, Forage harvesting, Work at forage storage	54	2323	43	85527	1584

Table 25 –continued

138	Crop production, Forage harvesting, Commuting related to forage harvesting	14	167	12	5339	381
139	Crop production, Forage harvesting, Other forage harvesting work	13	284	22	11366	874
141	Crop production, Hay harvesting, Mowing and mower-conditioning hay	26	642	25	24307	935
142	Crop production, Hay harvesting, Raking, windrowing hay	5	43	9	1252	250
143	Crop production, Hay harvesting, Handling hay poles	6	196	33	4815	802
144	Crop production, Hay harvesting, Putting hay on poles	10	152	15	8072	807
145	Crop production, Hay harvesting, Baling hay	26	581	22	20799	800
146	Crop production, Hay harvesting, Transporting hay from field to storage	119	5127	43	201591	1694
147	Crop production, Hay harvesting, Work at hay storage, transportation to barn	56	1735	31	64577	1153
151	Crop production, Hay harvesting, Connecting and disconnecting implements	23	897	39	37561	1633
158	Crop production, Hay harvesting, Commuting related to harvesting hay	12	319	27	12511	1043
159	Crop production, Hay harvesting, Other hay harvesting work	16	466	29	14468	904
161	Crop production, Grain harvesting, Combining, threshing, adjusting, cleaning and maintenance in the field	70	2153	31	85302	1219
162	Crop production, Grain harvesting, Transporting grain to storage	38	786	21	30657	807
163	Crop production, Grain harvesting, Harvesting and transporting straw to storage	25	583	23	24098	964
164	Crop production, Grain harvesting, Handling, drying, cash crops in storage	187	10388	56	421085	2252
165	Crop production, Grain harvesting, Handling, preserving, transporting feed grain	5	1748	350	55421	11 084
166	Crop production, Grain harvesting, Connecting and disconnecting implements	31	1320	43	51190	1651
168	Crop production, Grain harvesting, Commuting related to grain harvesting	23	774	34	25935	1128
169	Crop production, Grain harvesting, Other grain harvesting work	18	560	31	28974	1610
171	Crop production, Potato, root crop work, Potato field preparation, seed preparation, planting	25	940	38	23697	948

Table 25 --continued

172	Crop production, Potato, root crop work, Potato crop protection	8	142	18	6283	785
173	Crop production, Potato, root crop work, Potato harvesting and transport to storage	49	2576	53	114339	2333
174	Crop production, Potato, root crop work, Potato handling at storage	91	2515	28	104975	1154
175	Crop production, Potato, root crop work, Greenhouse work, nursery work, garden work	17	236	14	8062	474
176	Crop production, Potato, root crop work, Connecting and disconnecting implements	10	229	23	9180	918
178	Crop production, Potato, root crop work, Commuting related to potato, greenhouse, nursery, garden work	11	525	48	12053	1096
179	Crop production, Potato, root crop work, Other work related to potato, greenhouse, nursery, garden work	15	187	12	7909	527
181	Crop production, Field improvement, Field improvement, drainage tile, ditch work removing stumps etc.	102	2488	24	112240	1100
182	Crop production, Field improvement, Connecting and disconnecting implements	13	234	18	10124	779
188	Crop production, Field improvement, Commuting related to field improvement	2	158	79	4880	2440
189	Crop production, Field improvement, Other work related to field improvement	13	292	22	12869	990
199	Crop production, Field improvement, Other crop production work	209	4792	23	201125	962
211	Animal husbandry, Dairy and beef work, Preparation, mixing, milling dairy feed	73	2529	35	101167	1386
212	Animal husbandry, Dairy and beef work, Moving feed from storage to animals	699	18290	26	690705	988
213	Animal husbandry, Dairy and beef work, Feeding dairy and beef animals	443	30716	69	1334901	3013
214	Animal husbandry, Dairy and beef work, Watering dairy and beef animals	122	3710	30	125122	1026
215	Animal husbandry, Dairy and beef work, Removing manure, bedding	319	10781	34	416982	1307
216	Animal husbandry, Dairy and beef work, Cleaning housekeeping in the barn	149	3913	26	163498	1097
217	Animal husbandry, Dairy and beef work, Cleaning, brushing animals	100	11779	118	470643	4706
221	Animal husbandry, Dairy and beef work, Heating water (with wood) in the barn	42	697	17	22649	539

Table 25 --continued

222	Animal husbandry, Dairy and beef work, Preparation and cleanup of milking equipment	198	4318	22	165948	838
223	Animal husbandry, Dairy and beef work, Milking and handling milk	745	34116	46	1265648	1699
224	Animal husbandry, Dairy and beef work, Transporting and moving animals	874	21813	25	868400	994
225	Animal husbandry, Dairy and beef work, Artificial insemination, breeding, delivering, care of sick animals	278	9077	33	376696	1355
228	Animal husbandry, Dairy and beef work, Commuting related to dairy work	174	9765	56	348888	2005
229	Animal husbandry, Dairy and beef work, Other dairy work	215	11181	52	421177	1959
231	Animal husbandry, Swine work, Preparation of swine feed, feeding	96	5226	54	228614	2381
232	Animal husbandry, Swine work, Removal of swine manure, bedding, cleanup, heat lamp maintenance	114	3028	27	136295	1196
233	Animal husbandry, Swine work, Transporting and moving animals	118	2919	25	140308	1189
234	Animal husbandry, Swine work, Artificial insemination, breeding, delivering, care of sick animals, slaughtering	66	1327	20	68925	1044
238	Animal husbandry, Swine work, Commuting related to swine work	25	773	31	30547	1222
239	Animal husbandry, Swine work, Other swine work	22	413	19	20068	912
241	Animal husbandry, Horse work, Feeding horses	13	1064	82	41465	3190
242	Animal husbandry, Horse work, Removal of horse manure, bedding, cleanup	6	96	16	3084	514
243	Animal husbandry, Horse work, Transporting and moving animals	72	3707	51	176351	2449
244	Animal husbandry, Horse work, Brushing, cleaning, shoeing, medication, breeding	22	448	20	18473	840
245	Animal husbandry, Horse work, Racing, riding, training	41	3839	94	187491	4573
248	Animal husbandry, Horse work, Commuting related to horse work	3	48	16	1681	560
249	Animal husbandry, Horse work, Other horse work	13	306	24	10166	782
251	Animal husbandry, Poultry work, Feeding poultry	27	586	22	29425	1090

Table 25 --continued

252	Animal husbandry, Poultry work, Removal of poultry manure, cleaning	16	238	15	16882	1055
253	Animal husbandry, Poultry work, Transporting and moving animals, gathering and cleaning eggs, slaughtering	13	153	12	6860	528
258	Animal husbandry, Poultry work, Commuting related to poultry work	14	317	23	19365	1383
259	Animal husbandry, Poultry work, Other poultry work	13	855	66	26204	2016
261	Animal husbandry, Sheep work, Feeding, removing manure, bedding	26	679	26	19902	765
263	Animal husbandry, Sheep work, Transporting and moving animals, clipping, slaughtering	28	1113	40	43728	1562
268	Animal husbandry, Sheep work, Commuting related to sheep work	2	263	131	14096	7048
269	Animal husbandry, Sheep work, Other sheep work	11	123	11	5516	501
273	Animal husbandry, Fur animal work, Transporting and moving fur animals, slaughtering, skinning	1	96	96	2853	2853
299	Animal husbandry, Fur animal work, Other fur animal work	11	487	44	14137	1285
307	Forestry work, Timber felling, preparation, Preparation of felling trees	14	588	42	23882	1706
310	Forestry work, Timber felling, preparation, Felling trees	145	6211	43	206409	1424
311	Forestry work, Timber felling, preparation, Removing snag trees	19	1334	70	50065	2635
312	Forestry work, Timber felling, preparation, Cutting limbs	75	1874	25	66570	888
313	Forestry work, Timber felling, preparation, Cutting trunk	24	407	17	15699	654
314	Forestry work, Timber felling, preparation, Splitting	11	81	7	3411	310
315	Forestry work, Timber felling, preparation, Piling, lifting, carrying	145	3029	21	117402	810
316	Forestry work, Timber felling, preparation, Cutting trees for firewood	41	2175	53	47029	1147
317	Forestry work, Timber felling, preparation, Moving on woodlot	3	19	6	1593	531
329	Forestry work, Timber felling, preparation, Other felling and cutting work	12	289	24	15539	1295
331	Forestry work, Timber transportation, Loading, winching, dragging logs	35	862	25	42697	1220

Table 25 --continued

332	Forestry work, Timber transportation, Transporting, unloading, storing logs	39	680	17	29266	750
333	Forestry work, Timber transportation, Transporting firewood	12	430	36	9458	788
339	Forestry work, Timber transportation, Other timber transportation	1	7	7	272	272
340	Forestry work, Making woodchips, Making woodchips	101	2016	20	88774	879
351	Forestry work, Forest maintenance, Burning, planting trees, sowing tree seeds	11	469	43	12370	1125
352	Forestry work, Forest maintenance, Maintenance of planted lot	95	2201	23	107070	1127
353	Forestry work, Forest maintenance, Fertilizer and pesticide application	2	66	33	6495	3247
359	Forestry work, Forest maintenance, Other forest maintenance work	14	265	19	8940	639
361	Forestry work, Forest improvement, Making ditches	3	268	89	9591	3197
362	Forestry work, Forest improvement, Making forest roads	5	371	74	7051	1410
369	Forestry work, Forest improvement, Other forest improvement work	8	125	16	6333	792
370	Forestry work, Forestry equipment maintenance, Maintenance of forestry equipment	10	342	34	16569	1657
388	Forestry work, Commuting, forestry, Commuting related to forestry work	41	1345	33	54458	1328
399	Forestry work, Other Forest work, Other forest work	13	491	38	17373	1336
401	Construction work, Dwelling construction, New dwelling construction work	17	468	28	12101	712
402	Construction work, Dwelling construction, Dwelling renovation and adding on	6	302	50	7973	1329
403	Construction work, Dwelling construction, Dwelling maintenance	6	187	31	6496	1083
404	Construction work, Dwelling construction, Dwelling demolition	1	7	7	244	244
411	Construction work, Farm building construction, Construction of new farm buildings	219	6056	28	267116	1220
412	Construction work, Farm building construction, Farm building renovation and adding on	105	5724	55	223041	2124

Table 25 --continued

413	Construction work, Farm building construction, Farm building maintenance	262	7686	29	271464	1036
414	Construction work, Farm building construction, Demolition of farm buildings	50	806	16	35590	712
415	Construction work, Farm building construction, Making structures, fences, corrals	78	3128	40	104136	1335
418	Construction work, Commuting, construction, Commuting related to construction work	5	120	24	4333	867
419	Construction work, Other construction work	18	214	12	6193	344
511	Other farm work, Repair and maintenance of machines and equipment	1100	22063	20	932206	847
512	Other farm work, Farmstead and road maintenance, snow removal, mowing	104	3130	30	124869	1201
513	Other farm work, Heating	19	1293	68	39752	2092
514	Other farm work, Preparation of firewood, peat, woodchips	312	10189	33	373495	1197
515	Other farm work, Farm related household work	12	362	30	15795	1316
516	Other farm work, Dressing, undressing into work clothes, bathing related to farm work	15	2575	172	97651	6510
517	Other farm work, Management work, field inspection, serving on committees, training	18	602	33	21195	1177
521	Other farm work, Farm business trips	28	1290	46	53991	1928
522	Other farm work, Transporting supplies and commodities to and from farm	116	4091	35	159796	1378
523	Other farm work, Cleaning storages	58	928	16	33578	579
524	Other farm work, Farm related food preparation	61	575	9	20015	328
525	Other farm work, Farm related food acquisition, shopping	7	1765	252	49495	7071
526	Other farm work, Farm related food acquisition from own farm and garden	10	534	53	15903	1590
527	Other farm work, Farm related food storage	9	177	20	5522	614
528	Other farm work, Commuting related to other farm work	55	2265	41	68998	1255
599	Other farm work, Other farm related work, including fires, natural disasters	188	4819	26	202319	1076
611	Reindeer herding, Marking of reindeer calves	4	60	15	1627	407
612	Reindeer herding, Herding of reindeer	10	174	17	6671	667
613	Reindeer herding, Gathering reindeer, separation	29	766	26	27060	933
614	Reindeer herding, Feeding in common pastures	9	299	33	10006	1112

Table 25 --continued

615	Reindeer herding, Feeding in fenced pastures	7	109	16	4777	682
616	Reindeer herding, Slaughtering	12	169	14	4286	357
617	Reindeer herding, Fence work	8	198	25	6998	875
621	Reindeer herding, Maintenance of reindeer herding equipment and machinery	3	28	9	1197	399
628	Reindeer herding, Commuting related o reindeer herding	9	758	84	19976	2220
629	Reindeer herding, Other reindeer herding work	4	508	127	18106	4527
711	Fishing, Fishing, trolling	10	383	38	14159	1416
712	Fishing, Other fishing work	33	1227	37	35679	1081
713	Fishing, Fish handling, transportation, storage on shore	13	296	23	10105	777
714	Fishing, Maintenance of fishing machinery and equipment	15	200	13	8734	582
718	Fishing, Commuting related to fishing	7	139	20	3746	535
719	Fishing, Other fishing work	11	195	18	8039	731
Total		**10922**	**374218**	**34**	**14730479**	**1349**

Note: The costs in the Appendix include medical, lost time per diem, pension, survivors' pension, and rehabilitation costs. Permanent pension, impairment allowance, and insurance administration costs are excluded.

Table 26. Cause Codes, Claim Count, Lost Days, and Costs

		Claim	Lost Days		Cost EUR	
Code	Cause	Count	Sum	Avg	Sum	Avg
111	Tractor (stationary)	183	4880	27	203456	1112
112	Tractor steps	128	4290	34	178904	1398
113	Tractor controls	50	1200	24	51442	1029
114	Tractor, other part of tractor	180	6763	38	229177	1273
115	Tractor, moving off course, overturn	24	1135	47	36667	1528
116	Tractor, normal movement	8	78	10	2699	337
117	Trucks, cars, vans	73	2988	41	107604	1474
118	Motorcycles, mopes, bikes	19	671	35	21717	1143
121	Snowmobiles, sleds	21	872	42	28852	1374
122	Trailers, wagons	214	7622	36	309900	1448
123	Fishing vessels, boats	9	648	72	18728	2081
124	Horse, reindeer carriages, sleds	2	19	10	625	313
129	Other transportation vehicles	11	272	25	12123	1102
131	Plows, harrows, cultivators, rollers	56	1800	32	65914	1177
132	Manure wagons, spreaders, fertilizer spreaders, seeding and planting drills	40	1809	45	67867	1697
133	Pesticide spreaders, pumps, application equipment	7	174	25	7614	1088
139	Other tillage and planting equipment	3	73	24	3725	1242
141	Mowers, forage mowers	69	1341	19	53457	775
142	Rakes, windrowers, balers, forage harvesters	29	2197	76	94690	3265
143	Hay and forage elevators, blowers, handling machines	19	642	34	23349	1229
144	Combines, harvesters	88	2575	29	103520	1176
145	Grain augers, blowers, elevators, handling equipment	74	2398	32	88385	1194
146	Mills, mixers, root crop cutters	46	1225	27	48503	1054
147	Potato and root crop harvesters, handling equipment	34	1462	43	79099	2326
149	Other harvest and handling equipment	13	302	23	9415	724
151	Milking machines, washers, milk tanks, milk containers	20	403	20	15370	769
152	Feeding equipment, manure removal equipment, manure pumps	75	2424	32	96227	1283
153	Front- and back-end loaders, back hoes, loaders, compressors, tractor driven pumps	49	1659	34	70372	1436
154	PTO shafts	11	2309	210	95894	8718
155	Welding equipment, combustion engines, batteries, power sources	30	591	20	40989	1366
156	Circular saws, sawmills, splitters, chippers	174	9974	57	309803	1780
157	Hand drills, grinders, sanders	124	1842	15	61770	498

Table 26 --continued

158	Chainsaws	90	1587	18	57632	640
161	Clearing saws	5	124	25	4025	805
162	Timber loading, towing, winching machines	23	647	28	36262	1577
163	Blades, trenchers, peat machines, snow blades, snow blowers	18	1208	67	48919	2718
164	Mowers, garden tractors, garden tillers	9	245	27	9301	1033
165	Wheel barrows, feed carts, milk carts	27	525	19	25964	962
166	Water equipment, power washers	14	186	13	9589	685
167	Heaters	4	65	16	1716	429
169	Other equipment	87	2556	29	145699	1675
171	Electrical lines, cords, motors, equipment	2	211	106	14793	7396
179	Other electrical equipment, light bulbs	3	41	14	830	277
180	Knives, chisels	145	2077	14	73016	504
181	Axes,	105	2204	21	83058	791
182	Saws	23	219	10	6661	290
184	Pitch forks, spades, hoes, rakes, scythes	139	2003	14	76593	551
185	Grabbing, lifting, timber felling equipment	22	412	19	16698	759
186	Planes, hammers, files, screwdrivers	87	1026	12	52278	601
189	Other hand tools	34	456	13	26465	778
191	Fertilizer and grain sacks	14	275	20	12589	899
192	Pesticide and preservative containers	12	146	12	6494	541
193	Building materials, lumber, boards, nails, loose materials	134	3105	23	128029	955
199	Other raw materials	46	918	20	33437	727
211	Family members	4	72	18	1643	411
219	Other persons	4	53	13	1143	286
221	Dairy and beef animals	1761	53543	30	2098683	1192
222	Swine	134	3078	23	140891	1051
223	Horses	130	7063	54	309058	2377
224	Reindeer	26	789	30	26024	1001
225	Dogs	5	93	19	4358	872
226	Other domestic animals	36	1200	33	48531	1348
227	Other than domestic animals	30	323	11	15393	513
229	Unidentified animals	4	19	5	1000	250
301	Stairs	136	7342	54	248602	1828
302	Attached ladders	29	1075	37	45085	1555
303	Floors, walkways, steps, doorsills, vessel decks	633	19939	31	773767	1222
304	Ramps, loading docks,	33	777	24	29791	903
305	Feeding tables, stanchions, milking stations	91	1697	19	69576	765
306	Floor openings, feed drop openings	48	3929	82	114038	2376
307	Manure grooves	104	3451	33	119676	1151
308	Doors, windows, stalls, walls, bins	153	3775	25	151522	990

Table 26 --continued

311	Roofs	47	3992	85	132581	2821
312	Scaffoldings, loose ladders	214	9924	46	416277	1945
313	Loose obstacles indoors	62	1343	22	46961	757
319	Other structures	90	4262	47	148243	1647
321	Uneven terrain	505	12126	24	471423	934
322	Slippery terrain	546	19238	35	735566	1347
323	Breaking ice, soft terrain	32	1141	36	48653	1520
324	Dirt masses	4	89	22	7553	1888
325	Wells, drainages, ditches	31	1463	47	59666	1925
326	Loads of grain, hay, straw, logs, wood	105	4029	38	157724	1502
327	Fences, corrals	16	324	20	10720	670
328	Stacks, heaps, boxes, ground forage storages	117	3903	33	136438	1166
329	Obstacles outdoors	26	1299	50	44036	1694
331	Hay sticks, sharp objects, hooks, branches, fire logs, board pieces	245	3750	15	146813	599
332	Dirt particles, projectiles, dusts	329	29862	91	1232654	3747
333	Plants, trees, falling trees, stumps	149	7041	47	254283	1707
334	Rocks, loose stumps, logs, heavy loose objects	201	4640	23	163724	815
335	Fire, lightning, sparks	19	291	15	15655	824
336	Darkness, blinded by bright light	2	20	10	824	412
337	Heat, cold, (of air, water, substance), radiation	71	1265	18	41805	589
338	Wind, waves	4	69	17	2629	657
341	Fishing equipment	1	21	21	709	709
399	Other outside working environment	48	2341	49	88610	1846
401	Fertilizers, lime	4	4	1	308	77
402	Pesticides, herbicides, insecticides, fungicides	3	62	21	2655	885
403	Cleaning agent, solvents, fuels	43	751	17	32136	747
404	Preservatives, acids	55	701	13	27273	496
405	Explosives, gases	1	635	635	13413	13413
409	Other farm chemicals	10	702	70	21612	2161
511	Sudden or unusual movement or posture	926	14033	15	560740	606
512	Repetitive motion or posture	247	5324	22	202688	821
513	Rubbing against clothing, boots, surface, excluding machine or hand tool	6	78	13	2830	472
514	Unusual pressing	14	316	23	13392	957
519	Other working motions and postures	26	343	13	14187	546
600	Biological cause	197	33192	168	1386357	7037
900	Other	239	10548	44	482653	2019
Total		**10922**	**374218**	**34**	**14730479**	**1349**

Table 27. Nature of Incident Codes, Claim Count, Lost Days, and Costs

Code	Nature of Incident	Claim Count	Lost Days Sum	Lost Days Avg	Cost EUR Sum	Cost EUR Avg
11	Falling, slipping, tripping when lifting or carrying a load	1199	35193	29	1365503	1139
12	Falling, slipping, tripping without a load	1434	50732	35	1907273	1330
21	Falling from elevation when iifting or moving a carrying a load	143	12722	89	463023	3238
22	Falling from elevation without a load	322	15532	48	614079	1907
23	Falling from elevation when the platform, structure falls or fails	229	10653	47	425113	1856
24	Jumping or coming down from elevation	146	4251	29	170963	1171
31	Falling, sliding, tumbling objects, structures or masses	467	11458	25	471984	1011
32	Falling, sliding, tumbling machines or equipment	170	7362	43	285732	1681
41	Stepping on objects	137	1719	13	65918	481
51	Struck against machines or equipment due to own motion	635	20974	33	796292	1254
52	Struck against objects or materials due to own motion	613	11265	18	392736	641
53	Struck against tools due to own motion	462	7174	16	275410	596
54	Struck by moving, projecting machines, equipment, objects	824	18439	22	733111	890
55	Caught in, tangled, crushed by machine or equipment	100	6549	65	228223	2282
56	Caught in, tangled, crushed by objects	59	1690	29	56486	957
57	Struck by, run over by motor vehicle	44	1875	43	75404	1714
58	Struck by, run over by other vehicle	3	30	10	1477	492
61	Pushed by another person unintentionally or intentionally	5	23	5	4286	857
71	Kicked or stepped on by an animal	698	16954	24	701796	1005
72	Tossed, run over, thrown by animals	515	16749	33	706887	1373
73	Pushed, bucked, bit, hit by tail of an animal	686	16799	24	655139	955
74	Struck by animal	31	313	10	13450	434
81	Electrocution, explosion	9	355	39	21827	2425
82	Contact with hot or burning materials	76	1506	20	54798	721
83	Contact with cold materials	1	7	7	350	350
91	Specific injuries listed in statute	916	12178	13	505497	552
92	Occupational diseases	823	88388	107	3599982	4374
99	Drowning, other, unknown injuries	175	3328	19	137742	787
Total		**10922**	**374218**	**34**	**14730479**	**1349**

Table 28. ICD10 Codes, Claim Count, Lost Days, and Costs

		Claim	Lost Days		Cost EUR	
Code	ICD10 Health Outcome	Count	Sum	Avg	Sum	Avg
A21	Tularaemia	1	28	28	1452	1452
A260	Cutaneous erysipeloid	1	3	3	141	141
A320	Cutaneous listeriosis	2	39	20	2190	1095
A46	Erysipelas	2	20	10	1344	672
A692	Lyme disease	2	108	54	3788	1894
A98	Other viral haemorrhagic fevers, not elsewhere classified	2	33	17	1456	728
A985	Haemorrhagic fever with renal syndrome	23	564	25	25159	1094
B08	Other viral infections characterized by skin and mucous membrane lesions, not elsewhere classified	1	10	10	284	284
B080	Other orthopoxvirus infections	4	39	10	2159	540
B35	Dermatophytosis	1	0	0	0	0
B350	Tinea barbae and tinea capitis	1	0	0	216	216
B352	Tinea manuum	4	27	7	898	224
D150	Thymus	1	0	0	62	62
G243	Spasmodic torticollis	1	16	16	983	983
G573	Lesion of lateral popliteal nerve	4	55	14	2817	704
H010	Blepharitis	1	4	4	154	154
H108	Other conjunctivitis	3	0	0	1105	368
H160	Corneal ulcer	5	15	3	957	191
H605	Acute otitis externa, noninfective	1	0	0	229	229
H72	Perforation of tympanic membrane	2	0	0	269	134
H720	Central perforation of tympanic membrane	1	0	0	282	282
H83	Other diseases of inner ear	1	77	77	2740	2740
H833	Noise effects on inner ear	16	293	18	12496	781
J159	Bacterial pneumonia, unspecified	1	62	62	2561	2561
J30	Vasomotor and allergic rhinitis	9	759	84	41220	4580
J300	Vasomotor rhinitis	3	314	105	7761	2587
J303	Other allergic rhinitis	123	12172	99	534968	4349
J45	Asthma	9	1645	183	98379	10931
J450	Predominantly allergic asthma	12	3511	293	110444	9204
J4501	Predominantly allergic asthma	71	19738	278	821189	11566
J4502	Predominantly allergic asthma	27	9330	346	363025	13445
J4503	Predominantly allergic asthma	26	10708	412	374465	14402
J459	Asthma, unspecified	1	0	0	10	10
J668	Airway disease due to other specific organic dusts	5	10	2	998	200
J67	Hypersensitivity pneumonitis due to organic dust	43	8769	204	415413	9661
J670	Farmer's lung	4	1167	292	52335	13084

Table 28 --continued

J680	Bronchitis and pneumonitis due to chemicals, gases, fumes and vapours	1	11	11	616	616
J92	Pleural plaque	1	0	0	125	125
L23	Allergic contact dermatitis	4	265	66	8673	2168
L230	Allergic contact dermatitis due to metals	2	259	129	10297	5148
L235	Allergic contact dermatitis due to other chemical products	26	2270	87	78140	3005
L237	Allergic contact dermatitis due to plants, except food	12	1269	106	38959	3247
L238	Allergic contact dermatitis due to other agents	53	6707	127	268655	5069
L240	Irritant contact dermatitis due to detergents	13	205	16	8540	657
L248	Irritant contact dermatitis due to other agents	65	1641	25	71434	1099
L249	Irritant contact dermatitis, unspecified cause	1	6	6	658	658
L25	Unspecified contact dermatitis	4	239	60	14186	3547
L255	Unspecified contact dermatitis due to plants, except food	1	16	16	429	429
L309	Dermatitis, unspecified	1	255	255	15174	15174
L506	Contact urticaria	2	388	194	5517	2758
L56	Other acute skin changes due to ultraviolet radiation	1	3	3	205	205
M160	Primary coxarthrosis, bilateral	1	17	17	588	588
M173	Other post-traumatic gonarthrosis	2	19	10	700	350
M232	Derangement of meniscus due to old tear or injury	1	67	67	3016	3016
M250	Haemarthrosis	1	8	8	325	325
M254	Effusion of joint	1	42	42	1263	1263
M511	Lumbar and other intervertebral disc disorders with radiculopathy	1	15	15	854	854
M54	Dorsalgia	15	220	15	9071	605
M544	Lumbago with sciatica	5	45	9	1686	337
M545	Low back pain	823	10271	12	442022	537
M619	Calcification and ossification of muscle, unspecified	1	39	39	1255	1255
M626	Muscle strain	6	57	10	2559	426
M65	Synovitis and tenosynovitis	5	125	25	3656	731
M658	Other synovitis and tenosynovitis	126	1937	15	73087	580
M659	Synovitis and tenosynovitis, unspecified	1	14	14	511	511
M661	Rupture of synovium	1	143	143	5681	5681
M663	Spontaneous rupture of flexor tendons	2	33	17	1145	572
M70	Soft tissue disorders related to use, overuse and pressure	1	16	16	366	366
M702	Olecranon bursitis	6	87	15	3447	574
M703	Other bursitis of elbow	2	134	67	6907	3454

Table 28 --continued

M704	Prepatellar bursitis	34	728	21	29610	871
M711	Other infective bursitis	2	89	45	3701	1850
M712	Synovial cyst of popliteal space [Baker]	1	49	49	2343	2343
M715	Other bursitis, not elsewhere classified	1	53	53	4013	4013
M719	Bursopathy, unspecified	1	0	0	84	84
M75	Shoulder lesions	1	6	6	291	291
M750	Adhesive capsulitis of shoulder	1	14	14	481	481
M751	Rotator cuff syndrome	6	1326	221	58656	9776
M76	Enthesopathies of lower limb, excluding foot	1	10	10	380	380
M770	Medial epicondylitis	5	286	57	7553	1511
M771	Lateral epicondylitis	116	4110	35	159460	1375
M772	Periarthritis of wrist	3	224	75	7492	2497
M779	Enthesopathy, unspecified	1	18	18	652	652
M796	Pain in limb	1	9	9	267	267
N48	Other disorders of penis	1	356	356	6846	6846
R073	Other chest pain	1	3	3	49	49
R090	Asphyxia	1	0	0	3143	3143
R402	Coma, unspecified	1	42	42	1422	1422
S00	Superficial injury of head	3	0	0	1247	416
S000	Superficial injury of scalp	2	9	5	109	55
S001	Contusion of eyelid and periocular area	21	86	4	6576	313
S002	Other superficial injuries of eyelid and periocular area	5	3	1	954	191
S003	Superficial injury of nose	2	7	4	736	368
S004	Superficial injury of ear	1	7	7	301	301
S005	Superficial injury of lip and oral cavity	6	0	0	699	117
S007	Multiple superficial injuries of head	3	25	8	2698	899
S008	Superficial injury of other parts of head	3	19	6	2041	680
S009	Superficial injury of head, part unspecified	1	0	0	66	66
S01	Open wound of head	56	494	9	27023	483
S010	Open wound of scalp	1	74	74	3068	3068
S010	Open wound of scalp	12	78	7	10672	889
S011	Open wound of eyelid and periocular area	32	108	3	6662	208
S012	Open wound of nose	11	56	5	3436	312
S013	Open wound of ear	2	11	6	447	224
S015	Open wound of lip and oral cavity	11	0	0	3435	312
S0150	Open wound of lip and oral cavity	4	53	13	2523	631
S018	Open wound of other parts of head	7	33	5	1996	285
S019	Open wound of head, part unspecified	5	27	5	1218	244
S02	Fracture of skull and facial bones	13	113	9	10884	837
S021	Fracture of base of skull	2	73	36	4131	2065
S0210	Fracture of base of skull	1	1871	1871	50587	50587

Table 28 --continued

S022	Fracture of nasal bones	15	207	14	7516	501
S0230	Fracture of orbital floor	1	17	17	1716	1716
S024	Fracture of malar and maxillary bones	6	154	26	8127	1355
S025	Fracture of tooth	156	16	0	99942	641
S026	Fracture of mandible	1	22	22	709	709
S0260	Fracture of mandible	1	18	18	813	813
S0261	Fracture of mandible	1	153	153	2137	2137
S028	Fractures of other skull and facial bones	1	21	21	1020	1020
S029	Fracture of skull and facial bones, part unspecified	3	30	10	929	310
S031	Dislocation of septal cartilage of nose	2	15	8	663	332
S05	Injury of eye and orbit	3	51	17	2134	711
S050	Injury of conjunctiva and corneal abrasion without mention of foreign body	26	71	3	4591	177
S051	Contusion of eyeball and orbital tissues	46	662	14	34044	740
S055	Penetrating wound of eyeball with foreign body	84	1002	12	45084	537
S056	Penetrating wound of eyeball without foreign body	14	530	38	19677	1406
S058	Other injuries of eye and orbit	1	0	0	40	40
S06	Intracranial injury	5	89	18	3684	737
S060	Concussion	61	1905	31	110016	1804
S062	Diffuse brain injury	5	3327	665	145511	29102
S065	Traumatic subdural haemorrhage	3	198	66	7751	2584
S070	Crushing injury of face	1	0	0	73	73
S071	Crushing injury of skull	1	0	0	3143	3143
S088	Traumatic amputation of other parts of head	1	0	0	38	38
S09	Other and unspecified injuries of head	1	7	7	162	162
S090	Injury of blood vessels of head, not elsewhere classified	1	0	0	97	97
S097	Multiple injuries of head	1	0	0	3160	3160
S099	Unspecified injury of head	84	476	6	38708	461
S100	Contusion of throat	1	12	12	439	439
S101	Other and unspecified superficial injuries of throat	1	11	11	537	537
S108	Superficial injury of other parts of neck	4	29	7	1281	320
S122	Fracture of other specified cervical vertebra	3	1150	383	47656	15885
S127	Multiple fractures of cervical spine	1	35	35	1319	1319
S13	Dislocation, sprain and strain of joints and ligaments at neck level	3	27	9	1618	539
S134	Sprain and strain of cervical spine	65	1541	24	74950	1153
S136	Sprain and strain of joints and ligaments of other and unspecified parts of neck	1	14	14	426	426
S14	Injury of nerves and spinal cord at neck level	1	14	14	421	421
S140	Concussion and oedema of cervical spinal cord	1	1487	1487	65182	65182

Table 28 --continued

S141	Other and unspecified injuries of cervical spinal cord	1	0	0	3213	3213
S150	Injury of carotid artery	2	23	12	1288	644
S16	Injury of muscle and tendon at neck level	1	8	8	208	208
S17	Crushing injury of neck	1	8	8	365	365
S18	Traumatic amputation at neck level	1	31	31	1336	1336
S20	Superficial injury of thorax	6	114	19	3225	538
S200	Contusion of breast	4	439	110	5070	1268
S201	Other and unspecified superficial injuries of breast	1	17	17	630	630
S202	Contusion of thorax	302	4814	16	179069	593
S219	Open wound of thorax, part unspecified	1	21	21	929	929
S22	Fracture of rib(s), sternum and thoracic spine	297	9384	32	354962	1195
S220	Fracture of thoracic vertebra	3	91	30	4097	1366
S222	Fracture of sternum	1	8	8	209	209
S223	Fracture of rib	29	827	29	26778	923
S224	Multiple fractures of ribs	4	225	56	8441	2110
S23	Dislocation, sprain and strain of joints and ligaments of thorax	65	725	11	25316	389
S230	Traumatic rupture of thoracic intervertebral disc	1	4	4	142	142
S231	Dislocation of thoracic vertebra	1	47	47	2849	2849
S232	Dislocation of other and unspecified parts of thorax	1	4	4	125	125
S233	Sprain and strain of thoracic spine	3	52	17	1908	636
S234	Sprain and strain of ribs and sternum	2	48	24	2186	1093
S242	Injury of nerve root of thoracic spine	1	6	6	215	215
S250	Injury of thoracic aorta	1	17	17	923	923
S272	Traumatic haemopneumothorax	1	25	25	869	869
S290	Injury of muscle and tendon at thorax level	2	37	19	1746	873
S299	Unspecified injury of thorax	1	13	13	366	366
S30	Superficial injury of abdomen, lower back and pelvis	12	164	14	5490	457
S300	Contusion of lower back and pelvis	145	2263	16	94999	655
S301	Contusion of abdominal wall	26	356	14	11939	459
S302	Contusion of external genital organs	4	99	25	2298	574
S308	Other superficial injuries of abdomen, lower back and pelvis	3	69	23	3880	1293
S310	Open wound of lower back and pelvis	3	48	16	1897	632
S311	Open wound of abdominal wall	1	13	13	266	266
S313	Open wound of scrotum and testes	2	18	9	998	499
S315	Open wound of other and unspecified external genital organs	1	46	46	2506	2506
S32	Fracture of lumbar spine and pelvis	3	178	59	10694	3565

Table 28 --continued

S320	Fracture of lumbar vertebra	11	638	58	28253	2568
S321	Fracture of sacrum	3	386	129	16492	5497
S322	Fracture of coccyx	8	227	28	7576	947
S323	Fracture of ilium	1	200	200	12402	12402
S325	Fracture of pubis	2	147	74	4740	2370
S33	Dislocation, sprain and strain of joints and ligaments of lumbar spine and pelvis	31	621	20	26275	848
S333	Dislocation of other and unspecified parts of lumbar spine and pelvis	1	8	8	195	195
S335	Sprain and strain of lumbar spine	9	150	17	7076	786
S336	Sprain and strain of sacroiliac joint	6	75	13	2128	355
S337	Sprain and strain of other and unspecified parts of lumbar spine and pelvis	14	223	16	10700	764
S360	Injury of spleen	1	52	52	379	379
S383	Traumatic amputation of other and unspecified parts of abdomen, lower back and pelvis	1	159	159	5113	5113
S39	Other and unspecified injuries of abdomen, lower back and pelvis	2	7	4	578	289
S390	Injury of muscle and tendon of abdomen, lower back and pelvis	1	8	8	311	311
S398	Other specified injuries of abdomen, lower back and pelvis	3	53	18	1644	548
S399	Unspecified injury of abdomen, lower back and pelvis	11	109	10	3589	326
S40	Superficial injury of shoulder and upper arm	6	95	16	5081	847
S400	Contusion of shoulder and upper arm	194	7230	37	312455	1611
S411	Open wound of upper arm	9	117	13	4311	479
S42	Fracture of shoulder and upper arm	1	67	67	2379	2379
S420	Fracture of clavicle	8	341	43	12329	1541
S421	Fracture of scapula	7	274	39	7841	1120
S422	Fracture of upper end of humerus	16	1770	111	64102	4006
S423	Fracture of shaft of humerus	4	312	78	18575	4644
S424	Fracture of lower end of humerus	1	29	29	759	759
S43	Dislocation, sprain and strain of joints and ligaments of shoulder girdle	270	12548	46	495403	1835
S430	Dislocation of shoulder joint	16	3482	218	92569	5786
S431	Dislocation of acromioclavicular joint	2	286	143	9702	4851
S434	Sprain and strain of shoulder joint	107	8275	77	308829	2886
S435	Sprain and strain of acromioclavicular joint	24	630	26	24190	1008
S437	Sprain and strain of other and unspecified parts of shoulder girdle	4	26	7	1866	467
S441	Injury of median nerve at upper arm level	1	13	13	469	469

Table 28 --continued

S46	Injury of muscle and tendon at shoulder and upper arm level	26	1852	71	104175	4007
S460	Injury of tendon of the rotator cuff of shoulder	6	860	143	33216	5536
S461	Injury of muscle and tendon of long head of biceps	4	176	44	7145	1786
S462	Injury of muscle and tendon of other parts of biceps	3	1083	361	34976	11659
S463	Injury of muscle and tendon of triceps	1	20	20	1589	1589
S467	Injury of multiple muscles and tendons at shoulder and upper arm level	1	39	39	235	235
S468	Injury of other muscles and tendons at shoulder and upper arm level	4	141	35	6825	1706
S469	Injury of unspecified muscle and tendon at shoulder and upper arm level	6	231	39	10198	1700
S47	Crushing injury of shoulder and upper arm	1	10	10	349	349
S49	Other and unspecified injuries of shoulder and upper arm	1	706	706	22008	22008
S499	Unspecified injury of shoulder and upper arm	1	73	73	2925	2925
S50	Superficial injury of forearm	4	43	11	1366	342
S500	Contusion of elbow	82	1773	22	76125	928
S501	Contusion of other and unspecified parts of forearm	58	2316	40	115736	1995
S507	Multiple superficial injuries of forearm	1	0	0	99	99
S51	Open wound of forearm	4	25	6	1267	317
S510	Open wound of elbow	10	127	13	4666	467
S517	Multiple open wounds of forearm	1	47	47	1435	1435
S519	Open wound of forearm, part unspecified	1	0	0	32	32
S52	Fracture of forearm	2	308	154	20137	10069
S520	Fracture of upper end of ulna	13	1751	135	84578	6506
S521	Fracture of upper end of radius	5	345	69	13381	2676
S522	Fracture of shaft of ulna	14	1674	120	65961	4711
S523	Fracture of shaft of radius	7	381	54	17001	2429
S524	Fracture of shafts of both ulna and radius	5	528	106	16016	3203
S525	Fracture of lower end of radius	20	2691	135	82759	4138
S531	Dislocation of elbow, unspecified	6	1251	208	39275	6546
S533	Traumatic rupture of ulnar collateral ligament	1	196	196	6349	6349
S534	Sprain and strain of elbow	35	1257	36	46005	1314
S561	Injury of long flexor muscle and tendon of other finger(s) at forearm level	1	63	63	2890	2890
S578	Crushing injury of other parts of forearm	1	151	151	2559	2559
S59	Other and unspecified injuries of forearm	7	60	9	2946	421
S60	Superficial injury of wrist and hand	10	197	20	5766	577
S600	Contusion of finger(s) without damage to nail	227	3701	16	132865	585

Table 28 --continued

S601	Contusion of finger(s) with damage to nail	28	460	16	14107	504
S602	Contusion of other parts of wrist and hand	189	5009	27	182102	964
S608	Other superficial injuries of wrist and hand	6	50	8	2411	402
S609	Superficial injury of wrist and hand, unspecified	1	8	8	275	275
S61	Open wound of wrist and hand	145	1792	12	66221	457
S610	Open wound of finger(s) without damage to nail	602	9307	15	338907	563
S611	Open wound of finger(s) with damage to nail	41	1297	32	41450	1011
S617	Multiple open wounds of wrist and hand	6	148	25	4649	775
S618	Open wound of other parts of wrist and hand	7	122	17	4679	668
S619	Open wound of wrist and hand part, part unspecified	116	1660	14	59208	510
S62	Fracture at wrist and hand level	9	589	65	18041	2005
S620	Fracture of navicular [scaphoid] bone of hand	3	982	327	53040	17680
S621	Fracture of other carpal bone(s)	5	347	69	13752	2750
S622	Fracture of first metacarpal bone	4	251	63	8002	2001
S623	Fracture of other metacarpal bone	51	3114	61	109606	2149
S624	Multiple fractures of metacarpal bones	1	44	44	1502	1502
S625	Fracture of thumb	45	1999	44	67134	1492
S626	Fracture of other finger	174	8802	51	343491	1974
S627	Multiple fractures of fingers	8	673	84	24802	3100
S628	Fracture of other and unspecified parts of wrist and hand	108	7905	73	278052	2575
S63	Dislocation, sprain and strain of joints and ligaments at wrist and hand level	63	987	16	35506	564
S630	Dislocation of wrist	2	78	39	2484	1242
S631	Dislocation of finger	26	1026	39	37511	1443
S632	Multiple dislocations of fingers	7	223	32	10582	1512
S633	Traumatic rupture of ligament of wrist and carpus	1	64	64	1528	1528
S634	Traumatic rupture of ligament of finger at metacarpophalangeal and interphalangeal joint(s)	3	191	64	8001	2667
S635	Sprain and strain of wrist	43	578	13	20932	487
S636	Sprain and strain of finger(s)	99	2327	24	80975	818
S637	Sprain and strain of other and unspecified parts of hand	1	8	8	239	239
S64	Injury of nerves at wrist and hand level	1	12	12	384	384
S644	Injury of digital nerve of other finger	1	52	52	1402	1402
S658	Injury of other blood vessels at wrist and hand level	2	13	7	486	243
S66	Injury of muscle and tendon at wrist and hand level	2	87	44	4304	2152
S661	Injury of flexor muscle and tendon of other finger at wrist and hand level	32	2035	64	73207	2288

Table 28 --continued

S662	Injury of extensor muscle and tendon of thumb at wrist and hand level	2	122	61	4403	2202
S663	Injury of extensor muscle and tendon of other finger at wrist and hand level	4	352	88	7620	1905
S664	Injury of intrinsic muscle and tendon of thumb at wrist and hand level	1	60	60	2859	2859
S665	Injury of intrinsic muscle and tendon of other finger at wrist and hand level	2	7	4	202	101
S668	Injury of other muscles and tendons at wrist and hand level	1	7	7	230	230
S669	Injury of unspecified muscle and tendon at wrist and hand level	21	518	25	20083	956
S67	Crushing injury of wrist and hand	3	28	9	1060	353
S670	Crushing injury of thumb and other finger(s)	5	459	92	19670	3934
S68	Traumatic amputation of wrist and hand	3	65	22	2665	888
S680	Traumatic amputation of thumb (complete)(partial)	16	894	56	20555	1285
S681	Traumatic amputation of other single finger (complete)(partial)	35	3292	94	82866	2368
S682	Traumatic amputation of two or more fingers alone (complete)(partial)	7	908	130	27820	3974
S683	Combined traumatic amputation of (part of) finger(s) with other parts of wrist and hand	2	138	69	5098	2549
S69	Other and unspecified injuries of wrist and hand	1	0	0	20	20
S698	Other specified injuries of wrist and hand	1	12	12	355	355
S699	Unspecified injury of wrist and hand	1	20	20	844	844
S70	Superficial injury of hip and thigh	4	24	6	1712	428
S700	Contusion of hip	50	682	14	28289	566
S701	Contusion of thigh	117	2002	17	76888	657
S710	Open wound of hip	2	26	13	772	386
S711	Open wound of thigh	36	634	18	26075	724
S72	Fracture of femur	2	1195	597	18520	9260
S720	Fracture of neck of femur	2	478	239	21217	10608
S721	Pertrochanteric fracture	1	351	351	19312	19312
S723	Fracture of shaft of femur	2	397	199	11846	5923
S73	Dislocation, sprain and strain of joint and ligaments of hip	20	426	21	12154	608
S731	Sprain and strain of hip	2	58	29	3517	1758
S751	Injury of femoral vein at hip and thigh level	1	28	28	1367	1367
S76	Injury of muscle and tendon at hip and thigh level	24	950	40	36078	1503
S760	Injury of muscle and tendon of hip	5	47	9	1756	351
S762	Injury of adductor muscle and tendon of thigh	1	7	7	321	321

Table 28 --continued

S763	Injury of muscle and tendon of the posterior muscle group at thigh level	17	527	31	18429	1084
S764	Injury of other and unspecified muscles and tendons at thigh level	18	252	14	13201	733
S771	Crushing injury of thigh	1	18	18	701	701
S79	Other and specified injuries of hip and thigh	2	53	27	2099	1049
S798	Other specified injuries of hip and thigh	1	28	28	363	363
S80	Superficial injury of lower leg	8	168	21	6027	753
S800	Contusion of knee	1	26	26	692	692
S800	Contusion of knee	287	5167	18	182133	635
S801	Contusion of other and unspecified parts of lower leg	146	2759	19	110098	754
S808	Other superficial injuries of lower leg	3	44	15	1221	407
S81	Open wound of lower leg	12	166	14	5790	483
S810	Open wound of knee	54	527	10	19389	359
S818	Open wound of other parts of lower leg	24	502	21	20217	842
S819	Open wound of lower leg, part unspecified	25	329	13	13650	546
S82	Fracture of lower leg, including ankle	4	1113	278	34432	8608
S820	Fracture of patella	11	754	69	26413	2401
S821	Fracture of upper end of tibia	11	2659	242	92307	8392
S822	Fracture of shaft of tibia	15	5047	336	158975	10598
S823	Fracture of lower end of tibia	17	3396	200	114975	6763
S824	Fracture of fibula alone	10	799	80	31779	3178
S825	Fracture of medial malleolus	8	781	98	25982	3248
S826	Fracture of lateral malleolus	25	2860	114	93732	3749
S828	Fractures of other parts of lower leg	7	549	78	21670	3096
S829	Fracture of lower leg, part unspecified	1	78	78	2942	2942
S83	Dislocation, sprain and strain of joints and ligaments of knee	384	12869	34	505468	1316
S830	Dislocation of patella	6	235	39	7749	1292
S831	Dislocation of knee	2	104	52	3672	1836
S832	Tear of meniscus, current	57	4225	74	172923	3034
S833	Tear of articular cartilage of knee, current	2	50	25	2730	1365
S834	Sprain and strain involving (fibular)(tibial) collateral ligament of knee	51	3182	62	136169	2670
S835	Sprain and strain involving (anterior)(posterior) cruciate ligament of knee	20	2023	101	75950	3797
S836	Sprain and strain of other and unspecified parts of knee	81	3218	40	132700	1638
S841	Injury of peroneal nerve at lower leg level	1	19	19	779	779
S851	Injury of (anterior)(posterior) tibial artery	1	0	0	3143	3143
S86	Injury of muscle and tendon at lower leg level	24	420	18	15403	642
S860	Injury of Achilles tendon	6	49	8	2252	375

Table 28 --continued

S861	Injury of other muscle(s) and tendon(s) of posterior muscle group at lower leg level	1	45	45	1665	1665
S862	Injury of muscle(s) and tendon(s) of anterior muscle group at lower leg level	1	19	19	766	766
S863	Injury of muscle(s) and tendon(s) of peroneal muscle group at lower leg level	8	236	30	7639	955
S870	Crushing injury of knee	4	135	34	6199	1550
S899	Unspecified injury of lower leg	1	19	19	550	550
S90	Superficial injury of ankle and foot	9	243	27	8553	950
S900	Contusion of ankle	79	1455	18	55138	698
S901	Contusion of toe(s) without damage to nail	82	800	10	29584	361
S902	Contusion of toe(s) with damage to nail	19	274	14	8053	424
S903	Contusion of other and unspecified parts of foot	203	2564	13	92576	456
S907	Multiple superficial injuries of ankle and foot	4	53	13	1332	333
S909	Superficial injury of ankle and foot, unspecified	1	28	28	1713	1713
S91	Open wound of ankle and foot	136	1424	10	53058	390
S910	Open wound of ankle	2	157	79	8045	4023
S911	Open wound of toe(s) without damage to nail	33	409	12	17974	545
S913	Open wound of other parts of foot	19	198	10	8367	440
S917	Multiple open wounds of ankle and foot	7	265	38	7487	1070
S92	Fracture of foot, except ankle	55	4061	74	131534	2392
S920	Fracture of calcaneus	9	711	79	25167	2796
S921	Fracture of talus	2	343	172	7479	3740
S923	Fracture of metatarsal bone	44	2269	52	78946	1794
S924	Fracture of great toe	24	733	31	28659	1194
S925	Fracture of other toe	147	3657	25	135328	921
S929	Fracture of foot, unspecified	25	2465	99	101453	4058
S93	Dislocation, sprain and strain of joints and ligaments at ankle and foot level	253	5984	24	263814	1043
S930	Dislocation of ankle joint	2	315	158	6760	3380
S931	Dislocation of toe(s)	2	36	18	1425	712
S932	Rupture of ligaments at ankle and foot level	5	111	22	5559	1112
S934	Sprain and strain of ankle	288	5534	19	220675	766
S935	Sprain and strain of toe(s)	5	66	13	2427	485
S936	Sprain and strain of other and unspecified parts of foot	6	73	12	3612	602
S961	Injury of muscle and tendon of long extensor muscle of toe at ankle and foot level	2	67	34	2255	1127
S962	Injury of intrinsic muscle and tendon at ankle and foot level	1	10	10	254	254
S978	Crushing injury of other parts of ankle and foot	1	5	5	0	0
S981	Traumatic amputation of one toe	1	55	55	3562	3562
S983	Traumatic amputation of other parts of foot	1	1297	1297	41380	41380

Table 28 --continued

S99	Other and unspecified injuries of ankle and foot	1	12	12	427	427
S999	Unspecified injury of ankle and foot	4	29	7	1221	305
T001	Superficial injuries involving thorax with abdomen, lower back and pelvis	1	16	16	374	374
T003	Superficial injuries involving multiple regions of lower limb(s)	1	3	3	89	89
T006	Superficial injuries involving multiple regions of upper limb(s) with lower limb(s)	1	8	8	202	202
T03	Dislocations, sprains and strains involving multiple body regions	3	73	24	2413	804
T031	Dislocations, sprains and strains involving thorax with lower back and pelvis	506	7367	15	337756	668
T033	Dislocations, sprains and strains involving multiple regions of lower limb(s)	1	6	6	215	215
T038	Dislocations, sprains and strains involving other combinations of body regions	1	54	54	3950	3950
T044	Crushing injuries involving multiple regions of upper limb(s) with lower limb(s)	1	94	94	3774	3774
T09	Other injuries of spine and trunk, level unspecified	36	448	12	18081	502
T091	Open wound of trunk, level unspecified	3	35	12	1645	548
T099	Unspecified injury of trunk, level unspecified	40	711	18	31220	781
T112	Dislocation, sprain and strain of unspecified joint and ligament of upper limb, level unspecified	1	21	21	1006	1006
T132	Dislocation, sprain and strain of unspecified joint and ligament of lower limb, level unspecified	2	37	19	1090	545
T135	Injury of unspecified muscle and tendon of lower limb, level unspecified	2	17	9	727	364
T140	Superficial injury of unspecified body region	5	36	7	2224	445
T141	Open wound of unspecified body region	1	24	24	1012	1012
T15	Foreign body on external eye	2	0	0	63	32
T150	Foreign body in cornea	1	5	5	151	151
T150	Foreign body in cornea	163	256	2	20093	123
T151	Foreign body in conjunctival sac	6	22	4	1302	217
T16	Foreign body in ear	4	0	0	283	71
T172	Foreign body in pharynx	1	0	0	93	93
T20	Burn and corrosion of head and neck	6	50	8	2484	414
T200	Burn of unspecified degree of head and neck	5	39	8	1683	337
T201	Burn of first degree of head and neck	2	10	5	446	223
T202	Burn of second degree of head and neck	2	77	39	3113	1557
T21	Burn and corrosion of trunk	3	24	8	1382	461
T211	Burn of first degree of trunk	3	45	15	1664	555
T212	Burn of second degree of trunk	2	30	15	1276	638

Table 28 --continued

T22	Burn and corrosion of shoulder and upper limb, except wrist and hand	2	11	6	445	223
T220	Burn of unspecified degree of shoulder and upper limb, except wrist and hand	2	12	6	355	178
T222	Burn of second degree of shoulder and upper limb, except wrist and hand	1	28	28	127	127
T225	Corrosion of first degree of shoulder and upper limb, except wrist and hand	1	17	17	602	602
T23	Burn and corrosion of wrist and hand	4	33	8	943	236
T230	Burn of unspecified degree of wrist and hand	40	585	15	20824	521
T231	Burn of first degree of wrist and hand	1	3	3	141	141
T232	Burn of second degree of wrist and hand	6	64	11	2471	412
T234	Corrosion of unspecified degree of wrist and hand	1	13	13	500	500
T24	Burn and corrosion of hip and lower limb, except ankle and foot	11	212	19	7390	672
T240	Burn of unspecified degree of hip and lower limb, except ankle and foot	10	274	27	10926	1093
T242	Burn of second degree of hip and lower limb, except ankle and foot	3	40	13	1652	551
T243	Burn of third degree of hip and lower limb, except ankle and foot	1	30	30	901	901
T245	Corrosion of first degree of hip and lower limb, except ankle and foot	1	37	37	581	581
T25	Burn and corrosion of ankle and foot	3	85	28	3637	1212
T250	Burn of unspecified degree of ankle and foot	5	82	16	1766	353
T251	Burn of first degree of ankle and foot	7	86	12	3382	483
T252	Burn of second degree of ankle and foot	9	165	18	4646	516
T253	Burn of third degree of ankle and foot	2	197	99	10573	5286
T254	Corrosion of unspecified degree of ankle and foot	4	134	34	2053	513
T256	Corrosion of second degree of ankle and foot	1	7	7	216	216
T257	Corrosion of third degree of ankle and foot	1	32	32	1018	1018
T26	Burn and corrosion confined to eye and adnexa	33	67	2	3961	120
T261	Burn of cornea and conjunctival sac	2	27	14	1139	570
T262	Burn with resulting rupture and destruction of eyeball	1	0	0	24	24
T266	Corrosion of cornea and conjunctival sac	8	73	9	2979	372
T273	Burn of respiratory tract, part unspecified	1	16	16	1421	1421
T29	Burns and corrosions of multiple body regions	1	172	172	5475	5475
T291	Burns of multiple regions, no more than first-degree burns mentioned	1	388	388	14226	14226
T294	Corrosions of multiple regions, unspecified degree	1	635	635	13413	13413

Table 28 --continued

T296	Corrosions of multiple regions, no more than second-degree corrosions mentioned	1	15	15	345	345
T300	Burn of unspecified body region, unspecified degree	1	56	56	1975	1975
T302	Burn of second degree, body region unspecified	1	11	11	825	825
T305	Corrosion of first degree, body region unspecified	1	20	20	768	768
T33	Superficial frostbite	1	12	12	344	344
T330	Superficial frostbite of head	1	7	7	350	350
T500	Mineralocorticoids and their antagonists	1	0	0	8	8
T51	Toxic effect of alcohol	1	250	250	5360	5360
T510	Ethanol	1	0	0	122	122
T511	Methanol	1	5	5	133	133
T520	Petroleum products	1	0	0	24	24
T542	Corrosive acids and acid-like substances	4	39	10	1611	403
T603	Herbicides and fungicides	1	0	0	63	63
T63	Toxic effect of contact with venomous animals	6	68	11	2382	397
T630	Snake venom	3	13	4	510	170
T634	Venom of other arthropods	10	43	4	3273	327
T71	Asphyxiation	5	15	3	13709	2742
T782	Anaphylactic shock, unspecified	2	0	0	695	348
T793	Post-traumatic wound infection, not elsewhere classified	2	13	7	855	427
T933	Sequelae of dislocation, sprain and strain of lower limb	1	54	54	1543	1543
W4402	Foreign body entering into or through eye or natural orifice	1	0	0	54	54
W7682	Other accidental hanging and strangulation	1	0	0	3143	3143
W8082	Inhalation and ingestion of other objects causing obstruction of respiratory tract	1	0	0	3143	3143
W8902	Exposure to man-made visible and ultraviolet light	1	4	4	130	130
X49	Accidental poisoning by and exposure to other and unspecified chemicals and noxious substances	1	0	0	21	21
Total		**10922**	**374218**	**34**	**14730479**	**1349**

Table 29. Part of Body Codes, Claim Count, Lost Days, and Costs

		Claim	Lost Days		Cost EUR	
Code	Part of Body	Count	Sum	Avg	Sum	Avg
10	Head excluding eyes	398	11568	29	547592	1376
11	Teeth	164	35	0	106845	651
12	Eyes	458	3319	7	159312	348
20	Neck	94	2790	30	130786	1391
30	Torso excluding back	900	20941	23	798721	887
31	Back, spine	1596	25329	16	1097606	688
40	Upper limb from shoulder to wrist	1537	74264	48	2858131	1860
46	Hand	730	25784	35	985347	1350
47	Fingers	1418	39457	28	1388263	979
50	Lower limb from hip to ankle	2424	84846	35	3200428	1320
57	Foot and toes	807	16706	21	601014	745
70	Internal injury/illness	294	58387	199	2395941	8149
90	Other or multiple injuries	102	10791	106	460493	4515
Total		**10922**	**374218**	**34**	**14730479**	**1349**

Table 30. Type of Injury/Illness Codes, Claim Count, Lost Days, and Costs

		Claim	Lost Days		Cost EUR	
Code	Type of Injury/Illness	Count	Sum	Avg	Sum	Avg
1	Bone fracture	1499	90739	61	3350020	2235
2	Sprain, strain	3732	100155	27	4070702	1091
3	Internal injury, illness, concussion	398	52834	133	2152600	5409
4	Amputation	39	5043	129	135805	3482
5	Cut	1443	23573	16	861220	597
6	Rubbing, material in eye, splinter, minor skin injury	345	1570	5	78655	228
7	Bruise, crush	2714	54653	20	2229307	821
8	Burn	179	3774	21	126884	709
9	Skin disease	195	13610	70	524741	2691
10	Acute poisoning	7	12	2	1819	260
11	Electrocution	2	128	64	8630	4315
12	Hearing loss	13	212	16	9659	743
13	Other injury	356	27915	78	1180436	3316
Total		**10922**	**374218**	**34**	**14730479**	**1349**

Table 31. Worker Status Codes, Claim Count, Lost Days, and Costs

		Claim	Lost Days		Cost EUR	
Code	**Worker Status**	**Count**	**Sum**	**Avg**	**Sum**	**Avg**
00P0	Reindeer herder	107	3601	34	127871	1195
0K00	Fisherman	87	2375	27	81498	937
0KP0	Fisherman-reindeer herder	2	24	12	1620	810
A000	Uninsured family member-farmer	3	21	7	336	112
E000	Farm wife	2756	117333	43	4473674	1623
F000	Voluntarily insured-farmer	648	22689	35	481364	743
F0P0	Voluntarily insured-reindeer herder	2	15	8	525	263
FK00	Voluntarily insured-fisherman	3	110	37	1704	568
I000	Farmer	7054	220073	31	9385378	1331
J000	Other farming	3	199	66	9464	3155
M000	Other agricultural business	9	300	33	6480	720
MK00	Other agricultural business-fisherman	2	76	38	2332	1166
N000	14-17 year old farmer	1	4	4	68	68
O000	Part time pensioner-farmer	4	62	16	1340	335
OK00	Part time pensioner-fisherman	1	32	32	788	788
P000	Insured family member-farmer	174	4618	27	109019	627
P0P0	Insured family member-reindeer herder	2	25	13	670	335
S000	Generation change pensioner-farmer	60	2398	40	42754	713
T000	Unemployment pensioner-farmer	1	54	54	610	610
V000	Early retirement pensioner-farmer	2	57	29	1824	912
Z000	Other	1	153	153	1162	1162
Total		**10922**	**374218**	**34**	**14730479**	**1349**

Table 32. Type of Production Codes, Claim Count, Lost Days, and Costs

		Claim	Lost Days		Cost EUR	
Code	Type of Production	Count	Sum	Avg	Sum	Avg
1	Agriculture	5	35	7	2009	402
2	Forestry	45	1451	32	48478	1077
3	Fishing	17	765	45	22614	1330
4	Reindeer herding	88	3000	34	97330	1106
9	Leisure	10	368	37	12490	1249
11	Agriculture, livestock production	8555	305424	36	12150919	1420
12	Gardening, horticulture	6	191	32	6854	1142
13	Fur animal production	1	78	78	1677	1677
14	Other animal production	2	111	55	5418	2709
15	Other agricultural work	1578	44672	28	1722933	1092
21	Forest maintenance	116	2472	21	108983	940
22	Timber harvesting	411	13479	33	483921	1177
23	Other forestry work	33	880	27	24350	738
31	Trolling at the sea and costal areas	4	189	47	7700	1925
32	Trolling on lakes	3	137	46	4523	1508
33	Other sea and costal fishing	8	123	15	3331	416
34	Other lake fishing	6	190	32	3959	660
35	Fish farming	1	53	53	1628	1628
36	Other fishing work	30	503	17	18580	619
99	Other	3	97	32	2782	927
Total		**10922**	**374218**	**34**	**14730479**	**1349**

Table 33. Work Circumstance Codes, Claim Count, Lost Days, and Costs

Code	Work Circumstance	Claim Count	Lost Days		Cost EUR	
			Sum	Avg	Sum	Avg
1	Own work	10703	366189	34	14434191	1349
2	Commuting	158	6512	41	235956	1493
3	Other circumstances related to work	48	1157	24	45027	938
4	Working for someone else	6	158	26	5405	901
6	Leisure	5	196	39	7261	1452
7	Other	2	6	3	2639	1319
Total		**10922**	**374218**	**34**	**14730479**	**1349**

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