NOHSAC
National Occupational Health and Safety Advisory Committee
Komiti Tōhutohu Mahi A-Motu Hauora me te Haumaru

THE BURDEN OF

OCCUPATIONAL DISEASE AND INJURY

IN NEW ZEALAND

TECHNICAL REPORT

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Table of Contents

List of Tables

List of Figures

Abbreviations

ACC	Accident Compensation Corporation
AF	Attributable fraction
CC	Case control
CI	Confidence interval
IARC	International Agency for Research on Cancer
NODS	Notifiable Occupational Disease System
NZHIS	New Zealand Health Information Service
OR	Odds ratio
OSH	Occupational Safety and Health Service
PAH	Polycyclic aromatic hydrocarbon
RR	Relative risk
SIR	Standardised incidence ratio
SMR	Standardised mortality ratio
WRFIS	Work-related fatal injuries study

Executive Summary

BACKGROUND

The National Occupational Health and Safety Advisory Committee (NOHSAC) is responsible for providing independent advice to the Minister of Labour on occupational health and safety issues in New Zealand. NOHSAC plays a key role in providing an independent assessment to the Minister on the major occupational health and safety issues for the New Zealand workforce, of advising on the measures that would deliver the greatest benefit for the prevention of occupational injury and disease, and in developing an evidence-based approach to occupational health and safety issues.

This report is designed to provide a thorough understanding of the current state of occupational injury and disease in New Zealand, based on published information. This will in turn provide the evidence base for decisions by NOHSAC and the Minister regarding future activities and priorities.

METHODS

The information presented in this report is based on published literature and other relevant information from government reports, on-line sources and other appropriate sources. No new investigations were undertaken to obtain information on exposure or risk.

The focus of the project was New Zealand, and relevant studies based in New Zealand were relied upon wherever possible. Studies based elsewhere were used when there was insufficient New Zealand information and to put the New Zealand information into context. English language literature published up to June 2004 was searched for relevant articles.

For each condition, information is presented on exposures, occupations and industries known or suspected to be associated with increased risk. This information was based on New Zealand and international literature, but in most cases the available New Zealand information was not comprehensive. Where international information was used, review articles were relied upon as much as possible, but individual studies were also included where relevant. A detailed review of basic literature, including a formal meta-analysis, was not undertaken.

All conditions for which there is reasonable evidence of causation related to work were included. The final list of included conditions was determined by the conditions included in two recent review articles, identified literature, and conditions of particular relevance to New Zealand.

All work-related exposures for which there was reasonable evidence of relationship to a recognised disorder were included. However, very few of these were considered individually because of the lack of adequate exposure data for New Zealand.

We also produced quantitative estimates of the annual number of deaths from occupational disease and injury, and the annual number of new cases of work-related disease and injury in New Zealand. In many instances these could not be estimated directly from New Zealand data, because the necessary information was not available, so we used a combination of New Zealand and overseas data.

This report is a starting point, based on what is currently known, or can be reasonably inferred from international evidence. The intention is to update it at regular internals, to take advantage of better quality information and to track performance in occupational health and safety in New Zealand.

RESULTS

There are major shortcomings with the New Zealand data on occupational disease and injury, which has meant that the findings are based on a combination of New Zealand and overseas data. There are a large number of occupational exposures and activities which carry an increased risk of disease or injury. These include a number of recognised causes of occupational cancer (particularly lung cancer, mesothelioma, prostate cancer, bladder cancer, stomach cancer, colon cancer, pancreatic cancer and hematologic cancers), respiratory disease (particularly asthma, chronic obstructive pulmonary disease, and pneumoconioses), diseases of the nervous system (including peripheral neuropathy, and chronic solvent-induced toxic encephalopathy), vascular diseases (particularly ischaemic heart disease), musculoskeletal conditions (including upper limb disorders and low back pain), noise-induced hearing loss, vibration disorders, and various causes of fatal and non-fatal injury (particularly in agriculture, forestry and fishing, mining, construction and transport).

We estimate that each year in New Zealand there are:

- about 700-1,000 deaths from occupational disease, particularly cancer, respiratory disease and ischaemic heart disease
- about 100 deaths from occupational injury
- 17,000-20,000 new cases of work-related disease
- about 200,000 occupational accidents resulting in ACC claims, about half of which result in disability, and about 6% in permanent disability.

CONCLUSIONS

New Zealand systems for surveillance of work-related disease and injury are inadequate by international standards, and in many instances the relevant information is not available, and we therefore had to make estimates using a combination of New Zealand and international data. The relevance of international data to the New Zealand situation, and the validity of the assumptions that were required to make the estimates, are uncertain in some instances. The development of effective and comprehensive New Zealand systems for the surveillance of work-related disease and injury is therefore a priority.

There is a particular lack of information on work-related morbidity and mortality in women, Māori and Pacific people, and on work-related injuries and disease sustained by bystanders.

Further research is also required on costs associated with work-related disease and injury.

Bearing these limitations of the data in mind, it is clear that work-related disease and injury is responsible for considerable morbidity and mortality in New Zealand.

For mortality, disease represents a considerably greater (ten-fold) burden than does injury; about one-third of the work-related deaths are due to cancer, and substantial proportions are due to respiratory disease and ischaemic heart disease.

On the other hand, work-related accidents and injuries represent a greater burden of morbidity.

Therefore a balanced approach is required in which both the prevention of work-related disease and the prevention of work-related injury receive appropriate attention and resources from the Occupational Safety and Health Service, and other government agencies.

SECTION ONE

INTRODUCTION

1

1.1 BACKGROUND

The National Occupational Health and Safety Advisory Committee (NOHSAC) is responsible for providing independent advice to the Minister of Labour on occupational health and safety issues in New Zealand. NOHSAC plays a key role in providing an independent assessment to the Minister on the major occupational health and safety issues for the New Zealand workforce, of advising on the measures that would deliver the greatest benefit for the prevention of occupational injury and disease, and in developing an evidence-based approach to occupational health and safety issues.

This report, NOHSAC's first, is designed to provide a thorough understanding of the current state of occupational injury and disease in New Zealand, based on published information. This will in turn provide the evidence base for decisions by NOHSAC and the Minister regarding future activities and priorities.

1.2 PROJECT AIMS

The overall aim of the project was to provide a thorough and critical review of the burden of both fatal and non-fatal occupational disease and injury in New Zealand. This primarily involved a general review of the major established causes of occupational disease and injury, but we also attempted to produce specific quantitative estimates of the numbers of deaths and new cases of disease and injury from specific occupational causes.

This report is a starting point, based on what is currently known, or can be reasonably inferred from international evidence. The intention is to update it at regular internals, to take advantage of better quality information and to track performance in occupational health and safety in New Zealand.

1.3 OUTLINE OF THE STRUCTURE OF THE REPORT

The methodology for the report is described in Section 2. The report then has three main results sections. Section 3 presents information on the major occupational causes of infectious diseases, cancer, mental or neuropsychiatric disorders, diseases of the nervous system, vascular diseases, respiratory diseases, hepatic disease, diseases of the genitourinary system, non-cancerous skin conditions, musculoskeletal conditions, noise-induced hearing loss, vibration disorders, chemical poisoning/toxicity, reproductive risks, multiple chemical sensitivity, and fatal and non-fatal injury. Section 4 presents information on other aspects of workplace hazards including shift work, environmental tobacco smoke, job strain and job control, noise, occupational disease and injury in Māori, the changing nature of work, latency considerations, and the costs of occupational disease and injury. Section 5 presents quantitative information on the burden of occupational disease and injury due to occupational exposures in New Zealand. The focus is on fatal conditions, but non-fatal conditions are also included where possible.

The implications of the results for surveillance, research and prevention are considered in Sections 6 and 7, before a brief summary and concluding remarks.

SECTION TWO

METHODS

2

2.1 INTRODUCTION

The information presented in this report is based on published literature and other relevant information from government reports, on-line sources and other appropriate sources. No new investigations were undertaken to obtain information on exposure or risk.

2.2 IDENTIFYING RELEVANT LITERATURE

The focus of the project is New Zealand, and relevant studies based in New Zealand were relied upon wherever possible. English language literature published up to early 2004 was searched for relevant articles. Initial key words used initially included: “work”, “work-related”, “occupation”, “occupational”

AND “New Zealand”

AND one or more of:

- “injury”, “disease”, “disorder”, “condition”, “illness”
- “mental”, “neuropsychiatric”
- “musculoskeletal”, “sprain”, “strain”
- “noise”, “hearing loss”, “noise-induced”
- “asthma”, “chronic obstructive pulmonary disease”, “chronic obstructive lung disease”, “chronic airflow limitation”, “tuberculosis”, “lung”, “respiratory”, “laryngeal”, “nasal”
- “cancer”, “carcinogen”, “malignant”, “malignancy”
- “bladder”
- “mesothelioma”; “sarcoma”
- “leukaemia”, “lymphoma”, “myeloma”
- “skin”, “melanoma”, “dermatitis”
- “kidney”, “renal”
- “liver”, “hepatic”, “cirrhosis”, hepatitis”
- “coronary heart disease”, “atheroma”, “arterial”, “arteriosclerosis”, “circulatory”
- “falls”, “motor vehicle”, “tractor”, “electricity”, “accident”
- “exposure”, “arsenic”, “asbestos”, “beryllium”, “cadmium”, “chromium”, “diesel” “exhaust”, “nickel”, “silica”, “tobacco”, “smoke”, “environmental tobacco smoke”, “benzene”, “ethylene oxide”, “ionising radiation”, “noise”, “job strain”, “job control”, “shift work”.

This list was then refined, based on the initial results of the search.

Searches were conducted using Ovid Medline, OSH-ROM and NIOSHTIC. Secondary follow-up of sources cited in reference lists was also undertaken. The search was essentially confined to the last 20 years of published literature (i.e. from 1984 onwards). However, earlier studies were included when particularly relevant or when there was little other relevant information available, provided that the full publication could be obtained or there was enough information in an available abstract. Searches were undertaken from January 2004 to June 2004, and include publications up to June 2004 (2004 publications were only included if they were listed on the databases used).

For each condition, information is presented on exposures, occupations and industries known or suspected to be associated with increased risk. This information was based on New Zealand and international literature, but in most cases the available New Zealand information was not comprehensive. Where international information was

used, review articles were relied upon as much as possible, but individual studies were also included where relevant. A detailed review of basic literature, including a formal meta-analysis, was NOT undertaken.

The report is primarily based on published literature, but relevant unpublished literature was sought from government entities such as the Department of Labour and the Accident Compensation Corporation (ACC), from relevant individuals and through Internet searches.

REVIEWING LITERATURE

All articles identified through the literature search were considered for inclusion. Abstracts or the full text were read and assessed to determine the relevance of papers for the review. All New Zealand-based articles with original estimates of exposure, risk or relative risk were included.

SUMMARISING AND SYNTHESISING THE LITERATURE

For each condition, relevant literature was appraised and summarised. Estimates of relative risk, odds ratio, standardised incidence ratio or standardised mortality ratio above 1.0 were presented if the confidence interval provided for the estimate did not cross 1.0. In addition, estimates where the lower confidence bound was between 0.90 and 1.0 were included if the risk estimate was greater than 1.5 and the study was of reasonable quality.

EXPOSURE MEASURES

Past, current and future exposures and their relative impact on the overall burden of both fatal and non-fatal occupational disease and injury were considered. However, there was little comprehensive New Zealand-based exposure information. Similarly, environmental factors were included where relevant to work activities, but there was little useful New Zealand information.

In keeping with approaches taken elsewhere[1, 2], an attempt was made to identify risk estimates for the conditions arising from shift work, job strain/job control, and environmental tobacco smoke. However, there was little comprehensive New Zealand-based information on these areas.

2.3 INCLUDED CONDITIONS

All conditions for which there is reasonable evidence of causation related to work were included. The final list of included conditions was determined by the conditions included in the two main review articles mentioned earlier, identified literature, and conditions of particular relevance to New Zealand*.

* “Reasonable evidence” means evidence of an increased risk in one or more papers with sound methodology in the scientific literature. “Particular relevance” means the condition is known or suspected to occur in New Zealand workers.

2.4 INCLUDED EXPOSURES

All work-related exposures for which there was reasonable evidence of relationship to a recognised disorder were included. However, very few of these were considered individually because of the lack of adequate exposure data for New Zealand. Specific estimates of absolute workforce size for various exposures and conditions are not included. This is because exposures within a workforce change over time and the latency (time to disease onset after exposure) varies between conditions (and possibly within the same condition depending on the exposure characteristics), and there is little information available on either of these factors.

2.5 AGE

Age-specific risks were included where this information was available for New Zealand and relevant to consideration of the condition. Different age ranges were used, depending on the condition being considered.

2.6 GENDER

Separate risk measures are presented for males and females where such information was available and relevant. However, most of the studies from which the risk measures are derived were based on males. Gender is considered for particular conditions, rather than separate sections being presented for males and females.

2.7 ETHNICITY

We intended to pay special attention to the situation of Māori/Pacific workers, but there was little suitable ethnicity-based information available. As for gender and age, ethnicity is considered as part of the review of particular conditions, rather than separate sections being presented for different ethnicities. However, a separate overview regarding Māori workers is provided in Section 4.4.

2.8 ESTIMATES OF ABSOLUTE BURDEN

Wherever possible, New Zealand-specific data were used to estimate the burden of occupational disease and injury, but where adequate national data were lacking, a combination of New Zealand data and extrapolations from other countries was used. For work-related injury mortality and incidence, we mainly relied on published studies and reports of ACC. For work-related disease mortality we mainly used the likely population attributable fractions (AFs) from overseas studies together with New Zealand mortality data. For work-related disease incidence we used both approaches. The exposures and conditions included in Sections 3 and 4 are more extensive than those in Section 5 (absolute burden estimates) because Section 5 is based on data sources that incorporated a higher requirement for strength of evidence and that were not focused on New Zealand.

2.9 SOCIAL AND ECONOMIC COSTS

An attempt was made to quantify the burden of occupational diseases and injuries in terms of the social and economic costs. However, the literature to support this assessment was limited, and estimates were possible only for some conditions.

2.10 STRUCTURE OF THE RESULTS SECTION

Each condition is covered in a separate sub-section of the report. Usually this is about one page in length, but the length varies depending on the available information. A boxed summary appears at the top of each sub-section. The main information then covers a:

- brief definition of the condition
- summary of causative exposures, based on international literature, including New Zealand
- summary of the available international information on risk and population attribution
- review of any available New Zealand studies of risk
- summary of any available New Zealand exposure information.

SECTION THREE

REVIEW OF SPECIFIC

OCCUPATIONAL

DISEASES AND INJURY

3

3.1 INFECTIOUS DISEASES

TUBERCULOSIS

Summary Tuberculosis is an infection caused by Mycobacterium bacilli. It can affect many organs, but respiratory tuberculosis is the most common form of the disease. Health care workers are the occupational group at highest risk of developing tuberculosis from a work-related exposure, but clinical laboratory workers, funeral parlour staff, farmers and veterinarians are probably also at increased risk. One paper that showed a high rate of Mantoux conversion in New Zealand nurses, and another that documented two cases of occupationally acquired tuberculosis, confirm that tuberculosis remains an ongoing risk for New Zealand workers. All the occupations and exposures implicated as possible causes of tuberculosis are undertaken in New Zealand.

Introduction

Tuberculosis is an infection caused by Mycobacterium bacilli (usually Mycobacterium tuberculae). It can affect many organs, but respiratory tuberculosis is the most common form of the disease.

Exposures

Health care workers are the occupational group at highest risk of developing tuberculosis from a work-related exposure. Clinical laboratory workers, funeral parlour staff, farmers and veterinarians are probably also at increased risk, the latter two being at risk from exposure to bovine tuberculosis. Silicosis also predisposes the worker to developing pulmonary tuberculosis[3-7].

Recent estimates of attributable fraction were 5% to 6% for pulmonary tuberculosis in the United States[2] and 0.6% for tuberculosis in males in Finland[1].

New Zealand studies of risk

Two papers confirm that tuberculosis remains an ongoing risk for New Zealand workers. The first used hospital-based occupational health clinic records over 30 months to assess the effectiveness and outcome of implementation of the Tuberculosis Control Guidelines issued in 1992[8]. Although no active tuberculosis cases were identified, 22% of subjects had abnormal Mantoux results and 25 staff members had Mantoux conversion during the 30 months. The relative risk of conversion in high risk nurses was reported as 2.92 (95% CI 1.01 – 8.44)[9].

A later paper reported occupationally acquired tuberculosis in a general nurse and prison guard. The authors emphasised that the greatest risk came from unsuspected cases of tuberculosis[10].

The number of health care workers contracting tuberculosis each year in New Zealand is not known, although Harrison estimated it to be 13 in 1987[11].

New Zealand exposures

All the occupations and exposures implicated as possible causes of tuberculosis are undertaken in New Zealand.

Summary Pneumococcal disease is a common community infection. It usually causes respiratory tract infection, mainly pneumonia in adults. The risk of pneumococcal disease is increased by exposure to tobacco smoke, including environmental tobacco smoke. Occupations involving significant exposure to environmental tobacco smoke, such as bar worker and restaurant worker, have an increased risk of developing pneumococcal disease. There are no New Zealand studies of the risk of occupationally acquired pneumococcal disease. Several New Zealand studies have produced estimates of the prevalence of environmental tobacco smoke exposure in the workplace in New Zealand. These estimates range from 23% to 83%. Occupations involving exposure to environmental tobacco smoke are common in New Zealand.

Introduction

Pneumococcal disease is a common community infection. It usually causes respiratory tract infection, mainly pneumonia in adults, but may also cause severe, widespread infection.

Exposures

The risk of pneumococcal disease is increased by exposure to tobacco smoke, including environmental tobacco smoke. Occupations involving significant exposure to environmental tobacco smoke, such as bar worker and restaurant worker, have an increased risk of developing pneumococcal disease[12, 13].

New Zealand studies of risk

There are no New Zealand studies of the risk of occupationally acquired pneumococcal disease.

New Zealand exposures

Several New Zealand studies have produced estimates of the prevalence of environmental tobacco smoke exposure in the workplace in New Zealand. These estimates range from 23% to 83%, and are presented in more detail in Section 4.2. Occupations involving exposure to environmental tobacco smoke, as mentioned above, are common in New Zealand.

Summary Brucellosis is a zoonotic infection caused by the Brucella abortus bacteria. The main occupational sources are reproductive tract tissues of cattle, accidental exposures to Brucella vaccine, and exposure to the organism in laboratories. Occupations such as veterinarian, farmer and abattoir worker are likely to be most at risk. In 1974, a serological survey of New Zealand veterinarians found Brucella antibodies in 91% of subjects. However, exposure to Brucella, and human brucellosis, is now probably rare in New Zealand.

Introduction

Brucellosis is a zoonotic infection caused by the Brucella abortus bacteria. The main symptoms are fever, chills, sweating, fatigue, myalgia and headache.

Exposures

The main occupational sources of infection are reproductive tract tissues of cattle, accidental exposures to Brucella vaccine, and exposure to the organism in laboratories. Occupations such as veterinarian, farmer and abattoir worker are likely to be most at risk[14, 15].

New Zealand studies of risk

In 1974, a serological survey of a convenience sample of New Zealand veterinarians, representing about 10% of all New Zealand veterinarians, found Brucella antibodies in 91% of subjects[15]. Human brucellosis is now probably rare in New Zealand, although from March 1992 to June 1998 there were seven cases notified to the Notifiable Occupational Disease System (NODS)[16]. Between July 1994 and June 2003, ACC recorded only two 12-month periods (1995/6 and 1996/7) where there were new paid entitlement claims for brucellosis, being three or fewer in each period (the actual number was not recorded for privacy reasons). There have been no new cases recorded since June 1997[17].

New Zealand exposures

Exposure to Brucella has been of concern in the past, particularly for meat workers and veterinarians, but is now probably rare in New Zealand.

Summary Leptospirosis is a zoonotic infection caused by a range of small organisms called leptospira. The main occupational source of infection is the urine of infected animals. Farming, especially dairy farming, and abattoir work are the most common exposure circumstances, but other occupations such as forestry worker, hunter, veterinarian, plumber and transport operator are at increased risk. A 1980 serological survey of a random sample of farm residents and meat workers in New Zealand found seropositivity in dairy farmers, pig farmers, meat inspectors, sheep and beef farmers, and meat workers. In the 1980s, there were several hundred leptospirosis notifications in New Zealand each year. This had dropped to 56 in 1996, although there was probably considerable under-reporting. The annual incidence of leptospirosis was found to have halved between 1990-1992 and 1996-1998, and to be highest in meat processing workers, livestock farm workers and forestry-related workers.

Introduction

Leptospirosis is a zoonotic infection caused by a range of small organisms called leptospira. The main symptoms are fever, myalgia, nausea and vomiting.

Exposures

The main occupational source of infection is the urine of infected animals. Farming, especially dairy farming, and abattoir work are the most common exposure circumstances, but other occupations such as forestry worker, hunter, veterinarian, plumber and transport operator are at increased risk[14, 15, 18, 19].

New Zealand studies of risk

In 1974, a serological survey of a convenience sample of New Zealand veterinarians, representing about 10% of all New Zealand veterinarians, found only one of 86 subjects with positive leptospira titres, but this was said to be partly due to the short half life of the anti-leptospira antibodies[15].

A 1980 serological survey of a random sample of dairy farm residents in an area of the North Island of New Zealand found that 34% of people involved in milking cows had positive leptospira titres. One third of this 34% was known to have had a clinical history of leptospirosis. At that time, New Zealand was reported to have one of the highest incidences of leptospirosis in the world[18]. An extension of this survey covered a range of meat inspectors, meat workers and farm workers. The survey showed seropositivity in dairy farmers (44%), pig farmers (25% to 31%), meat inspectors (10%), sheep and beef farmers (8%), and meat workers (6%)[20-23].

In the 1980s, there were several hundred leptospirosis notifications in New Zealand each year. This had dropped to 56 in 1996, although there was probably considerable under-reporting[14]. From March 1992 to June 1998 there were 180 cases of leptospirosis notified to NODS[16].

For the period July 1994 to June 2004, there were 119 new paid entitlement claims for leptospirosis reported by ACC[17].

An outbreak of leptospirosis in 1992/3 involved three definite and one possible case on a dairy farm on which most of the cattle were found to have evidence of leptospirosis infection[24].

The most recent study used laboratory surveillance and disease notification data for the period 1990 to 1998 inclusive. The annual incidence of leptospirosis was found to have halved over the study period, falling from 5.7/100,000 in 1990-1992 to 2.9/100,000 in 1996-1998. The incidence of infection was highest in meat processing workers (164/100,000), livestock farm workers (92/100,000), and forestry-related workers (24/100,000)[25].

New Zealand exposures

Exposure to leptospira still occurs in New Zealand, but the extent of exposure is not known.

LEGIONELLOSIS

Summary Legionellosis (also known as Legionnaire's disease) is a disease caused by infection with the Legionella bacteria. It most commonly causes pneumonia, which may be severe. The source of Legionella infection in an occupational context is usually water aerosol from pooled warm water, such as occurs in association with air-conditioning cooling towers, but dust (such as potting mix) has also been documented as a source. Legionellosis has been clearly associated with a range of occupations, including air-conditioning maintenance workers, health care personnel, ship repair workers, gardeners, construction workers, sewerage workers, automotive plant workers, and miners. There are no New Zealand studies of legionellosis in relation to work, apart from a report on nosocomial pneumonia at a New Zealand hospital. Most of the occupations associated with increased risk of legionellosis occur in the New Zealand workforce.

Introduction

Legionellosis (also known as Legionnaire's disease) is a disease caused by infection with the Legionella bacteria. Legionella pneumophila is the most common form involved in human infection. It most commonly causes pneumonia, which may be severe.

Exposures

The source of Legionella infection in an occupational context is usually water aerosol from pooled warm water, such as occurs in association with air-conditioning cooling towers, but dust (such as potting mix) has also been documented as a source. Legionellosis has been clearly associated with a range of occupations, including air-conditioning maintenance workers, health care personnel, ship repair workers, gardeners, construction workers, sewerage workers, automotive plant workers, and miners[26].

New Zealand studies of risk

There are no New Zealand studies of legionellosis in relation to work, apart from a report on nosocomial pneumonia at a New Zealand hospital in which Legionella species were the most commonly implicated organism[27].

New Zealand exposures

There have been investigations examining the prevalence of Legionella contamination of various water systems in New Zealand, but none specifically related to occupational exposures[28]. Most of the occupations associated with increased risk of legionellosis occur in the New Zealand workforce.

Summary Viral hepatitis is an infection of the liver caused by one of a wide range of viruses. In an occupational context, hepatitis B (HBV) and hepatitis C (HCV) are the most important. The main routes of exposure are percutaneous (puncturing the skin) through needle stick injuries, and across mucous membranes or damaged skin, through contact with contaminated body fluids. Any occupation that increases the risk of such exposure increases the risk of contracting HBV or HCV through occupational exposures. This includes, in particular, health care workers, embalmers, persons who handle body substances, clinical laboratory staff, workers in long-term correctional facilities, police, members of the armed forces and emergency services workers, and business travellers. The risk of exposure to HBV in the New Zealand workforce is higher than in many other developed countries because of the high prevalence of HBV in the general New Zealand population. In the 1970s and 1980s, there were a number of serum surveys that examined the prevalence of HBV antibodies in various sections of the New Zealand workforce. These were reviewed in the mid-1990s. All the occupations at significant risk of exposure to HBV and HCV occur in New Zealand.

Introduction

Viral hepatitis is an infection of the liver caused by one of a wide range of viruses. Typical symptoms are fever, malaise and jaundice, although hepatitis C is often asymptomatic. In an occupational context, hepatitis B (HBV) and hepatitis C (HCV) are the most important.

Exposures

The main routes of exposure are percutaneous (puncturing the skin) through needle stick injuries, and across mucous membranes or damaged skin, through contact with contaminated body fluids. Any occupation that increases the risk of such exposure increases the risk of contracting HBV or HCV through occupational exposures. Therefore, a wide range of occupations is at increased risk of exposure to HBV and HCV, in particular health care workers, embalmers, persons who handle body substances, clinical laboratory staff, workers in long-term correctional facilities, police, members of the armed forces and emergency services workers, and business travellers[29].

The risk of exposure to HBV in the New Zealand workforce is higher than in many other developed countries because of the high prevalence of HBV in the general New Zealand population[30]. At-risk workers are provided with high levels of protection through vaccination against HVB. There is currently no vaccine for HCV[31-33].

New Zealand studies of risk

In the 1970s and 1980s, there were a number of serum surveys that examined the prevalence of HBV antibodies in various sections of the New Zealand workforce[34-38]. These were reviewed in the mid-1990s. Table 3.1 below is based on Table 2 from that publication[33]. The table indicates the high sero-prevalence of HBV in several different work groups, including health care workers, police officers and correctional facility officers. Not all of these workers would have contracted the HBV through occupational exposure, but it is reasonable to accept that many did.

One study documented the effectiveness in terms of seroconversion of the hepatitis B vaccine in health care workers[39].

Between July 1994 and June 2004, ACC reported only two 12-month periods (1994/5 and 1998/9) where there were new paid entitlement claims for occupational hepatitis. The numbers for each period were not given for privacy reasons, but were three or fewer. One claim in 2001/2 was later disallowed[17].

New Zealand exposures

All the occupations at significant risk of exposure to HBV and HCV occur in New Zealand.

TABLE 3.1 Hepatitis B sero-prevalence for selected occupations[1]

OCCUPATION	HEPATITIS ANTIBODY[2] (%)
Developmentally disabled institutions	
Psychopaedic workers	16
Psychopaedic nurses	12
Dental workers	
School dental nurses – European	26
School dental nurses – non-European	68
Dentists	14
Dental assistants	7
School dental nurses	7
Hospital workers	
Laboratory workers	11 - 20
Medical	22
Nursing	10
Dental staff	36
General staff	13
Police officers	12
Customs officers	6
Prison officers	23

1: Based on Wilson and Bandaranayake, 1995[33], covering studies published from 1977 to 1991
2: Anti-HBsAg

Summary HIV/AIDS is an acquired disorder of the immune system caused by the Human Immunodeficiency Virus (HIV). There have not been many confirmed cases of occupationally acquired HIV, but any occupation at risk of needle stick injury or other parenteral exposure to body fluids is potentially at increased risk of developing HIV/AIDS from workplace exposures. Health care workers are probably most at risk, but others such as sex workers, embalmers, clinical laboratory staff, police, corrections officers and security guards also have increased risk. Two New Zealand publications address HIV/AIDS and health care workers. These emphasise the need for appropriate control procedures, but do not provide estimates of risk or prevalence in the New Zealand context. All the occupations at significant risk of exposure to HIV occur in New Zealand.

Introduction

HIV/AIDS is an acquired disorder of the immune system caused by the Human Immunodeficiency Virus (HIV).

Exposures

There have not been many confirmed cases of occupationally acquired HIV, but any occupation at risk of needle stick injury or other parenteral exposure to body fluids is potentially at increased risk of developing HIV/AIDS from workplace exposures. Health care workers are probably most at risk, but others such as sex workers, embalmers, clinical laboratory staff, police, corrections officers and security guards also have increased risk[40, 41].

New Zealand studies of risk

Two New Zealand publications address HIV/AIDS and health care workers. These emphasise the need for appropriate control procedures, but do not provide estimates of risk or prevalence in the New Zealand context[42, 43].

New Zealand exposures

All the occupations at significant risk of exposure to HIV occur in New Zealand.

OTHER INFECTIONS

Introduction

This section describes other New Zealand papers relevant to work-related infection but that do not fit under any of the major headings in the infection section.

New Zealand studies of risk

In the two years leading up to June 2000, there were 101 notifications to NODS for non-viral infections and five for viral infectious disease[44].

One New Zealand paper (and a letter in response) describes Orf infection in meat industry workers in the early 1980s. In one year, 231 cases were reported, and Orf was confirmed pathologically in 85% of the cases for whom samples were available. Nearly all lesions were on the hand, and the highest risk tasks were handling pelts or wool[45, 46]. From March 1992 to June 1998 there 35 cases of Orf notified to NODS[16].

An Auckland-based case control study of the causes of giardiasis found a four-fold increased risk in workers with occupational exposure to human wastes, after allowing for age, gender and other relevant risk factors for which information was collected[47].

A study of workers in the freezing industry examined the reasons for sickness absence. Information was collected via questionnaire. Zoonotic illness was identified in 7% of workers[48].

Several studies examined seroepidemiology. A study examining antibodies for Streptococcus suis type 2 found evidence of previous infection in 21% of pig farmers, 10% of meat inspectors and 9% of dairy farmers. The authors suggested the annual incidence of infection in pig farmers was about 28%, but that most cases were asymptomatic[49]. Another study examined antibodies for Campylobacter pyloridis, finding high prevalences compared to random blood donors in meat workers, veterinary surgeons from freezing works and pest control officers[50].

Finally, a case report has been published on corynebacterium lymphadenitis contracted from sheep[51], and on a fungal nosocomial outbreak in a psychiatric hospital[52].

Exposures

A study of sex industry workers in New Zealand found that nearly all used condoms as a matter of course, but that 20% of street workers and 10% of indoor workers had been forced at some stage at have unprotected intercourse, thereby exposing them to a much higher risk of various sexually transmitted diseases[53].

A survey of country general practitioners investigating needle stick injuries found a reported incidence of 25/100 in six months for doctors and 17/100 in six months for nurses in the practices[54].

3.2 MALIGNANCY

ORAL CAVITY CANCER

Summary Oral cavity cancer is a malignant disease of the mouth, tongue and salivary glands. There are no occupational exposures that have been strongly and consistently implicated as causes of oral cavity cancer. However, several exposures, occupations and industries have been inconsistently associated with increased risk. These include polycyclic aromatic hydrocarbons (PAHs), solvents, formaldehyde, phenoxyacetic acid, and ionising radiation; working as a woodworker, wood product worker and carpet installer; outdoor work; and work in the pulp mill industry. There are no New Zealand-based estimates of oral cancer risk arising from specific exposures, nor any estimates of attributable fraction. One study identified an increased risk of lip cancer in New Zealand carpenters. There is no comprehensive published New Zealand information on the extent of workforce exposure to specific agents that have been implicated as possibly increasing the risk of oral cancer. A wide range of occupations in the New Zealand workforce is relevant to the implicated exposures.

Introduction

Oral cavity cancer is a malignant disease of the mouth, tongue and salivary glands.

Exposures

Smoking and alcohol are both strongly associated with an increased risk of oral cavity cancer. There are no occupational exposures that have been strongly and consistently implicated as causes of oral cavity cancer. However, several exposures, occupations and industries have been inconsistently associated with increased risk. These include PAHs, solvents, formaldehyde, phenoxyacetic acid, and ionising radiation; working as a woodworker, wood product worker and carpet installer; outdoor work; and work in the pulp mill industry[55-58].

International studies of risk

There are no international studies that provide robust risk estimates in terms of the main exposures. AFs of 1.2% for males and 0.3% for females were used in the recent Finnish study[1].

New Zealand studies of risk

There are no New Zealand-based estimates of oral cancer risk arising from specific exposures, nor any estimates of attributable fraction. One New Zealand-based study identified an increased risk of lip cancer in carpenters, based on only 13 exposed cases. The study was a population-based case-control study that used cancer registry cases registered between 1980 and 1984. Persons with other types of cancer served as the controls[59] (Table 3.2).

Another study examined risks of buccal cavity cancer as part of a study of occupational cancer mortality in all New Zealand men from 1974 to 1978. The study obtained cause of death information from the National Health Statistics Centre and denominator information from a 10% random sample of the 1976 New Zealand Census. Rates were standardised for age. No information was available for any other potential confounders, and the recorded occupations in some of the death records were likely to be inaccurate or irrelevant to the conditions causing death. Some of the resulting bias was partly overcome by controlling for social class in the analysis. This showed a suggestion of increased rates of buccal cancer in performing artists and composers (based on only two deaths), and cooks, waiters and bartenders (based on ten deaths)[60] (Table 3.2).

New Zealand exposures

There is no comprehensive published New Zealand information on the extent of workforce exposure to any of the specific agents that have been associated with possible increases in the risk of oral cancers. A wide range of occupations in the New Zealand workforce is relevant to the implicated exposures.

TABLE 3.2 Published estimates of increased risk of lip cancer in selected occupational groups – New Zealand-based studies only

WORK GROUP	RR	95% CI	RISK MEASURE AND STUDY DETAILS	YEAR AND SOURCE
Carpenters	2.28	1.23 – 4.14	OR[1]: CC[2], 1980-1984	Kawachi, 1989[59]
Performing artists, composers	13.2	1.48 – 47.6	RR[3]: cohort[4], 1974-1978	Pearce, 1985[60]
Cooks, waiters and bartenders	10.0	4.78 – 18.4	RR[3]: cohort[4], 1974-1978	Pearce, 1985[60]

1: Age-standardised; males only
2: Cancer registry used for cases and controls
3: Age-standardised and compared to males in the same social class
4: Cause of death information from the National Health Statistics Centre

OESOPHAGEAL CANCER

Summary Oesophageal cancer is a malignant disease of the oesophageus. There are no occupational exposures that have been strongly and consistently implicated as causes of oesophageal cancer. However, several exposures, occupations and industries have been inconsistently associated with increased risk. These include PAHs, asbestos, silica, metal dust and metal fumes; metal workers, plumbers and pipe-fitters, roofers and pavers, garage and service station workers, and administrative support workers; and workers in the financial, insurance, real estate, metal-working and health services industries. There are no New Zealand-based estimates of oesophageal cancer risk arising from specific exposures, nor any estimates of attributable fraction. One New Zealand study identified an increased risk of oesophageal cancer in New Zealand clerical workers and labourers. There is no comprehensive published New Zealand information on the extent of workforce exposure to specific agents that have been implicated as possibly increasing the risk of oesophageal cancer. A wide range of occupations in the New Zealand workforce is relevant to the implicated exposures.

Introduction

Oesophageal cancer is a malignant disease of the oesophageus.

Exposures

Smoking, obesity and gastro-oesophageal reflux are strongly associated with increased risk of oesophageal cancer. There are no occupational exposures that have been strongly and consistently implicated as causes of oesophageal cancer. However, several exposures, occupations and industries have been inconsistently associated with increased risk. These include PAHs, asbestos, silica, metal dust and metal fumes; metal workers, plumbers and pipe-fitters, roofers and pavers, garage and service station workers, and administrative support workers; and workers in the financial, insurance, real estate, metal-working and health services industries[55, 61, 62].

International studies of risk

There are no international studies that provide robust risk estimates in terms of the main exposures. AFs of 6.4% for males and 0.2% for females were used in the recent Finnish study[1].

New Zealand studies of risk

There are no New Zealand-based estimates of oesophageal cancer risk arising from specific exposures, nor any estimates of attributable fraction. One study examined risks of oesophageal cancer as part of a study of occupational cancer mortality in all New Zealand men from 1974 to 1978. The study obtained cause of death information from the National Health Statistics Centre and denominator information from a 10% random sample of the 1976 New Zealand Census. Rates were standardised for age. No information was available for any other potential confounders, and the recorded occupations in some of the death records were likely to be inaccurate or irrelevant to the conditions causing death. Some of the resulting bias was partly overcome by controlling for social

class in the analysis. This showed a suggestion of increased rates of oesophageal cancer in non-specific clerical workers and labourers[60] (Table 3.3).

New Zealand exposures

There is no comprehensive published New Zealand information on the extent of workforce exposure to any of the specific agents that have been associated with possible increases in the risk of oesophageal cancer. A wide range of occupations in the New Zealand workforce is relevant to the implicated exposures.

TABLE 3.3 Published estimates of increased risk of oesophageal cancer in selected occupational groups – New Zealand-based studies only

WORK GROUP	RR	95% CI	RISK MEASURE AND STUDY DETAILS	YEAR AND SOURCE
Clerical workers nec	1.39	0.79 – 2.26	RR[1]: cohort[2], 1974-1978	Pearce, 1985[60]
Labourers nec	1.57	0.88 – 2.59	RR[1]: cohort[2], 1974-1978	Pearce, 1985[60]

1: Age-standardised and compared to males in the same social class
2: Cause of death information from the National Health Statistics Centre

STOMACH CANCER

Summary Gastric carcinoma is a malignant disease of the stomach. No occupational exposures have been strongly implicated as causing stomach cancer. However, there is good evidence of an increased risk from work in coal and tin mining, metal processing and rubber manufacturing, and some evidence of increased risk from wood processing, construction, transportation and work in high temperature environments. There are no New Zealand-based estimates of stomach cancer risk arising from specific exposures, nor any estimates of attributable fraction. Three New Zealand studies provide estimates of increased risk in certain occupations. These occupations are machine tool operators; woodworkers; forestry workers; field crop workers; labourers; grain millers; and brewers, wine and beverage makers. Most of the occupations and industries implicated as possible causes of stomach cancer are undertaken in New Zealand.

Introduction

Gastric carcinoma is a malignant disease of the stomach.

Exposures

No occupational exposures have been strongly implicated as causing stomach cancer. However, there is good evidence of an increased risk from work in coal and tin mining, metal processing and rubber manufacturing, and some evidence of increased risk from wood processing, construction, transportation and work in high temperature environments[61, 63, 64].

International studies of risk

There are no international studies that provide robust risk estimates in terms of the main exposures. AFs of 10% for males and 5.4% for females were used in the recent Finnish study[1].

New Zealand studies of risk

There are no New Zealand-based estimates of stomach cancer risk arising from specific exposures, nor any estimates of attributable fraction. Four New Zealand studies provide estimates of increased risk in certain occupations. Two studies used a similar approach, calculating standardised rate ratios for males, based on the whole New Zealand population, using the cancer registry to identify cases. One examined mortality and the other incidence. Rates were standardised for age and socio-economic status. These studies identified an increased risk of stomach cancer mortality in machine tool operators, and an increased incidence in woodworkers[65, 66]. A third study examined the risks for stomach cancer in New Zealand. This study was based on cancer registry data from 1980 to 1984, using other cancer cases as controls. Odds ratios were adjusted for age, socio-economic status, ethnicity and smoking. This study showed an increased risk of stomach cancer in forestry workers and several specific occupation sub-groups[67] (Table 3.4)

A fourth study examined risks of stomach cancer as part of a study of occupational cancer mortality in all New Zealand men from 1974 to 1978. The study obtained cause of death information from the National Health Statistics Centre and denominator information from a 10% random sample of the 1976 New Zealand Census. Rates were standardised for age. No information was available for any other potential confounders, and the recorded

occupations in some of the death records were likely to be inaccurate or irrelevant to the conditions causing death. Some of the resulting bias was partly overcome by controlling for social class in the analysis. This study showed a suggestion of increased rates of stomach cancer in several occupation groups[60] (Table 3.4).

New Zealand exposures

There is no comprehensive published New Zealand information on the extent of workforce exposure to any of the specific agents that have been associated with possible increases in the risk of stomach cancer. Most of the occupations and industries implicated as possible causes of stomach cancer are undertaken in New Zealand.

TABLE 3.4 Published estimates of increased risk of stomach cancer in selected occupational groups – New Zealand-based studies only

WORK GROUP	RR	95% CI	RISK MEASURE AND STUDY DETAILS	YEAR AND SOURCE
Field crop workers	4.99	1.03 – 24.3	OR[1]; CC[2], 1980-1984	Dockerty, 1991[67]
Forestry workers	1.83	1.01 – 3.32	OR[1]; CC[2], 1980-1984	Dockerty, 1991[67]
Machine tool operators	3.57	1.28 – 7.82	SMR[3]: cohort[4], 1973-1986	Firth, 1993[65]
Toolmakers	2.86	1.15 – 5.89	RR[5]: cohort[6], 1974-1978	Pearce, 1985[60]
Woodworkers	1.44	1.10 – 1.86	SIR[3]: cohort[4], 1972-1984	Firth, 1996[66]
Plumbers, welders, erectors	1.62	0.84 – 2.83	RR[5]: cohort[6], 1974-1978	Pearce, 1985[60]
Transport supervisors	4.26	1.94 – 8.09	RR[5]: cohort[6], 1974-1978	Pearce, 1985[60]
Grain millers and related workers	6.63	1.74 – 25.3	OR[1]; CC[2], 1980-1984	Dockerty, 1991[67]
Brewers, wine and beverage makers	5.01	2.13 – 11.7	OR[1]; CC[2], 1980-1984	Dockerty, 1991[67]
Labourers nec	1.28	0.99 – 1.65	OR[1]; CC[2], 1980-1984	Dockerty, 1991[67]

1: Standardised for age, ethnicity, smoking and socio-economic status
2: Cancer registry used for cases and controls
3: Standardised for age and social class; males only
4: Cases from cancer registry; comparison to population data
5: Age-standardised and compared to males in the same social class
6: Cause of death information from the National Health Statistics Centre

COLON CANCER

Summary Colon cancer is a malignant disease of the large bowel (excluding the rectum). The only occupational factor consistently associated with increased colon cancer is low physical activity, although amphibole asbestos is probably also associated with increased risk. Several exposures, occupations and industries have been inconsistently associated with increased risk. These include inorganic insulation dust, iron oxides, benzene and aliphatic ketones; general machinists; and non-metallic mineral products and leather goods. There are no New Zealand-based estimates of colon cancer risk arising from specific exposures, nor any estimates of attributable fraction. One New Zealand study specifically examined the relationship between occupational physical activity and the risk of colon and rectal cancer and found raised risks in several occupations, and another study identified several occupations associated with an increased risk. There is no comprehensive published New Zealand information on the extent of workforce exposure to any of the specific agents that have been associated with possible increases in the risk of colon cancer. A wide range of occupations in the New Zealand workforce is relevant to the implicated exposures.

Introduction

Colon cancer is a malignant disease of the large bowel (excluding the rectum).

Exposures

The main risk factors for colon cancer are associated with diet, alcohol intake and other personal factors. The only occupational factor consistently associated with increased colon cancer is low physical activity, although amphibole asbestos is probably also associated with increased risk. Several exposures, occupations and industries have been inconsistently associated with increased risk. These include inorganic insulation dust, iron oxides, benzene and aliphatic ketones; general machinists; and non-metallic mineral products and leather goods[68-71].

International studies of risk

There are no international studies that provide robust risk estimates in terms of the main exposures. AFs of 5.6% for males and zero for females were used in the recent Finnish study[1].

New Zealand studies of risk

There are no New Zealand-based estimates of colon cancer risk arising from specific exposures, nor any estimates of attributable fraction. One New Zealand study specifically examined the relationship between occupational physical activity and the risk of colon and rectal cancer. This was a population-based study in which cases (registered from 1972 to 1980) were obtained from the New Zealand cancer registry and denominator data came from the 1976 national population Census. Occupations were allocated to sedentary, intermediate and high activity groups and relative risks, adjusted for age, calculated for the sedentary group compared to the other two groups combined. Raised relative risks for rectal cancer were found for sedentary occupations, but only for persons less than 55 years[72] (Table 3.5).

Two other studies provide information on colon cancer in New Zealand workers. One examined risks of large bowel cancer as part of a study of occupational cancer mortality in all New Zealand men from 1974 to 1978. The study obtained cause of death information from the National Health Statistics Centre and denominator information from a 10% random sample of the 1976 New Zealand Census. Rates were standardised for age. No information was available for any other potential confounders, and the recorded occupations in some of the death records were likely to be inaccurate or irrelevant to the conditions causing death. Some of the resulting bias was partly overcome by controlling for social class in the analysis. This showed increased rates of large bowel cancer in typists/stenographers (based on only four deaths) and cabinet makers/woodworkers (based on 11 deaths), and a suggestion of increased rates in printers (based on 12 deaths) and general labourers[60] (Table 3.5).

The second study was based on the whole New Zealand population, using the cancer registry to identify cases registered from 1973 to 1986. It identified an increased risk of colon cancer in managers and woodworkers[65].

New Zealand exposures

There is no comprehensive published New Zealand information on the extent of workforce exposure to any of the specific agents that have been associated with possible increases in the risk of colon cancer. A wide range of occupations in the New Zealand workforce is relevant to the implicated exposures.

TABLE 3.5 Published estimates of increased risk of colon cancer in selected occupational groups – New Zealand-based studies only

WORK GROUP	RR	95% CI	RISK MEASURE AND STUDY DETAILS	YEAR AND SOURCE
Sedentary occupations[1]	1.18	1.02 – 1.36	RR[2]: cohort[3], 1972-1980	Fraser, 1993[72]
- 15-34	1.01	0.45 – 2.30	RR[2]: cohort[3], 1972-1980	Fraser, 1993[72]
- 35-44	1.79	1.21 – 2.63	RR[2]: cohort[3], 1972-1980	Fraser, 1993[72]
- 45-54	1.45	1.12 – 1.88	RR[2]: cohort[3], 1972-1980	Fraser, 1993[72]
- 55-64	0.97	0.78 – 1.19	RR[2]: cohort[3], 1972-1980	Fraser, 1993[72]
Typists/stenographers	4.20	1.13 – 10.8	RR[4]: cohort[5], 1974-1978	Pearce, 1985[60]
Cabinet makers/ woodworkers	2.45	1.22 – 4.38	RR[3]: cohort[4], 1974-1978	Pearce, 1985[60]
Woodworkers	1.47	1.15 – 1.86	SMR[6]: cohort[7], 1973-1986	Firth, 1993[65]
Printers	1.84	0.95 – 3.21	RR[3]: cohort[4], 1974-1978	Pearce, 1985[60]
Labourers	1.52	0.89 – 2.43	RR[3]: cohort[4], 1974-1978	Pearce, 1985[60]
Managers	1.25	1.04 – 1.48	SMR[6]: cohort[7], 1973-1986	Firth, 1993[65]

1: Sedentary occupations were managers, clerical nec, book-keepers and cashiers, accountants, clerical supervisors, government executive officials, professional/technical nec, jurists, catering/lodging managers, authors/journalists, statisticians/mathematicians, telephone/telegraph operators, jewellery workers, legislative administrators/managers, computing machine operators, and economists and typists/stenographers

2: Age-standardised; males only

3: Cancer registry used for cases and controls

4: Age-standardised and compared to males in the same social class. Cases are all large bowel cancers

5: Cause of death information from the National Health Statistics Centre

6: Standardised for age and social class; males only

7: Cases from cancer registry; comparison to population data

RECTAL CANCER

Summary Rectal carcinoma is a malignant disease of the rectum, which is at the end of the large bowel. No occupational exposures have been strongly and consistently implicated as causes of rectal carcinoma, but several exposures have been implicated. These include rubber dust, rubber pyrolysis products, cotton dust, wool fibres, rayon fibres, solvents, polychloroprene, glass fibres, formaldehyde and ionising radiation. There are no New Zealand-based estimates of colon cancer risk arising from specific exposures, nor any estimates of attributable fraction. One New Zealand study specifically examined the relationship between occupational physical activity and the risk of colon and rectal cancer and found raised risks in several occupations, and two other studies identified several occupations associated with an increased risk. There is no comprehensive published New Zealand information on the extent of workforce exposure to any of the specific agents that have been associated with possible increases in the risk of rectal cancer. A wide range of occupations in the New Zealand workforce is relevant to the implicated exposures.

Introduction

Rectal carcinoma is a malignant disease of the rectum, which is at the end of the large bowel.

Exposures

There are no clear risk factors for rectal carcinoma, and no occupational exposures that have been strongly and consistently implicated as causes of rectal carcinoma. One recent exploratory case-control study identified an increased risk with a range of exposures, including rubber dust, rubber pyrolysis products, cotton dust, wool fibres, rayon fibres, solvents, polychloroprene, glass fibres, formaldehyde and ionising radiation[73, 74].

International studies of risk

There are no international studies that provide robust risk estimates in terms of the main exposures. AFs of 3.1% for males and 0.1% for females were used in the recent Finnish study[1].

New Zealand studies of risk

There are no New Zealand-based estimates of rectal cancer risk arising from specific exposures, nor any estimates of attributable fraction. Several studies provide information on rectal cancer risk in New Zealand workers.

One study specifically examined the relationship between occupational physical activity and the risk of colon and rectal cancer. This was a population-based study in which cases (registered from 1972 to 1980) were obtained from the New Zealand cancer registry and denominator data came from the 1976 national population Census. Occupations were allocated to sedentary, intermediate and high activity groups and relative risks, adjusted for age, calculated for the sedentary group compared to the other two groups combined. Raised relative risks for rectal cancer were found for sedentary occupations, and seemed to decrease with age[72] (Table 3.6).

Another study examined risks of large bowel cancer as part of a study of occupational cancer mortality in all New Zealand men from 1974 to 1978. These results were described in the previous section on colon cancer[60].

A third study calculated standardised incidence rate ratios for males, based on the whole New Zealand population, using the cancer registry to identify cases from 1972 to 1984. Rates were standardised for age and socio-economic status. This study identified an increased risk of rectal cancer incidence in woodworkers[66] (Table 3.6).

New Zealand exposures

There is no comprehensive published New Zealand information on the extent of workforce exposure to any of the specific agents that have been associated with possible increases in the risk of rectal cancer. A wide range of occupations in the New Zealand workforce is relevant to the implicated exposures.

TABLE 3.6 Published estimates of increased risk of rectal cancer in selected occupational groups – New Zealand-based studies only

WORK GROUP	RR	95% CI	RISK MEASURE AND STUDY DETAILS	YEAR AND SOURCE
Sedentary occupations[1]	1.26	1.04 – 1.52	RR[2]: cohort[3], 1972-1980	Fraser, 1993[72]
- age 15-34 years	2.85	1.15 – 7.08	RR[2]: cohort[3], 1972-1980	Fraser, 1993[72]
- age 35-44 years	1.26	0.69 – 2.31	RR[2]: cohort[3], 1972-1980	Fraser, 1993[72]
- age 45-54 years	1.47	1.04 – 2.08	RR[2]: cohort[3], 1972-1980	Fraser, 1993[72]
- age 55-64 years	1.12	0.87 – 1.45	RR[2]: cohort[3], 1972-1980	Fraser, 1993[72]
Woodworkers	1.46	1.16 – 1.81	SIR[4]: cohort[5], 1972-1984	Firth, 1996[66]

1: Sedentary occupations were managers, clerical nec, book-keepers and cashiers, accountants, clerical supervisors, government executive officials, professional/technical nec, jurists, catering/lodging managers, authors/journalists, statisticians/mathematicians, telephone/telegraph operators, jewellery workers, legislative administrators/managers, computing machine operators, and economists and typists/stenographers

2: Age-standardised; males only

3: Cancer registry used for cases and controls

4: Standardised for age and socio-economic status

5: Standardised mortality analysis using cases from the New Zealand cancer registry

Summary Liver cancer is a malignant disease of the liver. Occupation probably only plays a small role in its development. Occupational exposures known to be strongly associated with liver cancer are vinyl chloride monomer and hepatitis B (HBV) and hepatitis C (HCV) infection. Occupations at high risk of exposure to HBV and HVC (or high alcohol intake) therefore have increased risk of developing liver cancer. Other exposures and occupations have been less consistently associated with increased risk. These include organic solvents, welding fumes and silica, and working as a milker. There are no New Zealand-based estimates of liver cancer risk arising from specific exposures, nor any estimates of attributable fraction. Two New Zealand studies identified an increased risk of liver cancer in several different occupation groups. There is no comprehensive published New Zealand information on the extent of workforce exposure to any of the specific agents that have been associated with possible increases in the risk of liver cancer. A wide range of occupations in the New Zealand workforce is relevant to the implicated exposures, although there is little or no exposure to vinyl chloride monomer.

Introduction

Liver cancer is a primary malignant disease of the liver. The most common form is hepatocellular carcinoma.

Exposures

Known causes of hepatocellular carcinoma are hepatitis B and C infection, dietary aflatoxin B1 and cirrhosis (with alcohol being the main cause). Occupation probably only plays a small role in its development. Occupational exposures known to be strongly associated with liver cancer are vinyl chloride monomer and hepatitis B and C infection. Occupations at high risk of exposure to hepatitis B and C infection (or high alcohol intake) therefore have increased risk of developing liver cancer. Other exposures and occupations that have been less consistently associated with increased risk include some organic solvents, welding fumes and silica; and working as a milker (possibly due to exposure to aflatoxins)[75-79].

International studies of risk

There are no international studies that provide robust risk estimates in terms of the main exposures. Recent attributable fraction estimates have been 0.4% to 1.1% for the United States[2], and 3.5% for males and 5.3% for females were used in the recent Finnish study[1].

New Zealand studies of risk

There are no New Zealand-based estimates of liver cancer risk arising from specific exposures, nor any estimates of attributable fraction. One New Zealand-based study identified an increased risk of liver cancer in all woodworkers (based on 15 exposed cases), and particularly in sawmill, pulp and paper mill workers (based on only four exposed cases). The study was a population-based case-control study that used cancer registry cases registered between 1980 and 1984. Persons with other types of cancer served as the controls[59] (Table 3.7).

Another study examined risks of liver cancer as part of a study of occupational cancer mortality in all New Zealand men from 1974 to 1978. The study obtained cause of death information from the National Health Statistics Centre and denominator information from a 10% random sample of the 1976 New Zealand Census. Rates were standardised for age. No information was available for any other potential confounders, and the recorded occupations in some of the death records were likely to be inaccurate or irrelevant to the conditions causing death. Some of the resulting bias was partly overcome by controlling for social class in the analysis. This showed a suggestion of increased rates of liver cancer in performing artists and composers (based on only two deaths), wood preparation/paper workers (based on four deaths) and transport operators (based on ten deaths)[60] (Table 3.7).

New Zealand exposures

There is no comprehensive published New Zealand information on the extent of workforce exposure to any of the specific agents that have been associated with possible increases in the risk of liver cancer. A wide range of occupations in the New Zealand workforce is relevant to the implicated exposures, although there is little or no exposure to vinyl chloride monomer.

TABLE 3.7 Published estimates of increased risk of liver cancer in selected occupational groups – New Zealand-based studies only

WORK GROUP	RR	95% CI	RISK MEASURE AND STUDY DETAILS	YEAR AND SOURCE
Woodworkers	1.87	1.11 – 3.17	OR[1]: CC[2], 1980-1984	Kawachi, 1989[59]
Sawmill, pulp and paper mill workers	3.55	1.09 – 10.14	OR[1]: CC[2], 1980-1984	Kawachi, 1989[59]
Wood preparation/ paper workers	4.24	1.14 – 10.9	RR[3]: cohort[4], 1974-1978	Pearce, 1985[60]
Performing artists/ composers	25.1	13.5 – 42.5	RR[3]: cohort[4], 1974-1978	Pearce, 1985[60]
Transport operators	3.05	1.46 – 5.61	RR[3]: cohort[4], 1974-1978	Pearce, 1985[60]

1: Age-standardised; males only
2: Cancer registry used for cases and controls
3: Age-standardised and compared to males in the same social class
4: Cause of death information from the National Health Statistics Centre

GALL BLADDER CANCER

Summary Gall bladder cancer is a malignant disease of the gall bladder. There are no occupational exposures that have been strongly and consistently implicated as causes of gall bladder cancer, and occupation probably only plays a small role in its development. However, work in several industries has been inconsistently associated with increased risk. This includes work in the rubber industry, petroleum refining, paper mills, chemical processing, shoe making and repairing, and textiles. There are no New Zealand-based estimates of gall bladder cancer risk arising from specific exposures or occupations, nor any estimates of attributable fraction. There is no comprehensive published New Zealand information on the extent of workforce exposure to the industries that have been associated with possible increases in the risk of gall bladder cancer, but all occur in New Zealand.

Introduction

Gall bladder cancer is a malignant disease of the gall bladder.

Exposures

There are no clear external risk factors associated with gall bladder cancer. There are no occupational exposures that have been strongly and consistently implicated as causes of gall bladder cancer, and occupation probably only plays a small role in its development. However, work in the rubber industry, petroleum refining, paper mills, chemical processing, shoe making and repairing, and textiles has been inconsistently associated with increased risk[80, 81].

International studies of risk

There are no international studies that provide robust risk estimates in terms of the main exposures. AFs of 0.2% for males and 0.4% for females were used in the recent Finnish study[1].

New Zealand studies of risk

There are no New Zealand-based estimates of gall bladder cancer risk arising from specific exposures or occupations, nor any estimates of attributable fraction.

New Zealand exposures

There is no comprehensive published New Zealand information on the extent of workforce exposure to the industries that have been associated with possible increases in the risk of gall bladder cancer, but all occur in New Zealand.

PANCREATIC CANCER

Summary Pancreatic cancer is a malignant disease of the pancreas. There are no occupational exposures that have been strongly and consistently implicated as causes of pancreatic cancer, and occupation probably only plays a small role in its development. However, several exposures and occupations have been inconsistently associated with increased risk. These include pesticides and non-chlorinated solvents; and travel agent, librarian/archivist/curator, pharmacist/dietitian/therapist, electrical worker, glass/pottery/tile worker, metal processing worker, docker/freight handler and waiter. There are no New Zealand-based estimates of pancreatic cancer risk arising from specific exposures, nor any estimates of attributable fraction. One study identified an increased risk of pancreatic in New Zealand managers. There is no comprehensive published New Zealand information on the extent of workforce exposure to any of the specific agents and occupations that have been associated with possible increases in the risk of pancreatic cancer. All of the associated exposures and occupations occur in the New Zealand workforce.

Introduction

Pancreatic cancer is a malignant disease of the pancreas.

Exposures

Smoking and age are the main risk factors for pancreatic cancer. There are no occupational exposures that have been strongly and consistently implicated as causes of pancreatic cancer, and occupation probably only plays a small role in its development. Exposures and occupations that have been inconsistently associated with increased risk include pesticides and non-chlorinated solvents; and travel agent, librarian/archivist/curator, pharmacist/dietitian/therapist, electrical worker, glass/pottery/tile worker, metal processing workers, docker/freight handlers and waiters[82-85].

International studies of risk

There are no international studies that provide robust risk estimates in terms of the main exposures. AFs of 13.4% for males and 3.5% for females were used in the recent Finnish study[1].

New Zealand studies of risk

There are no New Zealand-based estimates of pancreatic cancer risk arising from specific exposures, nor any estimates of attributable fraction. Another study examined risks of pancreatic cancer as part of a study of occupational cancer mortality in all New Zealand men from 1974 to 1978. The study obtained cause of death information from the National Health Statistics Centre and denominator information from a 10% random sample of the 1976 New Zealand Census. Rates were standardised for age. No information was available for any other potential confounders, and the recorded occupations in some of the death records were likely to be inaccurate or irrelevant to the conditions causing death. Some of the resulting bias was partly overcome by controlling for social class in the analysis. This showed an increased rate of pancreatic cancer in managers[60] (Table 3.8).

New Zealand exposures

There is no comprehensive published New Zealand information on the extent of workforce exposure to any of the specific agents and occupations that have been associated with possible increases in the risk of pancreatic cancer. All of the associated exposures and occupations occur in the New Zealand workforce.

TABLE 3.8 Published estimates of increased risk of pancreatic cancer in selected occupational groups – New Zealand-based studies only

WORK GROUP	RR	95% CI	RISK MEASURE AND STUDY DETAILS	YEAR AND SOURCE
Managers	1.96	1.31 – 2.82	RR[1]: cohort[2], 1974-1978	Pearce, 1985[60]

1: Age-standardised and compared to males in the same social class
2: Cause of death information from the National Health Statistics Centre

SINO-NASAL CARCINOMA

Summary Sino-nasal carcinoma is a malignant disease of the lining tissues of the nose and upper airways. Exposure to wood dust has been consistently implicated as an occupational cause of sino-nasal cancer, and other exposures have been associated with an increased risk. These include leather dust, and work with welding, flame cutting and soldering. There are no New Zealand-based estimates of sino-nasal cancer risk arising from specific exposures, nor any estimates of attributable fraction. One study identified an increased risk of sino-nasal cancer in New Zealand forestry and logging workers. There is no comprehensive published New Zealand information on the extent of workforce exposure to specific agents that have been implicated as possibly increasing the risk of sino-nasal cancer. Forestry and logging, sawmill work and timber manufacturing occupations are the main New Zealand occupations relevant to the implicated exposures.

Introduction

Sino nasal carcinoma is a malignant disease of the lining tissues of the nose and upper airways. It has various forms, with adenocarcinoma probably the type most commonly associated with occupational exposures.

Exposures

Exposure to wood dust has been consistently implicated as an occupational cause of sino-nasal cancer. In addition, exposure to leather dust, and work with welding, flame cutting and soldering, have been associated with an increased risk[86-88].

International studies of risk

Sino-nasal carcinoma in males (but not females) was associated with wood dust in an analysis that pooled the results from several European case-control studies (OR = 2.4, 95% CI 1.8 – 3.2). Recent attributable fraction estimates have been 33% to 46% for the United States[2], and 24% (males) and 6.7% (females) in Finland[1].

New Zealand studies of risk

There are no New Zealand-based estimates of sino-nasal cancer risk arising from specific exposures, nor any estimates of attributable fraction. One New Zealand-based study identified an increased risk of sino-nasal cancer in foresters and loggers, although the estimate was imprecise and based on only two exposed cases. The study was a population-based case-control study that used cancer registry cases registered between 1980 and 1984. Persons with other types of cancer served as the controls[59] (Table 3.9).

New Zealand exposures

There is no comprehensive published New Zealand information on the extent of workforce exposure to any of the specific agents that have been associated with possible increases in the risk of sino-nasal cancers. Forestry and logging, sawmill work and timber manufacturing occupations are the main New Zealand occupations relevant to the implicated exposures.

TABLE 3.9 Published estimates of increased risk of sino-nasal cancer in selected occupational groups – New Zealand-based studies only

WORK GROUP	RR	95% CI	RISK MEASURE AND STUDY DETAILS	YEAR AND SOURCE
Foresters and loggers	6.02	1.01 – 28.41	OR[1]: CC[2], 1980-1984	Kawachi, 1989[59]

1: Age-standardised
2: Cancer registry used for cases and controls

LARYNX

Summary Laryngeal cancer is a malignant disease of the larynx. Many occupational exposures have been associated with an increased risk of laryngeal cancer. The strongest evidence is for sulphuric acid mists, asbestos and organic solvents. Implicated occupations and industries are those in construction; metal, textile, ceramic and food manufacturing; railway transport; logging; and manual work. There are no New Zealand-based estimates of laryngeal cancer risk arising from specific exposures, nor any estimates of attributable fraction. Two New Zealand studies provide estimates of increased risk in fire fighters and meat workers. There is no comprehensive published New Zealand information on the extent of workforce exposure to the main exposures. Exposure to the implicated agents is likely to occur in a range of manufacturing and construction occupations in New Zealand.

Introduction

Laryngeal cancer is a malignant disease of the larynx.

Exposures

Many occupational exposures have been associated with an increased risk of laryngeal cancer. The strongest evidence is for sulphuric acid mists, asbestos and organic solvents. Implicated occupations and industries are those in construction; metal, textile, ceramic and food manufacturing; railway transport; logging; and manual work[89-93].

International studies of risk

In terms of the main exposures, relevant estimates of relative risks are available from a recent large European case-control study. This showed raised odds ratios for exposure to organic solvents (OR = 1.7; 95% CI 1.1 – 2.5) and asbestos (OR = 1.6; 95% CI 1.0 – 2.5). Recent attributable fraction estimates have been 1% to 20% for the United States[2], and 9.3% (males) and 0.5% (females) in Finland[1].

New Zealand studies of risk

There are no New Zealand-based estimates of laryngeal cancer risk arising from specific exposures, nor any estimates of attributable fraction. Two New Zealand studies provide estimates of increased risk in certain occupations. One calculated standardised incidence rate ratios for males, based on the whole New Zealand population, using the cancer registry to identify cases from 1972 to 1984. Rates were standardised for age and socio-economic status. This study identified an increased risk of laryngeal cancer incidence in fire fighters (SIR = 10.7; 95% CI 2.8 – 27.8)[66]. The second study identified an increased risk in male meat workers (OR = 2.01; 95% CI 1.19 – 3.39). This was a case-control study based on cancer registry data from 1980 to 1984, using the other cancer cases as controls[94] (Table 3.10)

New Zealand exposures

There is no comprehensive published New Zealand information on the extent of workforce exposure to the main exposures. Exposure to the implicated agents is likely to occur in a range of manufacturing and construction occupations in New Zealand.

TABLE 3.10 Published estimates of increased risk of laryngeal cancer in selected occupational groups – New Zealand-based studies only

WORK GROUP	RR	95% CI	RISK MEASURE AND STUDY DETAILS	YEAR AND SOURCE
Fire fighters	10.7	2.8 – 27.8	SIR[1]: cohort[2], 1972-1984	Firth, 1996[66]
Meat workers	2.01	1.19 – 3.39	OR[3]: CC[4], 1980-1984	Reif, 1989[94]

1: Standardised for age and social class; males only
2: Cases from cancer registry; comparison to population data
3: Age-standardised
4: Cancer registry used for cases and controls

LUNG AND BRONCHUS

Summary Lung cancer is a malignant disease of the respiratory tree and gas exchange areas of the lung. Occupational exposures strongly implicated as causing lung cancer are asbestos, arsenic, beryllium, cadmium, chromium VI, diesel fumes, nickel, radon, silica, soots, bis-(chloro-methyl) ether and environmental tobacco smoke. There are no New Zealand-based estimates of lung cancer risk arising from specific exposures, nor any estimates of attributable fraction. However, there are several published measures of increased risk of developing lung cancer in certain New Zealand work groups, including bricklayers and carpenters, "asbestos-exposed" workers, machine tool operators, sawmillers, welders, pulp and paper mill workers and meat workers. There is little comprehensive published New Zealand information on the extent of workforce exposure to specific agents that have been identified as increasing the risk of lung cancer. One study produced New Zealand-based estimates of attributable fraction of 7.5% for men and 5.3% for women for lung cancer from occupational environmental tobacco smoke exposure. A wide range of occupations in New Zealand would involve exposure to one or more lung carcinogens.

Introduction

Lung cancer is a malignant disease of the respiratory tree and gas exchange areas of the lung.

Exposures

The main exposures associated with lung cancer are asbestos, arsenic, beryllium, cadmium, chromium VI, diesel fumes, nickel, radon, silica, soots, bis-(chloro-methyl) ether and environmental tobacco smoke[95-100]. All but diesel fumes have been listed by the International Agency for Research on Cancer (IARC) as definite human carcinogens causing lung cancer[96]. Diesel exhaust is classified by IARC as a probable human carcinogen[101]. There is a wide range of occupations and industries that have exposure to one or more of these substances.

International studies of risk

In terms of the main exposures, relevant estimates of relative risks are available. Estimates from a 1996 review paper by Steenland and co-workers are summarised in Table 3.11. Recent attributable fraction estimates have been 8.0% to 19.2% (males) and 2% (females) for the United States[2], and 29% (males) and 5.3% (females) in Finland[1].

TABLE 3.11 Published estimates of increased risk of lung cancer for exposure to selected agents[1]

EXPOSURE	RR	95% CI
Arsenic	3.69	3.06 – 4.46
Asbestos	2.0	1.90 – 2.11
Beryllium	1.49	
Cadmium	1.49	0.96 – 2.22
Chromium VI	2.78	2.47 – 3.52
Diesel exhaust	1.31	1.13 – 1.44
Nickel	1.56	1.41 – 1.73
Silica	1.33	1.21 – 1.45

Based on Steenland et al, 1996[100]

New Zealand studies of risk

There are two New Zealand-based estimates of lung cancer risk arising from specific exposures. The earlier study, based on 1985 data, examined the role of passive smoking in the development of lung cancer (and ischaemic heart disease). Pooled risk estimates were used to estimate the number of deaths related to environmental and workplace environmental tobacco smoke. The estimated pooled workplace relative risk was 2.2 (95% CI 1.4 – 3.0) for both men and women[102]. A later study, based on 1997 data and incorporating a more sophisticated approach, used relative risk estimates of 1.24 (95% CI 1.13 – 1.36) for both males and females, and estimated that there were 4.2 deaths of males and 1.4 deaths of females each year due to workplace exposure to environmental tobacco smoke. This second study produced New Zealand-based estimates of attributable fraction of 7.5% for men and 5.3% for women[103]. Slightly different numbers were presented in an earlier report by the same authors[104].

There are several published measures of the risk of developing lung cancer in certain work groups. These come from individual worker cohort studies, standardised analyses using whole population data, and population-based case-control studies that used cancer registry data. These case-control studies used other cancer cases as the controls. Some of the studies overlapped each other.

The studies showed increased risk of lung cancer in bricklayers and carpenters, "asbestos-exposed" workers, machine tool operators, sawmillers, welders, pulp and paper mill workers and meat workers[59, 60, 65, 105-110] (Table 3.12).

New Zealand data were also included in multi-centre IARC studies examining the role of phenoxyherbicides, including those contaminated by dioxins, in the development of various forms of cancer. These studies suggested a slight increase in the risk of lung cancer, based on a small number of cases[111, 112].

TABLE 3.12 Published estimates of increased risk of lung cancer in selected occupational groups – New Zealand-based studies only

WORK GROUP	RR	95% CI	RISK MEASURE AND STUDY DETAILS	YEAR AND SOURCE
Bricklayers and carpenters	1.25	1.10 – 1.41	SMR[1]: cohort[2], 1973-1986	Firth, 1993[65]
Carpenters	1.27	1.05 – 1.54	OR[3]: CC[4], 1980-1984	Kawachi, 1989[59]
"Asbestos-exposed" workers	1.2	1.1 – 1.3	OR[3]: CC[4], 1980-1984	Glass, 1991[105]
Machine tool operators	2.18	1.21 – 3.42	SMR[1]: cohort[2], 1973-1986	Firth, 1993[65]
Sawmillers	1.76	1.23 – 2.52	OR[3]: CC[4], 1980-1984	Kawachi, 1989[59]
Welders	1.40	1.20 – 1.61	SMR[1]: cohort[2], 1973-1986	Firth, 1993[65]
Pulp and paper mill workers	1.33	0.94 – 1.83	SMR[3]: cohort[5], 1978-1992	McLean, 2002[107]
Meat workers	1.79	1.13 – 2.68	SMR[3]: cohort[6], 1988-2000	McLean, 2003, 2004[108, 109]
Meat workers	1.70	1.11 – 2.49	SIR[3]: cohort[6], 1988-2000	McLean, 2003, 2004[108, 109]
Meat workers	1.30	1.06 – 1.58	OR[3]: CC[4], 1980-1984	Reif, 1989[94]
Cooks, waiters, bartenders	2.23	1.47 – 3.25	RR[1]: cohort[7], 1974-1978	Pearce, 1985[60]
Hairdressers, beauticians	2.54	0.82 – 5.93	RR[1]: cohort[7], 1974-1978	Pearce, 1985[60]
Fishermen, hunters	2.06	0.99 – 3.79	RR[1]: cohort[7], 1974-1978	Pearce, 1985[60]
Food and beverage processors	1.29	1.03 – 1.59	RR[1]: cohort[7], 1974-1978	Pearce, 1985[60]
Labourers nec	1.38	1.16 – 1.63	RR[1]: cohort[7], 1974-1978	Pearce, 1985[60]

1: Standardised for age and social class; males only
2: Cases from cancer registry; comparison to population data
3: Age-standardised
4: Cancer registry used for cases and controls
5: Cohort of pulp and paper mill workers
6: Cohort of meat workers
7: Cause of death information from the National Health Statistics Centre

New Zealand exposures

There is little comprehensive published New Zealand information on the extent of workforce exposure to specific agents that have been identified as increasing the risk of lung cancer. Several New Zealand studies have produced estimates of the prevalence of environmental tobacco smoke exposure in the workplace in New Zealand. These estimates range from 23% to 83%, and are presented in more detail in Section 4.2. A wide range of occupations in New Zealand would involve exposure to one or more lung carcinogens, and they are not listed individually here.

BONE

Summary Bone cancer is a rare primary malignant disease of bone. There is little firm evidence of occupational causes of bone cancer, but a weak relationship with ionising radiation in nuclear power plant workers and airline crew (via cosmic rays) has been identified. There are no New Zealand-based estimates of bone cancer risk arising from specific exposures, nor any estimates of attributable fraction. One case-control study suggested an increased risk in farmers. There is no comprehensive published New Zealand information on the extent of workforce exposure to specific agents that have been identified as increasing the risk of bone cancer.

Introduction

Bone cancer is a primary malignant disease of bone. There are several different types, but overall it is a rare cancer.

Exposures

There is little firm evidence of occupational causes of bone cancer, but a weak relationship with ionising radiation in nuclear power plant workers[113] and airline crew (via cosmic rays)[114] has been identified. An increased risk in the children of persons living on farms has also been suggested[115].

International studies of risk

The most robust available risk measures relating to specific exposures are standardised mortality ratios of 7.9 (1.6 to 32) and 4.1 (1.2 to 14) in plutonium plant workers[113] and a standardised incident ratio of 15.10 (1.82 to 54.40) in female airline crew[114].

New Zealand studies of risk

There are no New Zealand-based estimates of bone cancer risk arising from specific exposures, nor any estimates of attributable fraction. One study identified an increased risk of bone cancer in male farmers (OR = 1.95; 95% CI 1.00 – 3.80), particularly general farmers (OR = 2.57; 95% CI 1.29 – 5.10)[94]. This was a case-control study based on cancer registry data from 1980 to 1984, using the other cancer cases as controls (Table 3.14).

New Zealand exposures

There is no comprehensive published New Zealand information on the extent of workforce exposure to ionising radiation. Such exposure is likely to be primarily in the health sector (e.g. radiologists, radiographers, nuclear medicine technicians) and some industrial sectors where X-rays are used to assess structural integrity, but there are no nuclear power plants. Increased exposure to cosmic radiation can be expected in airline crew, but the extent of this increased exposure, and the associated risks, are not known.

TABLE 3.13 Published estimates of increased risk of bone cancer in selected occupational groups – New Zealand-based studies only

WORK GROUP	RR	95% CI	RISK MEASURE AND STUDY DETAILS	YEAR AND SOURCE
Farmers	1.95	1.00 – 3.80	OR[1]: CC[2], 1980-1984	Reif, 1989[94, 116]
- general	2.57	1.29 – 5.10	OR[1]: CC[2], 1980-1984	Reif, 1989[94, 116]

1: Age-standardised; males only
2: Cancer registry used for cases and controls

Summary Melanoma is a malignant disease of the melanin-containing cells of the skin. The only occupational exposure strongly implicated as increasing the risk of malignant melanoma is sunlight, although the relationship is not straightforward. However, there is some evidence that occupations that provide chronic sunlight exposure may provide protection from melanoma. There is also some evidence that artificial sources of ultraviolet light and polychlorinated biphenyls may increase the risk of melanoma. A range of exposures and occupations has been associated with an increased risk, particularly those involving outdoor work. There are no New Zealand-based estimates of melanoma risk arising from specific exposures, nor any estimates of attributable fraction. Two New Zealand-based studies suggested an increased risk in clerical workers and farmers. There is no comprehensive published New Zealand information on the extent of workforce exposure to specific agents. Many outdoor occupations in New Zealand have considerable exposure to sunlight, with farmers, forestry workers and fishermen probably the most common in New Zealand. Dentists are probably the New Zealand occupation most commonly exposed to artificial sources of ultraviolet light.

Introduction

Melanoma is a malignant disease of the melanin-containing cells of the skin.

Exposures

The only occupational exposure strongly implicated as increasing the risk of malignant melanoma is sunlight. However, the relationship is not straightforward, as there is some evidence that occupations that provide chronic sunlight exposure may provide protection from melanoma[117, 118]. There is also some evidence that artificial sources of ultraviolet light and polychlorinated biphenyls may increase the risk of melanoma[119]. Other agents have been suggested, but the evidence for them is inconclusive. Occupation and industry groups that have been identified as possibly having an increased risk of melanoma are outdoor workers (farmers); workers exposed to artificial ultraviolet light sources (dentists, physiotherapists and lithographers); and a variety of other occupations such as electricians, electricity linemen and repairmen, warehouse clerks, salesmen, and miners and quarrymen[120, 121].

International studies of risk

There are no international studies that provide robust risk estimates in terms of occupational exposures associated with increased melanoma risk, although several provide suggestive information[120, 121]. AFs of 4.3% for males and 0.4% for females were used in the recent Finnish study[1].

New Zealand studies of risk

There are no New Zealand-based estimates of melanoma risk arising from specific exposures, nor any estimates of attributable fraction. One study in the early 1980s specifically addressed aspects of melanoma risk in New Zealand workers. This study found increased risk in professional, technical, administrative and managerial workers, but stated that the increased risk may have been due to differences in socio-economic status[122].

There are also several published measures of the risk of developing melanoma in certain work groups. These come from a standardised analysis using whole population data, and a population-based case-control study that used cancer registry data. The case-control study used other cancer cases as the controls. Both studies only included males. These studies found an increased risk of melanoma in clerical workers and farmers[65, 94, 110] (Table 3.14).

New Zealand exposures

There is no comprehensive published New Zealand information on the extent of workforce exposure to specific agents that have been associated (although the evidence is weak for all these occupational exposures, apart from sun exposure) with an increased risk of melanoma. Many outdoor occupations in New Zealand have considerable exposure to sunlight, with farmers, forestry workers and fishermen probably the most common. Dentists are probably the New Zealand occupation most commonly exposed to artificial sources of ultraviolet light.

TABLE 3.14 Published estimates of increased risk of melanoma in selected occupational groups – New Zealand-based studies only

WORK GROUP	RR	95% CI	RISK MEASURE AND STUDY DETAILS	YEAR AND SOURCE
Clerical workers	1.47	1.06 – 1.99	SMR[1]: cohort[2], 1973-1986	Firth, 1993[65]
Farmers	1.25	1.05 – 1.50	OR[3]: CC[4], 1980-1984	Reif, 1989[94, 116]
Farmers – general	1.31	1.07 – 1.60	OR[3]: CC[4], 1980-1984	Reif, 1989[94, 116]

1: Standardised for age and social class; males only
2: Standardised mortality analysis using cases from the New Zealand cancer registry
3: Age-standardised; males only
4: Cancer registry used for cases and controls

SKIN (NON-MELANOMA)

Summary Skin cancer is a malignant disease of the cells making up the skin. The only occupational exposure strongly implicated as increasing the risk of skin cancer is sunlight. Occupation and industry groups that have been identified as having an increased risk of skin cancer are outdoor workers, such as farmers, forestry workers and fishermen. There are no New Zealand-based estimates of skin cancer risk arising from specific exposures or occupations, nor any estimates of attributable fraction. There is no comprehensive published New Zealand information on the extent of workforce exposure to sunlight. Many outdoor occupations in New Zealand have considerable exposure to sunlight, with farmers, forestry workers and fishermen probably the most common.

Introduction

Skin cancer is a malignant disease of the cells making up the skin. Melanoma is excluded for the purposes of this section.

Exposures

The only occupational exposure strongly implicated as increasing the risk of skin cancer is sunlight. Occupation and industry groups that have been identified as having an increased risk of skin cancer are outdoor workers, such as farmers, forestry workers and fishermen[123, 124].

International studies of risk

AFs for skin cancer of 13.1% for males and 3.8% for females were used in the recent Finnish study[1].

New Zealand studies of risk

There are no New Zealand-based estimates of skin cancer risk arising from specific exposures or occupations, nor any estimates of attributable fraction.

New Zealand exposures

There is no comprehensive published New Zealand information on the extent of workforce exposure to sunlight. Many outdoor occupations in New Zealand have considerable exposure to sunlight, with farmers, forestry workers and fishermen probably the most common.

MESOTHELIOMA

Summary Malignant mesothelioma is a malignant disease of the inside lining of the chest wall (pleura), pericardium and abdomen (peritoneum). The latency between exposure and development of disease is in the order of 20 to 50 or more years. Asbestos is the only known cause, and the vast majority of this exposure occurs in an occupational context. Work in a range of occupations has been associated with asbestos exposure and mesothelioma occurrence. In the New Zealand context, construction workers and waterside workers are likely to be, or to have been, exposed. These occupations account for the majority of identified occupational malignant mesothelioma cases in New Zealand. The only relevant New Zealand studies identified raised risks of malignant mesothelioma in "asbestos-exposed workers" and in "foundry and heavy engineering workers". The number and rate of mesothelioma cases are expected to rise at least until about 2010.

Introduction

Malignant mesothelioma is a malignant disease of the inside lining of the chest wall (pleura), pericardium and abdomen (peritoneum). Pleural mesothelioma is the most common form.

Exposures

Although there is a background rate of malignant mesothelioma of unknown cause, asbestos probably accounts for nearly all cases. The vast majority of this asbestos exposure occurs in an occupational context. The latency between exposure and development of disease is in the order of 20 to 50 or more years[125-127]. Asbestos exposure occurs in a wide variety of circumstances, such as construction occupations, machinery fitters, boilermakers, ships' firemen, waterside workers, railway workers and, in the past, asbestos miners and millers[105]. Asbestos is virtually no longer used in manufacturing, so exposure now occurs in occupations likely to come into contact with asbestos already in place in buildings, such as construction occupations and asbestos removalists.

International studies of risk

Amphibole asbestos is four to 30 times more carcinogenic than chrysotile asbestos. Strong evidence for the causal association between asbestos exposure and malignant mesothelioma, with a clear dose-response relationship and a latency of 20 to 60 years, comes from animal, cellular and human cohort and case-referent studies[125, 126, 128, 129]. Occupational exposures seem to be the primary source of asbestos exposures in approximately 90% of male cases and 25% of female cases[1, 2, 130].

New Zealand studies of risk

One study reporting a New Zealand-based case series of 128 malignant mesothelioma cases between 1954 and 1986 was published in 1989[131]. Two years later, a population-based case-control study of asbestos-exposed workers showed an increased risk of pleural and peritoneal cancers (presumably nearly all malignant mesotheliomas), using other cancer cases as controls[105]. Two standardised mortality analyses provided some further information. One, based on a cohort of workers from a foundry and heavy engineering plant, found an increased risk of pleural mesothelioma[132]. The second study was based on the whole New Zealand population,

using the cancer registry to identify cases. This study identified an increased estimated risk of pleural mesothelioma in bricklayers and carpenters, but the point estimate was imprecise and so the relevance of the result difficult to assess[65]. There are no New Zealand-based estimates of malignant mesothelioma risk arising from specific asbestos exposures (Table 3.15).

Kjellstrom and Smartt, in 2000, examined New Zealand malignant mesothelioma incidence rates from the 1960s to 1995. They clearly demonstrated the rising incidence of malignant mesothelioma due to past use of asbestos in New Zealand, something that had been predicted many years before[133]. The incidence rates rose steadily from the 1960s, with male rates of 25 per million persons in 1995. Rates were predicted to double by 2010. As expected from the long latency, incidence rates were highest in persons in their 60s and 70s[134].

The Occupational Safety and Health Service (OSH) has an asbestos exposure register. This consists of persons self-nominated as being, or having been, exposed to asbestos, and so provides a lower limit of asbestos-exposed persons. Along with this exposure register, an asbestos disease register was established, and this forms part of the broader NODS. An associated panel verifies all notified cases. From March 1992 to June 1998, there were 113 notifications of malignant mesothelioma. Of these, 107 were Caucasian and four Māori. The highest numbers of cases were in plumbers, fitters, laggers, carpenters and builders. Other occupations represented were waterside workers, electricians, asbestos processors and sprayers, and friction product workers[135].

New Zealand exposures

Imports of asbestos in New Zealand occurred from the 1940s and peaked in 1974, with a rapid decline after this time[134]. As mentioned above, asbestos exposure now occurs in occupations likely to come into contact with asbestos already in place in buildings, such as construction occupations and asbestos removalists.

TABLE 3.15 Published estimates of increased risk of malignant mesothelioma in selected occupational groups – New Zealand-based studies only

WORK GROUP	RR	95% CI	RISK MEASURE AND STUDY DETAILS	YEAR AND SOURCE
Pleural				
Asbestos-exposed workers	3.1	1.7 – 5.5	OR[1]: CC[2], 1980-1984	Glass, 1991[105]
Foundry and heavy engineering workers	6.58	1.24 – 19.49	SMR[1]: cohort[3], 1945-1991	Firth, 1999[132]
Bricklayers and carpenters	2.22	0.70 – 5.22	SMR[1]: cohort[4], 1973-1986	Firth, 1993[65]
Peritoneal				
Asbestos-exposed workers	2.1	1.0 – 4.7	OR[1]: CC[2], 1980-1984	Glass, 1991[105]

1: Age-standardised
2: Cancer registry used for cases and controls
3: Cohort of workers at a foundry and heavy engineering plant. Compared to New Zealand population
4: Standardised mortality analysis using cases from the New Zealand cancer registry

Summary Breast cancer is a malignant disease of the breast tissues. There are no occupational exposures that have been strongly and consistently implicated as causes of breast cancer, although several exposures and occupations have been weakly associated with increased risk. These include ionising radiation, for which there is moderate evidence, and exposure to asbestos, man-made vitreous fibres, chlorinated solvents, chlorinated hydrocarbon pesticides and polychlorinated biphenyls; work as a beautician, cosmetologist, chemist and in occupations with low physical activity; and work in the pharmaceutical industry. There are no New Zealand-based estimates of breast cancer risk arising from specific exposures or occupations, nor any estimates of attributable fraction. There is no comprehensive published New Zealand information on the extent of workforce exposure to any of the specific agents that have been associated with possible increases in the risk of breast cancer. A wide range of occupations in the New Zealand workforce is relevant to the implicated exposures.

Introduction

Breast cancer is a malignant disease of the breast tissues.

Exposures

The main external causes of breast cancer appear to be ionising radiation, oral contraceptives and dietary factors. There are no occupational exposures that have been strongly and consistently implicated as causes of breast cancer. The only occupational exposure for which there is moderate evidence of increased risk is ionising radiation. There is also some evidence for exposure to asbestos, man-made vitreous fibres, chlorinated solvents, chlorinated hydrocarbon pesticides and polychlorinated biphenyls; work as a beautician, cosmetologist, chemist and in occupations with low physical activity; and work in the pharmaceutical industry[136-141].

International studies of risk

There are no international studies that provide robust risk estimates in terms of the main exposures. An attributable fraction of 1.7% was used in the recent Finnish study[1].

New Zealand studies of risk

There are no New Zealand-based estimates of breast cancer risk arising from specific exposures or occupations, nor any estimates of attributable fraction.

New Zealand exposures

There is no comprehensive published New Zealand information on the extent of workforce exposure to any of the specific agents that have been associated with possible increases in the risk of breast cancer. A wide range of occupations in the New Zealand workforce is relevant to the implicated exposures.

Summary Cervical cancer is a malignant disease of the uterine cervix. There are no occupational exposures that have been strongly and consistently implicated as causes of cervical cancer. However, several exposures, occupations and industries have been inconsistently associated with increased risk. These include chlorinated and aromatic solvents, silica dust, wood dust and pesticides; and hotel/restaurant staff, cooks, maids, cleaners and woodworkers. There are no New Zealand-based estimates of cervical cancer risk arising from specific exposures or occupations, nor any estimates of attributable fraction. There is no comprehensive published New Zealand information on the extent of workforce exposure to any of the specific agents that have been associated with possible increases in the risk of cervical cancer. A wide range of occupations in the New Zealand workforce is relevant to the implicated exposures.

Introduction

Cervical cancer is a malignant disease of the uterine cervix.

Exposures

The main external risk factors associated with cervical cancer are infection with the human papilloma virus (HPV), cigarette smoking and possibly use of the oral contraceptive. There are no occupational exposures that have been strongly and consistently implicated as causes of cervical cancer. However, several exposures, occupations and industries have been inconsistently associated with increased risk. These include chlorinated and aromatic solvents, silica dust, wood dust and pesticides; and hotel/restaurant staff, cooks, maids, cleaners and woodworkers[1,42].

International studies of risk

There are no international studies that provide robust risk estimates in terms of the main exposures. An attributable fraction of 5.9% was used in the recent Finnish study[1].

New Zealand studies of risk

There are no New Zealand-based estimates of uterine cancer risk arising from specific exposures or occupations, nor any estimates of attributable fraction.

New Zealand exposures

There is no comprehensive published New Zealand information on the extent of workforce exposure to any of the specific agents that have been associated with possible increases in the risk of cervical cancer. A wide range of occupations in the New Zealand workforce is relevant to the implicated exposures.

UTERINE CANCER

Summary Uterine cancer is a malignant disease of the uterus. There are no occupational exposures that have been strongly and consistently implicated as causes of endometrial cancer, and occupation probably only plays a small role in its development. A small number of exposures and occupations have been inconsistently associated with increased risk. These include asbestos, animal dust and occupations with low physical activity. There are no New Zealand-based estimates of uterine cancer risk arising from specific exposures or occupations, nor any estimates of attributable fraction. There is no comprehensive published New Zealand information on the extent of workforce exposure to the few specific agents that have been associated with possible increases in the risk of uterine cancer. Several occupations in the New Zealand workforce are relevant to the implicated exposures.

Introduction

Uterine cancer is a malignant disease of the uterus. The most common form is endometrial cancer.

Exposures

The main external risk factors associated with endometrial cancer are oestrogen replacement therapy, obesity and dietary factors. There are no occupational exposures that have been strongly and consistently implicated as causes of endometrial cancer, and occupation probably only plays a small role in its development. However, asbestos, animal dust and occupations with low physical activity have been inconsistently associated with increased risk[1,42].

International studies of risk

There are no international studies that provide robust risk estimates in terms of the main exposures. An attributable fraction of 1.1% was used in the recent Finnish study[1].

New Zealand studies of risk

There are no New Zealand-based estimates of uterine cancer risk arising from specific exposures or occupations, nor any estimates of attributable fraction.

New Zealand exposures

There is no comprehensive published New Zealand information on the extent of workforce exposure to the few specific agents that have been associated with possible increases in the risk of uterine cancer. Several occupations in the New Zealand workforce are relevant to the implicated exposures.

OVARIAN CANCER

Summary Ovarian cancer is a malignant disease of the ovaries. There are no occupational exposures that have been strongly and consistently implicated as causes of ovarian cancer, and occupation probably only plays a small role in its development. However, several exposures, occupations and industries have been inconsistently associated with increased risk. These include exposure to aromatic and aliphatic hydrocarbons, aromatic amines, organic dust, leather dust, man-made vitreous fibres, asbestos, and gasoline and diesel exhausts; work as a hairdresser and beautician; and employment in the printing, dry cleaning, telegraph and telephone, paper packaging and graphic and printing industries. There are no New Zealand-based estimates of ovarian cancer risk arising from specific exposures or occupations, nor any estimates of attributable fraction. There is no comprehensive published New Zealand information on the extent of workforce exposure to any of the specific agents that have been associated with possible increases in the risk of ovarian cancer. A wide range of occupations in the New Zealand workforce is relevant to the implicated exposures.

Introduction

Ovarian cancer is a malignant disease of the ovaries.

Exposures

There are no important external risk factors associated with ovarian cancer. There are also no occupational exposures that have been strongly and consistently implicated as causes of ovarian cancer, and occupation probably only plays a small role in its development. However, several exposures, occupations and industries have been inconsistently associated with increased risk. These include exposure to aromatic and aliphatic hydrocarbon, aromatic amines, organic dust, leather dust, man-made vitreous fibres, asbestos, and gasoline and diesel exhausts; work as a hairdresser and beautician; and employment in the printing, dry cleaning, telegraph and telephone, paper packaging and graphic and printing industries[143-145].

International studies of risk

There are no international studies that provide robust risk estimates in terms of the main exposures. An attributable fraction of 2.1% was used in the recent Finnish study[1].

New Zealand studies of risk

There are no New Zealand-based estimates of ovarian cancer risk arising from specific exposures or occupations, nor any estimates of attributable fraction.

New Zealand exposures

There is no comprehensive published New Zealand information on the extent of workforce exposure to any of the specific agents that have been associated with possible increases in the risk of ovarian cancer. A wide range of occupations in the New Zealand workforce is relevant to the implicated exposures.

PROSTATE CANCER

Summary Prostate cancer is a malignant disease of the prostate. There are no occupational exposures that have been strongly and consistently implicated as causes of prostate cancer. However, an association with pesticides is suggested by published studies, and there is also some evidence of an association with other occupations and industries. One New Zealand-based study specifically investigated occupational risk factors for prostate cancer. The study found raised odds ratios only for teachers and sales and service workers. Agricultural workers did not appear to have an elevated risk. However, a later study suggested there was a moderately increased risk in farmers. Farmers and other agricultural workers are the occupations in New Zealand most associated with increased risk of prostate cancer. Most of the occupations and industries weakly associated with an increased risk of prostate cancer are undertaken in New Zealand.

Introduction

Prostate cancer is a malignant disease of the prostate.

Exposures

There are no occupational exposures that have been strongly and consistently implicated as causes of prostate cancer. However, an association with pesticides, and occupations involved in pesticide exposure (such as pesticide applicators and farming) is suggested by published studies. There is also some evidence of an association with exposures to cadmium and fertilizers; policemen; and men with low occupational physical activity levels[146-149].

International studies of risk

A recent meta-analysis found a meta-rate ratio of 1.13 (95% CI 1.04 – 1.22) for occupational exposure to pesticides and the risk of prostate cancer[148]. An attributable fraction of 6% (males only) was used in the recent Finnish study[1].

New Zealand studies of risk

One New Zealand-based study specifically investigated occupational risk factors for prostate cancer. This was a cancer registry-based case-control study, with all cases and controls coming from notifications to the New Zealand cancer registry during 1979. Controls were notified persons who had other forms of malignancy. Female controls were excluded. Matching for age, and adjustment for social class, did not affect the results, so crude results were presented. The study found raised odds ratios only for teachers and sales and service workers. Agricultural workers did not appear to have an elevated risk[150]. A later New Zealand study using a similar design and investigating cancer risks in farmers did find an elevated prostate cancer risk in farmers[94] (Table 3.16).

New Zealand exposures

Farmers and other agricultural workers are the occupations in New Zealand most associated with increased risk of prostate cancer. Most of the occupations and industries weakly associated with an increased of prostate cancer are undertaken in New Zealand.

TABLE 3.16 Published estimates of increased risk of prostate cancer in selected occupational groups – New Zealand-based studies only

WORK GROUP	RR	95% CI	RISK MEASURE AND STUDY DETAILS	YEAR AND SOURCE
Agricultural workers	1.08	0.86 – 1.36[1]	OR[2]: CC[3], 1979	Pearce, 1987[150]
Farmers	1.26	1.13 – 1.41	OR[4]: CC[3], 1980-1984	Reif, 1989[94]
Farmers – dairy	1.41	1.02 – 1.96	OR[4]: CC[3], 1980-1984	Reif, 1989[94]
Farmers – general	1.31	1.16 – 1.48	OR[4]: CC[3], 1980-1984	Reif, 1989[94]
Teachers	2.44	1.05 – 5.70[1]	OR[2]: CC[3], 1979	Pearce, 1987[150]
Sales and service workers	1.29	0.99 – 1.69[1]	OR[2]: CC[3], 1979	Pearce, 1987[150]

1: 90% confidence interval
2: Crude results, but no difference when age-matched and adjusted for social class
3: Cancer registry used for cases and controls
4: Age adjusted

TESTICULAR CANCER

Summary Testicular cancer is a malignant disease of the testes. No occupational exposures have been strongly implicated as causing testicular cancer. Several occupation or industry groups have been identified as possibly having an increased risk, but metal workers are the only group for which there is moderately consistent evidence. There are no New Zealand-based estimates of testicular cancer risk arising from specific exposures, nor any estimates of attributable fraction. Several New Zealand studies have identified an increased risk of testicular cancer in fire fighters. Metal workers and fire fighters are the New Zealand occupation groups most closely linked with increased risk of testicular cancer.

Introduction

Testicular cancer is a malignant disease of the testes.

Exposures

No occupational exposures have been strongly implicated as causing testicular cancer. Several occupation or industry groups have been identified as possibly having an increased risk, but metal workers are the only group for which there is moderately consistent evidence[151-157].

New Zealand studies of risk

There are no New Zealand-based estimates of testicular cancer risk arising from specific exposures, nor any estimates of attributable fraction. A case-control study investigating the role of occupation in the development of testicular cancer in New Zealand, based on cases registered from 1958 to 1979, did not identify any clear work-related causes[156].

Two related New Zealand studies then investigated the risk of testicular cancer in fire fighters, prompted by a cluster of four cases in the 1980s. The first study based its standardised incidence rate on the four cases identified in the initial cluster (only two of which were registered with the New Zealand cancer registry), covering the period 1980 to 1991[151] (Table 3.17).

A later study, covering 1987 to 1996, examined mortality and cancer incidence in male New Zealand fire fighters. There was no clearly raised risk for any form of malignancy for the entire period, although the point estimate for testicular cancer incidence was 1.55 (95% CI 0.8 – 2.8). When the cluster cases were excluded, and the rates determined for 1990 to 1996, testicular cancer was the only malignancy with a raised risk. No cause for this increase was apparent[152, 158] (Table 3.17).

New Zealand exposures

Metal workers and fire fighters are the New Zealand occupation groups most closely linked with increased risk of testicular cancer.

TABLE 3.17 Published estimates of increased risk of testicular cancer in selected occupational groups – New Zealand-based studies only

WORK GROUP	RR	95% CI	RISK MEASURE AND STUDY DETAILS	YEAR AND SOURCE
Fire fighters	8.2	2.2 – 21	SIR[1]: cohort[2], 1980-1991	Bates, 1995[151]
Fire fighters	1.6	0.8 – 2.8	SIR[1]: cohort[2], 1987-1996	Bates, 2001[152]
Fire fighters	3.0	1.3 – 5.9	SIR[1]: cohort[2], 1990-1996	Bates, 2001[152]

1: Standardised for age and social class; males only
2: Cases from cancer registry; comparison to population data

RENAL CANCER

Summary Renal carcinoma is a malignant disease of the kidney. There are no definite occupational causes of renal cell carcinoma, although the disease has been the subject of many studies and a wide range of exposures, occupations and industries have been associated with an increased risk. The exposures include arsenic, asbestos, aviation gasoline, benzene, cadmium, chromium compounds, chromium (VI) compounds, cutting fluids, felt dust, hair dust, hydrogen sulphide, inks, inorganic acid solutions, jet fuel engine emissions, jet fuel, lead, mineral oils, ozone, paints, phosphoric acid, polycyclic hydrocarbons, styrene-butadiene rubber and ultraviolet radiation; the occupations include aircraft mechanics, farmers, horticulturists, nursery workers (gardening), oil refinery workers, printers and truck drivers; and the industries include defence services, dry cleaning, printing-related services, retail trade and wholesale trade. There are no New Zealand-based estimates of renal cell carcinoma risk arising from specific exposures, nor any estimates of attributable fraction. One New Zealand-based study specifically investigated occupational risk factors for renal cell carcinoma and found increased risk in fire fighters and painters. There is no comprehensive published New Zealand information on the extent of workforce exposure to specific agents that have been implicated as possibly increasing the risk of renal cell carcinoma. Exposure to these agents occurs in a wide range of occupations and industries, many of which are still undertaken in New Zealand.

Introduction

Renal carcinoma is a malignant disease of the kidney. The most common form is renal cell carcinoma.

Exposures

There are no definite occupational causes of renal cell carcinoma, although the disease has been the subject of many studies and a wide range of exposures, occupations and industries has been associated with an increased risk. The exposures include arsenic, asbestos, aviation gasoline, benzene, cadmium, chromium compounds, chromium (VI) compounds, cutting fluids, felt dust, hair dust, hydrogen sulphide, inks, inorganic acid solutions, jet fuel engine emissions, jet fuel, lead, mineral oils, ozone, paints, phosphoric acid, polycyclic hydrocarbons, styrene-butadiene rubber and ultraviolet radiation; the occupations include aircraft mechanics, farmers, horticulturists, nursery workers (gardening), oil refinery workers, printers and truck drivers; and the industries include defence services, dry cleaning, printing-related services, retail trade and wholesale trade[159-165].

International studies of risk

There are no international studies that provide robust risk estimates in terms of the main exposures, but several identified increased (but imprecise) risks in exploratory analyses, as described above. AFs of 4.7% for males and 0.8% for females were used in the recent Finnish study[1].

New Zealand studies of risk

One New Zealand-based study specifically investigated occupational risk factors for renal cell carcinoma. This was a cancer registry-based case-control study, with all cases and controls coming from notifications to the New Zealand cancer registry between 1978 and 1986. Controls were notified persons who did not have a urinary tract malignancy. Females were excluded, and odds ratios were adjusted for age and smoking history. The study found raised odds ratios for fire fighters and painters[166]. A second study, also based on cancer registry data, suggested an increased risk in male painters under the age of 60 years[167] (Table 3.18).

New Zealand exposures

There is no comprehensive published New Zealand information on the extent of workforce exposure to any of the specific agents that have been associated with possible increases in the risk of renal cell carcinoma. Exposure to these agents occurs in a wide range of occupations and industries, many of which are still undertaken in New Zealand.

TABLE 3.18 Published estimates of increased risk of renal cell carcinoma in selected occupational groups – New Zealand-based studies only

WORK GROUP	RR	95% CI	RISK MEASURE AND STUDY DETAILS	YEAR AND SOURCE
Fire fighters	4.69	2.47 – 8.93	OR[1]: CC[2], 1978-1986	Delahunt, 1995[166]
Painters	1.79	1.31 – 3.44	OR[1]: CC[2], 1978-1986	Delahunt, 1995[166]
Painters	1.45	0.85 – 2.50	OR[3]: CC[2], 1980-1984	Bethwaite, 1990[167]
- age 20-59 years	1.94	0.91 – 4.19	OR[3]: CC[2], 1980-1984	Bethwaite, 1990[167]
- age 60+ years	1.16	0.54 – 2.48	OR[3]: CC[2], 1980-1984	Bethwaite, 1990[167]

1: Standardised for age and smoking history; males only
2: Cancer registry used for cases and controls
3: Age-standardised; males only

BLADDER CANCER

Summary Bladder cancer is a malignant disease of the urinary bladder. Occupational exposures strongly or moderately implicated as causing bladder cancer are aromatic amines, PAHs, paints, dyes, chlorinated hydrocarbons, and other solvents, metals and industrial oils/cutting fluids. Work in certain occupation or industry groups has also been implicated as a cause of bladder cancer. There are no New Zealand-based estimates of bladder cancer risk arising from specific exposures, nor any estimates of attributable fraction. However, two New Zealand studies provide measures of risk in some occupation groups. There is no comprehensive published New Zealand information on the extent of workforce exposure to specific agents that have been identified as increasing the risk of bladder cancer. Relevant occupations that have been associated with increased risk of bladder cancer and that employ persons in New Zealand include painters, dry cleaners, truck and other vehicle drivers and metal workers.

Introduction

Bladder cancer is a malignant disease of urothelial tissue lining the urinary tract.

Exposures

Occupational exposures strongly implicated as causing bladder cancer are aromatic amines and PAHs. Other exposures associated with an increased risk for bladder cancer are paints, dyes, chlorinated hydrocarbons, and other solvents, metals and industrial oils/cutting fluids[168]. These exposures occur in such substances and tasks as the manufacture of textile dyes, paints and pigments (2-naphthylamine), and leather and rubber (aromatic amines), as well as in truck and bus driving and dry cleaning. There is also some evidence of increased risk in agricultural workers exposed to pesticides, metal workers (exposed to cutting fluids and lubricating oils), hairdressers and salesmen[1, 162, 169-181].

International studies of risk

In terms of the main exposures, relevant estimates of relative risks are available. These are summarised in Table 3.19. Various studies have provided estimates of relative risks from 1.6 to 7.0[162, 175-177]. The main epidemiological studies have been reviewed but no summary relative risks have been suggested. Recent assessments of attributable fraction have been 7%-19% in men and 3%-19% in women in the United States[2], and 14% in men and 1% in women in Finland[1].

TABLE 3.19 Published estimates of increased risk of bladder cancer for exposure to selected agents

EXPOSURE	RR	95% CI	SOURCE
Beta-naphthylamine	7.0	3.9 – 12.4	Schulte, 1986[175]
Phenyl-beta-naphthylamine*	2.77	1.27 – 5.26	Sorahan, 2000[176]
Industrial occupation	2.21	1.21 – 4.02	Sadetzki, 2000[177]
PAH	1.6	1.1 – 2.3	Pesch, 2000[162]
Chlorinated solvents	1.8	1.2 – 2.6	Pesch, 2000[162]
Metal degreasing	2.3	1.4 – 3.8	Pesch, 2000[162]
Rubber	2.5	1.23 – 5.08	Claude, 1988[169]
Plastics and synthetics	2.64	1.35 – 5.14	Claude, 1988[169]
Dyestuffs	1.88	1.06 – 3.36	Claude, 1988[169]
Inks	2.01	1.1 – 3.6	Hours, 1994[171]
Cutting fluids	2.56	1.2 – 5.4	Hours, 1994[171]
Land transport	1.58	1.06 – 2.28	Jensen, 1987[182]

* *also exposed to 2-mercaptobenzothiazole, aniline and o-toluidine*

New Zealand studies of risk

There are no New Zealand-based estimates of bladder cancer risk arising from specific exposures, nor any estimates of attributable fraction. However, two New Zealand studies provide measures of risk in some occupation groups. One study provided a measure of the risk of developing bladder cancer in painters. This study was based on cancer registry data, using other cancer cases as controls, and showed the highest risk was in workers less than 60 years of age[167] (Table 3.20).

Another study examined risks of bladder cancer as part of a study of occupational cancer mortality in all New Zealand men from 1974 to 1978. The study obtained cause of death information from the National Health Statistics Centre and denominator information from a 10% random sample of the 1976 New Zealand Census. Rates were standardised for age. No information was available for any other potential confounders, and the recorded occupations in some of the death records were likely to be inaccurate or irrelevant to the conditions causing death. Some of the resulting bias was partly overcome by controlling for social class in the analysis. This showed a suggestion of increased rates of bladder cancer in authors and journalists (based on only two deaths) and hairdressers and beauticians (also based on only two deaths)[60] (Table 3.20).

A third study examined bladder cancers registered in New Zealand in 2001 and classified cases as "probably", "possibly" or not likely to be occupationally related on the basis of exposure history and published estimates of relative risk associated with relevant exposures. This study found that 28% of cases of bladder cancer in males, and 6% of cases of bladder cancer in females, were probably related to occupational exposures. Another 7% of male cases and 2% of female cases were considered possibly related to occupational exposures. The largest number of cases were in truck drivers (51%), engineering and metal workers (18%), crop farmers and orchardists (7%), textile and leather workers (7%), and painters and furniture finishers (7%)[183, 184].

New Zealand exposures

There is no comprehensive published New Zealand information on the extent of workforce exposure to specific agents that have been identified as increasing the risk of bladder cancer. There is likely to be little exposure to the relevant aromatic amines in New Zealand, as these have been phased out of the manufacturing tasks with the

high exposures. Exposure to one or more of PAHs, organic solvents and lead is likely to occur in a wide variety of jobs in New Zealand.

Relevant occupations that have been associated with increased risk of bladder cancer and that employ persons in New Zealand include painters and dry cleaners.

TABLE 3.20 Published estimates of increased risk of bladder cancer in selected occupational groups – New Zealand-based studies only

WORK GROUP	RR	95% CI	RISK MEASURE / STUDY DETAILS	YEAR AND SOURCE
Painters	1.52	1.00 – 2.31	OR[1]; CC[2], 1980-1984	Bethwaite, 1990[167]
- age 20-59 years	2.27	1.15 – 4.48	OR[1]; CC[2], 1980-1984	Bethwaite, 1990[167]
- age 60+ years	1.27	0.75 – 2.15	OR[1]; CC[2], 1980-1984	Bethwaite, 1990[167]
Authors and journalists	11.8	1.32 – 42.5	RR[3]: cohort[4], 1974-1978	Pearce, 1985[60]
Hairdressers and beauticians	12.9	1.45 – 46.7	RR[3]: cohort[4], 1974-1978	Pearce, 1985[60]

1: Age-standardised
2: Cancer registry used for cases and controls
3: Age-standardised and compared to males in the same social class
4: Cause of death information from the National Health Statistics Centre

BRAIN CANCER

Summary Brain cancer is a malignant disease of central nervous system tissues in and around the brain. There are no occupational exposures that have been strongly and consistently implicated as causes of malignant brain tumours. However, several exposures, occupations and industries have been inconsistently associated with increased risk. There are no New Zealand-based estimates of brain cancer risk arising from specific exposures, nor any estimates of attributable fraction. One New Zealand study identified an increased risk of brain cancer in farmers, particularly livestock farmers. There is no comprehensive published New Zealand information on the extent of workforce exposure to specific agents that have been implicated as possibly increasing the risk of brain cancer. Of the implicated occupations and industries, workers involved in farming, manufacturing and electrical work are probably the most commonly exposed in New Zealand.

Introduction

Brain cancer is a malignant disease of central nervous system tissues in and around the brain. It has various forms, with gliomas and meningiomas the types most commonly associated with occupational exposures.

Exposures

There are no occupational exposures that have been strongly and consistently implicated as causes of malignant brain tumours. However, several exposures, occupations and industries have been inconsistently associated with increased risk. These include exposure to extremely low frequency electromagnetic fields (EMF), lead, pesticides, arsenic, mercury and petroleum products; farmers and metal workers; and work in the petrochemical, agriculture, electrical services and nuclear industries[185-192].

International studies of risk

There are no international studies that provide robust risk estimates in terms of the main exposures. Probably the most reliable (but imprecise) result comes from a Finnish study of lead-exposed workers that found an odds ratio of 11 (95% CI 1.0-630) for workers with a blood lead level of 1.4 or more, compared to workers with lower blood lead levels[190]. AFs of 11% for males and 1.3% for females were used in the recent Finnish study[1].

New Zealand studies of risk

One New Zealand-based study identified an increased risk of brain cancer in farmers. The study was a population-based case-control study that used cancer registry cases registered between 1980 and 1984. Persons with other types of cancer served as the controls. The increased risk was particularly in livestock farmers, and was evident primarily in persons older than 60 years of age. The risk was not elevated in farmers more likely to be exposed to pesticides (such as orchardists and crop farmers)[94, 116] (Table 3.21).

New Zealand exposures

There is no comprehensive published New Zealand information on the extent of workforce exposure to any of the specific agents that have been associated with possible increases in the risk of brain cancer, apart from patchy information that may be available regarding exposure to lead or work with pesticides. Of the implicated

occupations and industries, workers involved in farming, manufacturing and electrical work are probably the most common in New Zealand.

TABLE 3.21 Published estimates of increased risk of brain cancer in selected occupational groups – New Zealand-based studies only

WORK GROUP	RR	95% CI	RISK MEASURE AND STUDY DETAILS	YEAR AND SOURCE
Farmers	1.34	1.04 – 1.74	OR[1]: CC[2], 1980-1984	Reif, 1989[94, 116]
– livestock	2.96	1.46 – 4.95	OR[1]: CC[2], 1980-1984	Reif, 1989[94, 116]
– age 20-59 years	1.18	0.81 – 1.73	OR[1]: CC[2], 1980-1984	Reif, 1989[94, 116]
– age 60+ years	1.51	1.06 – 2.13	OR[1]: CC[2], 1980-1984	Reif, 1989[94, 116]

1: Age-standardised; males only
2: Cancer registry used for cases and controls
OR[1]: CC[2], 1980-1984

Summary Lymphoma and myeloma are malignant diseases of a subset of white blood cells. No occupational exposures have been strongly and consistently implicated as causing lymphoma and myeloma. Work in a wide range of occupations and industries has been associated with one or both of them, with farmers, meat workers and woodworkers of particular relevance to New Zealand. The only New Zealand-based estimates of lymphoma risk from exposures relate to phenoxyherbicides and chlorophenol, and neither exposure appeared to have an increased risk. There are several published measures of the risk of developing lymphoma and myeloma in certain New Zealand work groups. Most of the occupations and industries associated with lymphoma exist in New Zealand, with farmers, meat workers and fencers the most prominent of these.

Introduction

Lymphoma and myeloma are malignant diseases of a subset of white blood cells. Lymphoma has two main forms – Hodgkin's lymphoma and Non-Hodgkin's lymphoma. Myeloma is a malignant condition of a related cell type.

Exposures

Woodworking is the occupation most strongly linked to Hodgkin's lymphoma, but the causative exposures are not known, and other occupations (e.g. textile workers and machinery fitters) have a less consistent link[193, 194]. A wide range of occupations (teachers, farmers, and welders and solderers) has been linked to Non-Hodgkin's lymphoma or myeloma and industries (agricultural work, agriculture and forestry work, metalworking, machinery and equipment, motor vehicles and motor vehicle equipment, telephone communications and transport)[193, 195-199]. No occupational exposures have been consistently and strongly implicated as causing lymphoma or myeloma. Phenoxyherbicides, chlorophenols and organic solvents have been found to be associated with a markedly increased risk of lymphoma in some studies[200-202], but these findings have not been reproduced consistently[203-205].

International studies of risk

In terms of the main identified associated exposures, a few relevant international estimates of relative risks are available. These are summarised in Table 3.22. Attributable fraction estimates available from Finland are 3.9% (males) and zero (females) for Hodgkin's lymphoma and 13.5% (males) and 3.1% (females) for Non-Hodgkin's lymphoma[1].

TABLE 3.22 Published estimates of risk of lymphoma and myeloma for exposure to selected agents

EXPOSURE	RR	95% CI	YEAR AND SOURCE
Herbicides	1.6	1.0 – 2.5	Hardell, 1999[201]
Phenoxyherbicides	1.5	0.9 – 2.4	Hardell, 1999[201]
Phenoxyherbicides	1.4	0.7 – 2.5[1]	Pearce, 1986[205]
Phenoxyherbicides	1.0	0.7 – 1.5[1]	Pearce, 1987[204]
Fungicides	3.7	1.1 – 13.0	Hardell, 1999[201]
Chlorophenols	1.3	1.3 – 3.0[1]	Pearce, 1986[205]
Chlorophenols	1.4	0.8 – 2.3[1]	Pearce, 1987[204]

1: 90% confidence interval

New Zealand studies of risk

One New Zealand-based study has examined the association between Non-Hodgkin's lymphoma and exposure to phenoxyherbicides and chlorophenols. This was a population-based case-control study that used cancer registry cases registered between 1977 and 1981. Persons with Non-Hodgkin's lymphoma were the cases and persons with other cancers served as the controls. The study found no significant difference in exposure to phenoxyherbicides (OR = 1.4; 90% CI 0.7 – 2.5) or chlorophenols (OR = 1.3; 90% CI 1.3 – 3.0)[205]. An expanded version of the study confirmed the earlier results, with no association found between Non-Hodgkin's lymphoma and either phenoxyherbicides (OR = 1.0, 90% CI 0.7 – 1.5) or chlorophenols (OR = 1.4, 90% CI 0.8 – 2.3)[204]. A later re-analysis of the data used in the second paper examined phenoxyherbicide exposure in terms of duration and frequency of use and again found no evidence of an association with Non-Hodgkin's lymphoma[203] (Table 3.22).

There are several published measures of the risk of developing lymphoma and/or myeloma in certain work groups. These were population-based case-control studies that examined the risk of developing malignancies in farmers and meat workers. They found an increased risk of Non-Hodgkin's lymphoma in farmers, meat workers and fencing workers; of Hodgkin's lymphoma in farmers; and of lymphoma and myeloma in agriculture, forestry and fishing workers and during fencing work[60, 116, 198, 204-206] (Table 3.23).

New Zealand data were also included in multi-centre IARC studies examining the role of phenoxyherbicides, including those contaminated by dioxins, in the development of various forms of cancer. These studies suggested a slight increase in the risk of lymphoma, based on a small number of cases[111, 112].

There are no New Zealand estimates of attributable fraction of lymphoma from work exposures.

New Zealand exposures

Since there are no exposures strongly and consistently associated with lymphoma, exposure data for New Zealand are unlikely to be of much use. Regardless, little such published exposure information exists. However, most of the occupations and industries associated with lymphoma exist in New Zealand, with farmers, meat workers and fencers the most prominent of these.

TABLE 3.23 Published estimates of increased risk of lymphoma and myeloma in selected occupational groups – New Zealand-based studies only

WORK GROUP	RR	95% CI	RISK MEASURE AND STUDY DETAILS	YEAR AND SOURCE
Non-Hodgkin's				
Farmers	1.24	0.99 – 1.56	OR[1]: CC[2], 1980-1984	Reif, 1989[94]
– general	1.25	0.96 – 1.62	OR[1]: CC[2], 1980-1984	Reif, 1989[94]
Orchard workers	3.7	1.1 – 12.1	OR[1]: CC[2], 1977-1981	Pearce, 1987[204]
Fencing workers	2.0	1.3 – 3.0[3]	OR[1]: CC[2], 1977-1981	Pearce, 1986[205]
Fencing workers	1.4	1.0 – 2.0[3]	OR[1]: CC[2], 1977-1981	Pearce, 1987[204]
Meat workers	1.8	1.1 – 3.1[3]	OR[1]: CC[2], 1977-1981	Pearce, 1986[205]
Meat workers	1.8	1.2 – 2.6[3]	OR[1]: CC[2], 1977-1981	Pearce, 1987[204]
Hodgkin's Lymphoma				
Livestock farmers	2.41	0.92 – 6.30	OR[1]: CC[2], 1980-1984	Reif, 1989[94]
Myeloma				
Painters (combined)	1.95	1.05 – 3.65	OR[1]; CC[2], 1980-1984	Bethwaite, 1990[167]
Painters – car/spray	2.81	0.73 – 10.7	OR[1]; CC[2], 1980-1984	Bethwaite, 1990[167]
Painters – contractor/ general	1.80	0.89 – 3.64	OR[1]; CC[2], 1980-1984	Bethwaite, 1990[167]
Painters – age 20-59 years	4.23	1.80 – 9.91	OR[1]; CC[2], 1980-1984	Bethwaite, 1990[167]
Painters – age 60+ years	1.16	0.54 – 2.48	OR[1]; CC[2], 1980-1984	Bethwaite, 1990[167]
Painters	3.52	1.40 – 7.29	SMR[3]: cohort[4], 1973-1986	Firth, 1993[65]
Farmers	1.18	0.88 – 1.58	OR[1]: CC[2], 1980-1984	Reif, 1989[94]
Farmers	1.7	1.0 – 2.9	OR[1]: CC[2], 1977-1981	Pearce, 1986[206]
- general	1.25	0.90 – 1.73	OR[1]: CC[2], 1980-1984	Reif, 1989[94]
- sheep	1.9	1.0 – 3.6	OR[1]: CC[2], 1977-1981	Pearce, 1986[206]
- beef cattle	1.7	1.0 – 2.9	OR[1]: CC[2], 1977-1981	Pearce, 1986[206]
- fencing work	1.6	0.9 – 2.7	OR[1]: CC[2], 1977-1981	Pearce, 1986[206]
Lymphoma and Myeloma				
Agriculture, forestry and fishing	1.25	1.00 – 1.56[5]	OR[1]: CC[2], 1977-1981	Pearce, 1985[198]
age 20-64 years	1.45	1.08 – 1.95[5]	OR[1]: CC[2], 1977-1981	Pearce, 1985[198]
age 65+ years	1.05	0.75 – 1.47[5]	OR[1]: CC[2], 1977-1981	Pearce, 1985[198]
Farmers	1.36	0.95 – 1.89	RR[3]: cohort[6], 1974-1978	Pearce, 1985[60]
Managers	1.53	0.97 – 2.30	RR[3]: cohort[6], 1974-1978	Pearce, 1985[60]
Labourers nec	1.52	0.89 – 2.43	RR[3]: cohort[6], 1974-1978	Pearce, 1985[60]

1: Age-standardised
2: Cancer registry used for cases and controls
3: Standardised for age and social class; males only
4: Cases from cancer registry; comparison to population data
5: 90% confidence interval
6: Cause of death information from the National Health Statistics Centre

Summary Leukaemia is a malignant disease of a subset of white blood cells. Occupational exposures strongly implicated as causing leukaemia are ionising radiation, benzene and ethylene oxide. Work in certain occupation or industry groups has also been implicated as a cause of leukaemia. There are no New Zealand-based estimates of leukaemia risk arising from specific exposures, nor any estimates of attributable fraction. However, there are several published measures of the risk of developing leukaemia in certain New Zealand work groups. There is no comprehensive published New Zealand information on the extent of workforce exposure to specific agents that have been identified as increasing the risk of leukaemia, but all the main exposures occur in the New Zealand workforce. Relevant occupations that have been associated with increased risk of leukaemia and that employ persons in New Zealand include electrical workers, agricultural workers and meat workers.

Introduction

Leukaemia is a malignant disease of a subset of white blood cells. It has various forms, with the most relevant in occupational terms probably being acute lymphatic leukaemia (ALL) and acute myelocytic leukaemia (AML).

Exposures

Occupational exposures strongly implicated as causing leukaemia are ionising radiation, benzene and ethylene oxide[207]. There is also some evidence that exposure to low-frequency electromagnetic fields may cause leukaemia[1]. Other agents have been suggested, but the evidence for them is inconclusive. IARC has classified work in the rubber industry and the boot and shoe manufacture industry as causing leukaemia[89]. Several other occupation or industry groups have also been identified as possibly having an increased risk of leukaemia, presumably because the workers are exposed to one or more of the above exposures, or some other exposure that increases the risk of leukaemia. These include a range of electrical occupations and farming.

International studies of risk

In terms of the main exposures, relevant estimates of relative risks are available. These are summarised in Table 3.24. Recent attributable fraction estimates have been 0.8% to 2.2% for the United States[2], and 18% (males) and 2% (females) in Finland[†].

[†] The higher estimate for Finland seems to result from the inclusion of occupational exposure to electromagnetic fields, the reliance on different studies for relative risk estimates, and from the exposure patterns in the Finnish population.

TABLE 3.24 Published estimates of increased risk of leukaemia for exposure to selected agents

EXPOSURE	RR	95% CI	YEAR AND SOURCE
Ionising radiation (low)	1.22	1.07 – 1.70	IARC, 2000[208]
			Beir V, 1990[209]
Ionising radiation (high)	1.57	1.18 – 2.88	IARC, 2000[208]
			Beir V, 1990[209]
Benzene (low)	2.0	1.8 – 2.2	Lynge, 1997[78]
Benzene (high)	4.0	3.6 – 4.4	Lynge, 1997[78]
Ethylene oxide	1.1 – 3.5		Steenland, 1996[100]
			Blair, 1997[210]
Electromagnetic fields (ge 0.2 microT)	1.7		Feychting, 1997[211]

New Zealand studies of risk

There are no New Zealand-based estimates of leukaemia risk arising from specific exposures, nor any estimates of attributable fraction. However, there are several published measures of the risk of developing leukaemia in certain work groups. The most comprehensive of these was a population-based case-control study that examined the risk of developing acute leukaemia in relation to occupation, with detailed consideration of "electrical workers" and "meat industry workers" being published separately. The study found an increased risk in electrical workers as a whole, and particularly in telephone line workers and welders/flame cutters[212], and an increased risk in abattoir workers with over two years' employment in the industry and who were involved in contact with animals or animal tissues as part of their job[213] (Table 3.25).

Several other relevant studies were based on cancer registry data. Some of these studies overlapped. These showed increased risks of leukaemia in electrical workers, particularly radio/television repairers and electricians[214-217]; agriculture and forestry workers, particularly livestock farmers[217]; meat workers, particularly for AML[110]; and toolmakers and painters[60] (Table 3.25).

TABLE 3.25 Published estimates of increased risk of leukaemia in selected occupational groups – New Zealand based studies only

WORK GROUP	RR	95% CI	RISK MEASURE AND STUDY DETAILS	YEAR AND SOURCE
Electrical workers	1.9	1.0 – 3.8	OR[1]: CC[2], 1989-1991	Bethwaite, 2001[212]
Electrical workers	1.62	1.04 – 2.52	OR[1]: CC[3], 1980-1984	Pearce, 1989[214]
Electrical workers[4]	1.70	0.97 – 2.97	OR[1]: CC[3], 1979-1983	Pearce, 1985[216], 1988[215]
Electrical workers	1.72	0.92 – 2.30	OR[1]: CC[3], 1979-1983	Pearce, 1986[217]
Radio/television repairers	8.17	1.49 – 44.74	OR[1]: CC[3], 1979-1983	Pearce, 1988[215]
				Pearce, 1985[216]
Radio/television repairers	7.86	2.20 – 28.09	OR[1]: CC[3], 1980-1984	Pearce, 1989[214]
Electricians	4.75	1.59 – 14.23	OR[1]: CC[3], 1979-1983	Pearce, 1988[215]
				Pearce, 1985[216]
Electricians	1.68	0.75 – 3.79	OR[1]: CC[3], 1980-1984	Pearce, 1989[214]
Telephone line workers	5.8	1.2 – 27.8	OR[1]: CC[2], 1989-1991	Bethwaite, 2001[212]
Electrical linemen	2.35	0.97 – 5.70	OR[1]: CC[3], 1980-1984	Pearce, 1989[214]
Power station operators	3.89	1.00 – 15.22	OR[1]: CC[3], 1980-1984	Pearce, 1989[214]
Welders/flame cutters	2.8	1.2 – 6.8	OR[1]: CC[2], 1989-1991	Bethwaite, 2001[212]
Agriculture	1.24	0.99 – 1.55	OR[1]: CC[3], 1980-1984	Reif, 1989[94]
Agriculture and forestry workers	1.24	0.95 – 1.61	OR[1]: CC[3], 1979-1983	Pearce, 1986[217]
General farmers	1.19	0.92 – 1.54	OR[1]: CC[3], 1980-1984	Reif, 1989[94]
Livestock farmers	2.09	1.17 – 3.72	OR[1]: CC[3], 1980-1984	Reif, 1989[94]
Livestock farmers	3.00	1.23 – 7.32	OR[1]: CC[3], 1979-1983	Pearce, 1986[217]
Meat workers	1.45	0.90 – 2.31	OR[1]: CC[3], 1980-1984	Reif, 1989[110]
Abattoir workers[5]	5.2	1.2 – 22.2	OR[1]: CC[2], 1989-1991	Bethwaite, 2001[213]
Toolmakers	4.46	1.79 – 9.19	RR[6]: cohort[7], 1974-1978	Pearce, 1985[60]
Painters	2.00	0.86 – 3.94	RR[6]: cohort[7], 1974-1978	Pearce, 1985[60]

1: Age-standardised
2: Cases from any of six tertiary referral centres and controls randomly selected from the population
3: Cancer registry used for cases and controls
4: "Selected occupational groups involving potential exposure to electrical and magnetic field"
5: Abattoir workers with over two years' employment in the industry and who were involved in contact with animals or animal tissues as part of their job
6: Age-standardised and compared to males in the same social class
7: Cause of death information from the National Health Statistics Centre

New Zealand exposures

There is no comprehensive published New Zealand information on the extent of workforce exposure to specific agents that have been identified as increasing the risk of leukaemia. Exposure to benzene is likely to occur in a wide variety of jobs in New Zealand, including chemical manufacturing plants, refineries and machine production and clothing factories. Ionising radiation exposure is likely to be primarily in the health sector (e.g. radiologists, radiographers, nuclear medicine technicians) and some industrial sectors where X-rays are used to assess structural integrity. One New Zealand study considered radiation exposure in orthopaedic operating theatres. It found that the highest exposure was to the hands, but that the whole body dose was well within recommended limits[218]. Workers involved in sterilising are likely to be the main persons exposed to ethylene oxide, although some exposure may also occur in chemical plant workers.

Relevant occupations that have been associated with increased risk of leukaemia and that employ persons in New Zealand include electrical workers, agricultural workers and meat workers.

SOFT TISSUE SARCOMA

Summary Soft tissue sarcoma is a malignant disease of the muscle and related tissues. There are no definite occupational causes of soft tissue sarcoma. Exposure to phenoxyherbicides and chloronated phenols has been suggested, as have woodworking occupations, but the evidence is weak and inconsistent. Two related New Zealand studies specifically investigated the relationship between phenoxyherbicides and chlorophenols (or occupations associated with exposure to these agents) and the risk of soft tissue sarcoma. Elevated odds ratios were found for exposure to both substances, but the estimates were very imprecise and consistent with there being no increased risk. Persons working in a wide range of farming occupations in New Zealand will have been exposed to phenoxyherbicides and chlorophenol.

Introduction

Soft tissue sarcoma is a malignant disease of the muscle and related tissues.

Exposures

There are no definite occupational causes of soft tissue sarcoma. Exposure to phenoxyherbicides and chloronated phenols has been suggested, as have woodworking occupations, but the evidence is weak and inconsistent[219-224].

International studies of risk

There are no international studies that provide robust risk estimates in terms of the few implicated exposures associated with soft tissue sarcoma.

New Zealand studies of risk

Two related New Zealand studies specifically investigated the relationship between phenoxyherbicides and chlorophenols (or occupations associated with exposure to these agents) and the risk of soft tissue sarcoma. These were cancer registry-based case-control studies, with all cases and controls coming from notifications to the New Zealand cancer registry between 1976 and 1980. Controls were notified persons who had other forms of cancer. Females were excluded, and odds ratios were adjusted for age and smoking history. Neither study found good evidence of an association. The second, more detailed study, found elevated odds ratios for exposure to both phenoxyherbicides and chlorophenols, but the estimates were very imprecise and consistent with there being no increased risk[221, 222] (Table 3.26).

New Zealand data were also included in multi-centre IARC studies examining the role of phenoxyherbicides, including those contaminated by dioxins, in the development of various forms of cancer. These studies suggested an increased risk of sarcoma, based on a small number of cases[111, 112].

New Zealand exposures

Persons working in a wide range of agricultural occupations in New Zealand will have been exposed to phenoxyherbicides and chlorophenol.

TABLE 3.26 Published estimates of increased risk of soft tissue sarcoma arising from selected exposures – New Zealand-based studies only

WORK GROUP	RR	95% CI	RISK MEASURE AND STUDY DETAILS	YEAR AND SOURCE
Phenoxyherbicides	1.3	0.6 – 2.5	OR[1]: CC[2], 1976-1980	Smith, 1984[222]
Chlorophenols	1.5	0.5 – 4.5	OR[1]: CC[2], 1976-1980	Smith, 1984[222]

1: Age-standardised; males only
2: Cancer registry used for cases and controls

ALL CANCERS

Summary All cancers covers any form of malignancy. A vast array of exposures, occupations and industries has been associated with an increased risk of total cancers. Also, many workforces have been found to have a decreased risk compared to the general population of developing or dying from cancer because most workers are more healthy than the general population. There are no New Zealand-based estimates of all cancers risk arising from specific exposures, nor any estimates of attributable fraction. However, there are several published measures of the risk of developing any cancer in certain New Zealand work groups. The studies showed increased risk of all cancers in foundry and heavy engineering workers; athletes; cooks, waiters and bartenders; hairdressers and beauticians; fishermen and hunters; and general labourers. Information on relevant individual exposures is provided in the sections on specific cancers. However, there is little comprehensive information on relevant exposures in New Zealand. Most of the New Zealand workforce is exposed, at least at low levels, to exposures identified as definite, probable or possible carcinogens.

Introduction

All cancers covers any form of malignancy.

Exposures

A vast array of exposures, occupations and industries has been associated with an increased risk of total cancers. Also, many workforces have been found to have a decreased risk compared to the general population of developing or dying from cancer because most workers are more healthy than the general population.

International studies of risk

There are many international studies that provide risk estimates of overall cancer in association with various occupational exposures. Recent attributable fraction estimates have been 3.3% to 7.3% (males) and 0.8% to 1.0% (females) for the United States[2], and 13.8% (males) and 2.2% (females) in Finland[1].

New Zealand studies of risk

There are no New Zealand-based estimates of all cancers risk arising from specific exposures, nor any estimates of attributable fraction. However, there are several published measures of the risk of developing any cancer in certain New Zealand work groups. These come from individual worker cohort studies and standardised analyses using whole population data. The studies showed increased risk of all cancers in foundry and heavy engineering workers; athletes; cooks, waiters and bartenders; hairdressers and beauticians; fishermen and hunters; and general labourers[65, 66, 107-109, 132] (Table 3.27).

New Zealand data were also included in multi-centre IARC studies examining the role of phenoxyherbicides, including those contaminated by dioxins, in the development of various forms of cancer. These studies suggested a slight increase in the risk of all cancers, based on a small number of cases[111, 112].

New Zealand exposures

Information on relevant individual exposures is provided in the sections on specific cancers. However, there is little comprehensive information on relevant exposures in New Zealand. Most of the New Zealand workforce is exposed, at least at low levels, to exposures identified as definite, probable or possible carcinogens.

TABLE 3.27 Published estimates of risk of total cancer arising from selected occupational groups – New Zealand-based studies only

WORK GROUP	RR	95% CI	RISK MEASURE AND STUDY DETAILS	YEAR AND SOURCE
Foundry and heavy engineering workers	1.15	1.01 – 1.31	SMR[1]: cohort[2], 1945-1991	Firth, 1999[132]
Pulp and paper mill workers	0.95	0.78 – 1.15	SMR[1]: cohort[3], 1978-1992	McLean, 2002[107]
Meat workers	1.08	0.63 – 1.74	SMR[1]: cohort[4], 1988-2000	McLean, 2003, 2004[108, 109]
Athletes	2.98	1.19 – 6.14	RR[5]: cohort[6], 1974-1978	Pearce, 1985[60]
Cooks, waiters, bartenders	1.86	1.42 – 2.39	RR[5]: cohort[6], 1974-1978	Pearce, 1985[60]
Hairdressers, beauticians	3.14	1.89 – 4.90	RR[5]: cohort[6], 1974-1978	Pearce, 1985[60]
Fishermen, hunters	1.73	1.11 – 2.57	RR[5]: cohort[6], 1974-1978	Pearce, 1985[60]
Toolmakers	1.71	1.33 – 2.17	RR[5]: cohort[6], 1974-1978	Pearce, 1985[60]
Labourers, nec	1.32	1.19 – 1.46	RR[5]: cohort[6], 1974-1978	Pearce, 1985[60]

1: Age-standardised
2: Cohort of workers at a foundry and heavy engineering plant. Compared to New Zealand population
3: Cohort of pulp and paper mill workers
4: Cohort of meat workers
5: Age-standardised and compared to males in the same social class
6: Cause of death information from the National Health Statistics Centre

3.3 MENTAL OR NEUROPSYCHIATRIC DISORDERS

OCCUPATIONAL STRESS-RELATED CONDITIONS

Summary Stress-related psychological disorders related to work can result when the demands of the workplace (known as "job strain") place undue psychological strain on the worker. Anxiety, depression and related psychological disorders can result from this occupational strain. Many characteristics of the working environment have been associated with stress-related disorders. These include heavy workload, leadership/management style, professional conflict, excessive emotional demands of the job, and lack of job security. Virtually any occupation can have associated stress issues at some stage. Several New Zealand-based studies have considered occupational stress and resulting disorders. There are no useful measures of factors leading to increased occupational stress in New Zealand. However, most of the relevant factors occur in the New Zealand workforce.

Introduction

Stress-related psychological disorders related to work can result when the demands of the workplace (known as "job strain") place undue psychological strain on the worker. Anxiety, depression and related psychological disorders can result from this occupational strain. Job strain is also sometimes described as "workplace stress", but stress is also used to describe the psychological disorder that might arise from excessive job strain, so job strain is the preferable term.

Exposures

Many characteristics of the working environment have been associated with stress-related disorders. These include heavy workload, leadership/management style, professional conflict, excessive emotional demands of the job, and lack of job security. Virtually any occupation can have associated stress issues at some stage, and personal factors also play an important role in determining whether a particular factor or factors gives rise to symptoms of stress-related conditions in an individual worker[225-228].

New Zealand studies of risk

Several New Zealand-based studies have considered psychological disorders arising from job strain. A cross-sectional study of the combined multicultural workforce (5,467 employees aged 40 years or more) from 41 companies obtained information via questionnaire. This showed increased levels of stress arising from issues of job scope in males, job pressure in administrative workers, and rapport with management in workers of Pacific Island ethnicity[229].

Another study used a self-administered questionnaire and clinical examination to investigate the level of self-reported stress and associated health parameters in a sample of workers. "Stress" was reported by 8% of all subjects (11% of subjects between 45 and 54 years). This stress was not specifically work-related stress, but work-related stress was the focus of the investigation. Those persons who reported being stressed had higher levels of mild hypertension and smoking, and a lower level of exercise[230].

A study of workers in the freezing industry examined the reasons for sickness absence, with a focus on stress. Information was collected via questionnaire. "Stress-related disease" was responsible for 15% of sickness absence, compared to 39% for viral infections, 17% for operations and 7% for zoonotic illness[48].

The same author provided a case report of a meat worker awarded compensation for stress (anxiety, claustrophobia, weakness and nausea) associated with his work at a freezing works. This author stated that 8% to 10% of the workforce were estimated to have stress (presumably work-related stress) at any one time[231].

A survey of nurses in their first year of practice found that 22% had experienced a verbal or physical threat or assault that they described as most distressing. Six per cent of respondents reported psychological consequences of their work due to threats and violent behaviour, including fear, anxiety, over-caution, mistrust and resentfulness. Considerable psychological distress was also caused by colleagues[232, 233].

Other New Zealand papers considered occupational stress in medical interns, rehabilitation providers, nurses and air traffic controllers[234-240].

For the period July 1994 to June 1997, ACC recorded 18 new paid entitlement claims for mental injury/nervous shock (of which one in 1997/8 was later disallowed). New cases for each 12-month period 1998/9, 1999/2000 and 2001/2 were given as three or fewer (the absolute numbers were not recorded for privacy reasons), and there were no recorded cases for 2000/1[17].

New Zealand exposures

There are no useful measures of factors leading to increased occupational stress in New Zealand. However, most of the relevant factors occur in the New Zealand workforce.

3.4 DISEASES OF THE NERVOUS SYSTEM

PARKINSON'S DISEASE

Summary Parkinson's disease is a neurodegenerative disease of the central nervous system. The only known causative occupational exposure is manganese, but pesticides have also been strongly implicated, and there is some evidence for exposures such as organic solvents and wood preservatives, and combined exposure to lead and copper. There are no New Zealand studies of Parkinson's disease in relation to work. There are no New Zealand data available on relevant exposures, but relevant occupations include some metal working tasks and farming.

Introduction

Parkinson's disease (and parkinsonism) is a neurodegenerative disease of the central nervous system associated with damage to the substantia nigra. Persons with the disease characteristically have slow and decreased movement, muscular rigidity, tremor and postural instability.

Exposures

The only known causative occupational exposure is manganese[241], although pesticides have been strongly implicated[242]. Other occupational exposures such as organic solvents and wood preservatives, and combined exposure to lead and copper have also been implicated[242-246].

AFs of 16% for males and 5% for females were used in the recent Finnish study[1].

New Zealand studies of risk

There are no New Zealand studies of Parkinson's disease in relation to work.

New Zealand exposures

There are no New Zealand data available on exposure to manganese or the other exposures implicated as possible causes of Parkinson's disease. Relevant occupations in New Zealand include some metal working tasks and farming.

Summary Peripheral neuropathy describes a group of disorders characterised by temporary or permanent damage to nerves outside the central nervous system. Neurotoxins are substances that result in damage to nerves. There are many peripheral neurotoxins in the occupational environment. These include metals such as lead, mercury and arsenic; organic solvents such as n-hexane, carbon disulphide and trichloroethylene; pesticides such as organophosphates; and other substances such as acrylamide. There are no New Zealand studies of occupational causes of peripheral neuropathy. There are no comprehensive New Zealand data available on exposure to substances implicated as possible peripheral neurotoxins. All the occupational exposures implicated as possibly causing peripheral neuropathy occur in New Zealand.

Introduction

Peripheral neuropathy describes a group of disorders characterised by temporary or permanent damage to nerves outside the central nervous system.

Exposures

Neurotoxins are substances that result in damage to nerves. There are many peripheral neurotoxins in the occupational environment. These include metals such as lead, mercury and arsenic; organic solvents such as n-hexane, carbon disulphide and trichloroethylene; pesticides such as organophosphates; and other substances such as acrylamide. Occupations that involve exposure to one or more of these substances are at increased risk of developing peripheral neuropathy[247-249].

New Zealand studies of risk

There are no New Zealand studies of occupational causes of peripheral neuropathy.

New Zealand exposures

There are no comprehensive New Zealand data available on exposure to substances implicated as possible peripheral neurotoxins. All the occupational exposures implicated as possibly causing peripheral neuropathy occur in New Zealand.

Summary Chronic solvent-induced toxic encephalopathy (or chronic solvent neurotoxicity) is a disorder of the nervous system arising from exposure to certain organic solvents. Causative occupational exposures occur in processes that require the use of organic solvents. These include processes using degreasing agents, paints and glues, as well as in the manufacture of textiles, plastics, polymers and pharmaceuticals, and in the use of fibreglass, as occurs in boat building. It is estimated that in 1998 there were about 100,000 New Zealand workers potentially exposed to organic solvents. There were 193 notified cases, 76 of which were confirmed, between 1993 and 1997.

Introduction

Chronic solvent-induced toxic encephalopathy (or chronic solvent neurotoxicity) is a disorder of the nervous system arising from exposure to certain organic solvents. Symptoms and signs include peripheral neuropathies and toxic encephalopathies, with alterations of affect, memory loss, tiredness, personality change and cognitive dysfunction[250-253].

Exposures

Causative occupational exposures occur in processes that require the use of organic solvents. These include processes using degreasing agents, paints and glues, as well as in the manufacture of textiles, plastics, polymers and pharmaceuticals, and in the use of fibreglass, as occurs in boat building[250-253].

New Zealand studies of risk

New Zealand information on chronic solvent-induced toxic encephalopathy comes from NODS and a paper based on notifications to this system. The paper described the 193 cases notified to NODS from 1993 to 1997. Seventy-six of these were confirmed as "verified" cases. Spray painting (39%), printing (16%) and boat building (9%) were the most common occupations represented in the verified group; most workers were exposed to a mixture of solvents, and all but two of the affected persons were male[252]. A later study showed that more severely affected persons were more likely to improve than less severely affected persons, raising doubts about the diagnosis in the mildly affected, and that in most instances the condition was not completely reversible, especially in more severe cases[254]. There were many factors that influenced the extent and type of recovery[247, 254]. Visual contrast sensitivity has been found to be abnormal in some cases, and has been proposed as a possible additional test in the diagnosis of chronic solvent-induced toxic encephalopathy[255].

A survey of a randomly selected group of boat builders in New Zealand did not find any cases of chronic neurotoxic symptoms, but the design of the study was such that these cases were not likely to have been identified[256, 257].

New Zealand exposures

Organic solvents are used in a wide range of occupations that occur in New Zealand[252, 253, 257]. The only estimate of New Zealand exposure was based on estimates for the United States in a National Institute for Occupational Safety and Health document, and suggested that in 1998 there were about 100,000 New Zealand workers "potentially exposed to organic solvents"[253].

Summary Dementia is a progressive, degenerative disease of the brain. The two main types are Alzheimer's disease and vascular dementia. No occupational exposures have been strongly associated with the development of dementia, but several have been linked to it. These include pesticides, herbicides, liquid plastic, rubber and electrical work. There are no New Zealand studies that examined the role of dementia and occupational exposures. There is no comprehensive published New Zealand information on the extent of workforce exposure to any of the specific agents that have been associated with possible increases in the risk of dementia. All the occupational exposures implicated as possibly increasing the risk of dementia occur in New Zealand.

Introduction

Dementia is a progressive, degenerative disease of the brain. The two main types are Alzheimer's disease and vascular dementia.

Exposures

No occupational exposures have been strongly associated with the development of dementia, but several have been linked to it. These include pesticides, herbicides, liquid plastic, rubber and electrical work[258-261].

AFs of 3.4% for males and 1.8% for females were used in the recent Finnish study[1].

New Zealand studies of risk

There are no New Zealand studies that examined the role of dementia and occupational exposures.

New Zealand exposures

There is no comprehensive published New Zealand information on the extent of workforce exposure to any of the specific agents that have been associated with possible increases in the risk of dementia. All the occupational exposures implicated as possibly increasing the risk of dementia occur in New Zealand.

3.5 VASCULAR DISEASES

ISCHAEMIC HEART DISEASE

Summary Ischaemic heart disease is a condition characterised by partial or complete blockage of arteries taking blood to the muscle of the heart. It can result in angina (chest pain), myocardial infarction (heart attack), heart failure or sudden death. The connection between occupational exposures and ischaemic heart disease is controversial. Of current exposures, the clearest evidence is probably for carbon monoxide, and there is good, but not compelling, evidence for an association with low job control (possibly exacerbated by high job demands) and environmental tobacco smoke. Some evidence also exists for a wide range of other exposures and occupations, most of which occur in New Zealand. The only relevant New Zealand studies examined the role of passive smoking in the development of ischaemic heart disease, estimating that in 1985 there were 152 deaths, and in 1997 there were 48 deaths, from ischaemic heart disease arising from workplace tobacco smoke. There is little comprehensive published New Zealand information on the extent of workforce exposure to specific agents that have been identified as increasing the risk of ischaemic heart disease. Several New Zealand studies have produced estimates of the prevalence of environmental tobacco smoke exposure in the workplace in New Zealand. These estimates range from 23% to 83%. Most of the relevant exposures and work tasks associated with ischaemic heart disease occur in the New Zealand workforce.

Introduction

Ischaemic heart disease is a condition characterised by partial or complete blockage of arteries taking blood to the muscle of the heart. It can result in angina (chest pain), myocardial infarction (heart attack), heart failure or sudden death.

Exposures

The connection between occupational exposures and ischaemic heart disease is controversial. The clearest evidence is probably for carbon disulphide and nitroglycerin, both of which are now rare workplace exposures, and carbon monoxide. There is now good, but not compelling, evidence for an association with low job control (possibly exacerbated by high job demands) and environmental tobacco smoke. Suggestive but weaker or inconsistent evidence of an increased risk of ischaemic heart disease exists for noise, electromagnetic fields, manual work, heat and cold, psychological "strain", imbalance between effort and reward, shift work, "strenuous occupations", law enforcement officers, fire fighters, machine operators and taxi drivers[102, 262-277].

International studies of risk

Recent estimates of attributable fraction of ischaemic heart disease due to work have been 6.3% to 18% in the United States[2], and 19% in males and 9.1% in females in Finland[1].

New Zealand studies of risk

There are two New Zealand-based estimates of ischaemic heart disease risk arising from passive smoking. The earlier study, based on 1985 data, examined the role of passive smoking in the development of ischaemic heart disease (and lung cancer). Pooled risk estimates were used to estimate the number of deaths related to environmental and workplace environmental tobacco smoke. The estimated pooled workplace relative risks were 2.3 (95% CI 1.4 – 3.4) for men and 1.9 (95% CI 1.4 – 2.5) for women and there were estimated to be 152 deaths (95% CI 62 – 274)[102]. A later study, based on 1997 data and incorporating a more sophisticated approach, used relative risk estimates of 1.21 (95% CI 1.04 – 1.41) for both males and females, and estimated that there were 42.0 deaths of males and 5.9 deaths of females each year due to workplace exposure to environmental tobacco smoke. This second study produced New Zealand-based estimates of attributable fraction of 5.7% for men and 3.7% for women[103]. Slightly different numbers were presented in an earlier report by the same authors[104]. A related study on morbidity states that admissions to hospital after heart attack include 190 events each year that would not occur if there were no workplace exposure to environmental tobacco smoke[278].

Another study examined risks of ischaemic heart disease as part of a study of occupational mortality in all New Zealand men from 1974 to 1978. The study obtained cause of death information from the National Health Statistics Centre and denominator information from a 10% random sample of the 1976 New Zealand Census. Rates were standardised for age. No information was available for any other potential confounders, and the recorded occupations in some of the death records were likely to be inaccurate or irrelevant to the conditions causing death. Some of the resulting bias was partly overcome by controlling for social class in the analysis[60] (Table 3.28).

ACC data show no new claims for work-related heart attack or stroke for the period July 1994 to July 2003, except for 1995/6, for which the number of cases was three or fewer (the actual number was not given for privacy reasons)[17].

New Zealand exposures

There are few useful measures of occupational exposure for the wide range of occupations and exposures identified as leading to an increased risk of ischaemic heart disease. However, most of the relevant exposures and work tasks occur in the New Zealand workforce. Several New Zealand studies have produced estimates of the prevalence of environmental tobacco smoke exposure in the workplace in New Zealand. These estimates range from 23% to 83%, and are presented in more detail in Section 4.2.

TABLE 3.28 Published estimates of increased risk of ischaemic heart disease in selected occupational groups – New Zealand-based studies only

WORK GROUP	RR	95% CI	RISK MEASURE AND STUDY DETAILS	YEAR AND SOURCE
Hairdressers, beauticians	2.14	1.25 – 3.43	RR[1]: cohort[2], 1974-1978	Pearce, 1985[60]
Spinners, weavers, dyers	1.68	1.26 – 2.19	RR[1]: cohort[2], 1974-1978	Pearce, 1985[60]
Shoemakers, leather goods	2.29	1.59 – 3.20	RR[1]: cohort[2], 1974-1978	Pearce, 1985[60]
Labourers, nec	1.26	1.15 – 1.38	RR[1]: cohort[2], 1974-1978	Pearce, 1985[60]

1: Age-standardised and compared to males in the same social class
2: Cause of death information from the National Health Statistics Centre

3.6 RESPIRATORY DISEASES (NON-MALIGNANT)

ASTHMA

Summary Occupational asthma is a disorder characterised by bronchial hyper-responsiveness or variable airflow limitation related to workplace exposures. Occupational asthma is probably the most common work-related respiratory disorder in industrialised countries, and many hundreds of occupational agents, including some inorganic and organic dusts, have been associated with it. Several studies have considered occupational asthma in New Zealand. These found asthma was more common in farmers and farm workers, food processors other than bakers and laboratory technicians. Studies of specific work groups found increased risks of occupational asthma, sometimes in a dose-response manner, in sawmill workers, plywood mill workers, green mussel openers and some farmers. Notifications to NODS (94 cases from 1993 to 1999) probably significantly underestimate the incidence of occupational asthma, but have identified many causative exposures. Assessments of some causative workplace exposures have been published. Many of the wide range of occupations and exposures identified as leading to an increased risk of asthma are undertaken in New Zealand.

Introduction

Occupational asthma is a disorder characterised by bronchial hyper-responsiveness (BHR) or variable airflow limitation related to workplace exposures. Whether only immunologically mediated asthma should be considered to be occupational asthma, or whether asthma arising as a result of workplace exposure to irritants, or exacerbation of pre-existing asthma by workplace irritants, should also be considered in the definition is still the subject of debate[279-281]. However, the broader definition seems currently to be more widely accepted[282].

Exposures

Occupational asthma is probably the most common work-related respiratory disorder in industrialised countries[283], and is either stable[99] or increasing in incidence[284]. Many hundreds of occupational agents, including some inorganic and organic dusts, have been associated with occupational asthma. Biological agents include grains, flours, plants and gums, fur, feathers and other animal parts, insects and fungi, drugs and enzymes, and various types of wood. Chemical agents include chlorofluorocarbons, alcohols, metals and their salts, and welding fumes. These agents are found in a variety of workplaces, including food and natural products processing, animal handling facilities, manufacturing, and construction[282, 285-287].

International studies of risk

Recent estimates of attributable fraction of asthma due to work have been 11% to 21% in the United States[2], 18% in males and females in Finland[1], and 17% (for women) and 29% (for men) in Finland[288].

New Zealand studies of risk

Several studies have considered occupational asthma in New Zealand. The major study was a population-based cross-sectional study of a random sample of persons aged between 20 and 44 years. A further random sample of persons was contacted at a later time and included if they had respiratory symptoms suggestive of asthma. The survey was questionnaire based and included five different definitions of asthma (wheezing or whistling, asthmatic symptoms or medication, BHR alone, wheezing and BHR, and asthmatic symptoms and BHR). The response rate was 64%. Lung function measurements, including of bronchial reactivity, were also made on 70% of those completing the questionnaire. Prevalence odds ratios were calculated in relation to the group "remainder professional, clerical and administrative workers", and adjusted for age, sex and tobacco smoking. Current occupation, or the previous occupation if the person had changed jobs because of respiratory problems, was used in the analysis. The prevalence ratio for asthma (based on one or more of the five definitions) was raised in farmers and farm workers, food processors other than bakers, and laboratory technicians. An attributable fraction of 1.9% to 3.1% for asthma from work was estimated[289] (Table 3.29).

A study of 50 randomly selected New Zealand woodworkers in the early 1990s identified four definite cases, and one suspected case, of occupational asthma[290].

A more recent study administered a face-to-face respiratory health questionnaire to 772 pine sawmill workers (about 86% of eligible workers) at five sawmills. Subjects were divided into four exposure categories on the basis of job title. Questionnaire results were compared to results from a general population survey in the same geographical area, and within the subject group. Prevalence odds ratios were adjusted for sex, age, ethnicity, smoking status (although smoking was not included for the general population comparisons) and mill. The study found an increased risk of asthma in exposed workers compared to the general population, a dose-response of increasing odds ratio with increasing dust exposure, and a higher odds ratio in those exposed to green dust than to dry dust. Symptoms of cough, eye irritation and nose irritation were also more common in exposed workers[291] (Table 3.29).

A recent study of respiratory symptoms in plywood mill workers administered a face-to-face respiratory health questionnaire to 112 workers from the one plant (about 60% of those approached, and 55% of workers in the mill). Workplace levels of various atmospheric contaminants, including inhalable dust, bacterial endotoxin, abietic acid, terpenes and formaldehyde, were measured. Questionnaire results were compared to results from a general population survey in the same geographical area, and within the subject group. Prevalence odds ratios were adjusted for sex, age, ethnicity and smoking (although smoking was not included for the general population comparisons). The study found asthma symptoms were more common in the plywood mill workers compared to the general population and were directly associated with duration of employment. There was an increased symptom prevalence in workers more highly exposed to formaldehyde, but no relationship to other exposures[292] (Table 3.29).

A series of New Zealand studies has found increased risks of asthma symptoms in welders. These found an increased prevalence of work-related cough, and a significantly increased risk of a fall in lung function (FEV_1) of at least 5% after 15 minutes of work[293, 294]. The workers who had the greatest acute fall in lung function also showed the greatest decline in lung function over time[295]. Nickel exposure from metal inert gas (MIG) and tungsten inert gas (TIG) welding was particularly associated with work-related respiratory symptoms, and aluminium exposure from welding was particularly associated with a fall in FEV_1[296].

Work-related respiratory symptoms suggestive of asthma, and lung function, were investigated in New Zealand workers opening green-lipped mussels. This study had been prompted by a series of apparent occupational asthma cases linked to this occupation in New Zealand, and previous reports linking work in the seafood industry with the development of occupational asthma. The study had virtually complete coverage of the workforce at nine

mussel processing sites. A questionnaire was administered and pulmonary function measurements undertaken in all workers. Across-shift pulmonary function measurements were also undertaken at one processing site. Odds ratios were adjusted for age, sex, smoking status and other risk factors included in the relevant logistic regression model. One third of the workers reported work-related respiratory symptoms. Work-related respiratory symptoms were directly associated with length of work as a mussel opener. Females appeared to have increased risk compared to males. Lung function was considerably reduced compared to predicted values, but there was no consistent change in these measures across the working shift[297] (Table 3.29).

A national survey of a random sample of New Zealand farmers investigated asthma and allergy in farmers. The study analysed data from a self-administered questionnaire. The 1,706 participants who returned the mailed questionnaires represented 78% of the initial sample. Prevalence odds ratios were adjusted for age, sex and, where appropriate, other relevant variables. Three definitions of asthma were used (waking with an attack of shortness of breath; an attack of asthma; and current asthma medications in the last year). The overall prevalence of asthma was lower in farmers than a comparable non-farming population (12% versus 15%). Horse breeders and groomers (17%), pig farmers (18%), poultry farmers (17%), farmers working with oats (17%), and farmers exposed to cleaning powders (15%) had the highest prevalence of current asthma. Elevated prevalence odds ratios after adjusting for other relevant variables were found for working with horses, working with pigs, working with oat crops, and using cleaning powders[298] (Table 3.29).

A study of occupational respiratory symptoms suggestive of asthma, and lung function, was undertaken with New Zealand hairdressers, using office staff and shop workers for comparison. A higher prevalence of asthma symptoms, asthma attacks and diagnosed asthma was found in hairdressers, but this was largely accounted for by differences in age, sex and smoking. There was no consistent difference in lung function[299].

Two papers describe occupational asthma cases reported to NODS in the 1990s. These showed that a wide range of exposures was identified as the causal agents. Isocyanates were the largest single category, with other identified exposures being avain proteins, milk protein, mussel protein, flour, western red cedar, unspecified wood dusts, formalin, formaldehyde, glutaraldehyde, epoxy resins, chlorine-based cleaners, organophosphate, ozone, aluminium smelting, "fumes", welding fumes, colophony solder, detergent enzymes, irritant mineral dusts, acrylates, dibutyl phthalate, polyvinyl chloride fumes, polyurethane foam and fumes and triglycidylisocyanurate. Ninety-four confirmed cases of occupational asthma were notified between 1993 and 1999 (116 from March 1992 to June 1998[16]), suggesting that there was a major underestimation of true occupational asthma cases[300, 301].

The same under-reporting is seen in ACC statistics, where for the period July 1994 to June 1998 there were no new paid entitlement claims for occupational asthma, and between 1998/9 and 2002/3 there were four claims for each of 1999/2000 and 2001/2, and three or fewer (actual numbers were not given for privacy reasons) for the other 12-month periods[17].

A survey of a randomly selected group of boat builders in New Zealand found that 14% to 16% of workers reported wheezing with a pattern that met criteria for occupational asthma. Relevant exposures were to isocyanates, epoxy resins and detergents[257], with the role of isocyanates being highlighted in an accompanying editorial[256].

Brief reports have addressed the criteria required to diagnose occupational asthma clinically or for compensation purposes[302]. They argued that these two different purposes require different criteria[303, 304], and that occupational asthma is under-diagnosed[305]; reviewed asthma in relation to aluminium smelting[306, 307]; and considered the problems that asthma raises for affected employees, whether the asthma is caused by workplace exposures or just exacerbated by them[308].

New Zealand was included in a recent international study investigating occupational asthma[283].

New Zealand exposures

The survey of a randomly selected group of boat builders in New Zealand found exposure to solvents (98%), epoxy resins (90%), glues (76%), isocyanates (65%), detergents (47%), and oils and lubricants (46%)[257].

Exposures to airborne dust, endotoxin and _(1,3)-glucan in two New Zealand sawmills found that endotoxin levels were high enough to cause respiratory symptoms[309].

Many of the wide range of occupations and exposures identified as leading to an increased risk of asthma are undertaken in New Zealand.

TABLE 3.29 Published estimates of increased risk of asthma in selected occupational groups – New Zealand-based studies only

WORK GROUP	RR	95% CI	RISK MEASURE AND STUDY DETAILS	YEAR AND SOURCE
Farmers and farm workers	4.16	1.33 – 13.1	OR[1,2,3]: XS[4], mid-1990s	Fishwick, 1997[289]
- horses	1.5	1.0 – 2.2	OR[5,6]: XS[4], mid-1990s	Kimbell-Dunn, 1999[298]
- pigs	1.3	0.9 – 2.0	OR[5,6]: XS[4], mid-1990s	Kimbell-Dunn, 1999[298]
- oats	1.6	0.9 – 2.8	OR[5,6]: XS[4], mid-1990s	Kimbell-Dunn, 1999[298]
- use of cleaning powders	1.3	0.9 – 1.8	OR[5,6]: XS[4], mid-1990s	Kimbell-Dunn, 1999[298]
Food processors other than bakers	2.45	1.05 – 5.72	OR[1,2,7]: XS[4], mid-1990s	Fishwick, 1997[289]
Laboratory technicians	4.94	1.29 – 18.9	OR[1,2,8]: XS[4], mid-1990s	Fishwick, 1997[289]
Sawmill workers	1.6	1.1 – 2.3	OR[9,10]: XS[4], late 1990s	Douwes, 2001[291]
- low exposure	1.9	0.7 – 4.9	OR[11,12]:XS[4], late 1990s	Douwes, 2001[291]
- high exposure to green dust	2.7	0.9 – 7.6	OR[11,12]: XS[4], late 1990s	Douwes, 2001[291]
- high exposure to dry dust	2.1	0.8 – 5.7	OR[11,12]: XS[4], late 1990s	Douwes, 2001[291]
Plywood mill workers	1.5	0.9 – 2.8	OR[9,10]: XS[4], late 1990s	Fransman, 2003[292]
Mussel openers				
- 2-7 years' work	2.29	1.07 – 4.91	OR[13,14]: XS[4], late 1990s	Glass, 1998[297]
- 7+ years' work	3.72	1.52 – 9.11	OR[13,14]: XS[4], late 1990s	Glass, 1998[297]

1: Prevalence odds ratio, adjusted for age, sex and smoking status
2: Compared to "the remaining professional, clerical and administrative workers"
3: Based on BHR and wheezing
4: Cross-sectional study
5: Prevalence odds ratio, adjusted for age, sex and other relevant variables
6: Based on "current asthma" as determined by any of three definitions (see text)
7: Based on wheezing
8: Based on BHR
9: Prevalence odds ratio, adjusted for age, sex and ethnicity
10: Compared to general population
11: Prevalence odds ratio, adjusted for sex, age, ethnicity, smoking status and mill
12: Compared to unexposed sawmill workers
13: Prevalence odds ratio, adjusted for sex, age, ethnicity and smoking status
14: Compared to mussel openers working for fewer than two years

Summary Chronic obstructive pulmonary disease (COPD) and chronic bronchitis are lung diseases characterised by a widespread reduction in the diameter of the airways that cannot be reversed by treatment, and bronchial mucous hypersecretion. Tobacco smoking is the most important risk factor for the development of these conditions, but work-related exposures such as coal, silica, cotton dust and grain dust, and the occupations in which these exposures occur (mining, construction, farming) have been demonstrated to be strongly associated with COPD. There are several New Zealand studies of COPD and chronic bronchitis in relation to work. These found increased risks in some farmers, food processors other than bakers, bakers, chemical processors, some metal and electrical workers (particularly welders) and spray painters, and in farmers exposed to fertilizers and formaldehyde. Increases in symptoms, and decreases in lung function, were also found in association with various exposures in welders. There are no comprehensive New Zealand data available on relevant exposures, but most of the occupations identified as leading to an increased risk of COPD and chronic bronchitis are undertaken in New Zealand.

Introduction

Chronic obstructive pulmonary disease (COPD) (also known as chronic airflow limitation) is a lung disease characterised by a widespread reduction in the diameter of the airways that cannot be reversed by treatment. Chronic bronchitis is a related condition characterised by bronchial mucous hypersecretion. There is a significant overlap between the two conditions, and they are considered together here[310, 311].

Exposures

Tobacco smoking is the most important risk factor for the development of COPD and bronchitis, but many work-related exposures have been demonstrated to cause COPD. The causative agents of COPD include dust and fumes, with dusts showing a more consistent relationship than fumes. Relevant dusts include coal, silica, cotton dust and grain dust. Occupations in which these exposures occur – mining, construction, farming – have been associated with increased risks of developing COPD[282, 310-314].

International studies of risk

Recent estimates of attributable fraction of COPD due to work have been 5% to 24% in the United States[2] and 14% in males and 3.8% in females in Finland[1].

New Zealand studies of risk

There are several New Zealand-based studies of chronic bronchitis. The major study was a population-based cross-sectional study of a random sample of persons aged between 20 and 44 years. A further random sample of persons was contacted at a later time and included if they had respiratory symptoms. A questionnaire was administered, and lung function testing performed. The response rate for the questionnaire was 64%, and 70% of these subjects had comprehensive lung function measurements. Four different definitions of COPD were used

(chronic bronchitis, chronic bronchitis and airway obstruction, shortness of breath, and shortness of breath and airway obstruction), all of which excluded anyone who had been previously diagnosed with asthma by a doctor. Prevalence odds ratios were calculated in relation to the group "remainder professional, clerical and administrative workers", and adjusted for age, sex and tobacco smoking. Current occupation, or the previous occupation if the person had changed jobs because of respiratory problems, was used in the analysis. The prevalence ratio for COPD (based on one or more of the four definitions) was raised in food processors other than bakers, bakers, chemical processors, other metal and electrical workers, and spray painters. Measured airway obstruction was worse in spray painters. Reporting having ever been exposed to fumes, gases, vapour or dust was associated with a higher prevalence of reporting symptoms consistent with chronic bronchitis, chronic bronchitis and airway obstruction and shortness of breath. An attributable fraction of 19.3% for COPD from work was estimated[293] (Table 3.30).

A national survey of a random sample of New Zealand farmers investigated work-related respiratory symptoms. The study analysed data from a self-administered questionnaire. The 1,706 participants who returned the mailed questionnaires represented 78% of the initial sample. Prevalence odds ratios were adjusted for smoking and sex (where appropriate). Questions examined the prevalence of work-related breathing problems, shortness of breath, bronchitis and organic dust toxic syndrome. Farmers not working with pigs, poultry, stored grain or grain were used as the reference category for the multivariate analyses. Horse, poultry and crop farmers reported the highest rate of respiratory symptoms. High rates were also seen in farmers exposed to fertilizers and formalin dip. Work-related respiratory symptoms were reported by 18% of all farmers, and chronic bronchitis by 9.4%. Higher rates of chronic bronchitis occurred in horse and crop (particularly oats and barley) farming[315] (Table 3.30).

A cross-sectional study of 62 welders and 75 non-welders examined respiratory symptoms and lung function. Chronic bronchitis was found to be more common in current welders compared to non-welders and in welders with a higher cumulative exposure compared to non-welders, and to be associated with lower measurements of lung function. Total exposure to welding fumes of greater than ten years was found to be a significant independent risk factor (along with smoking) for chronic bronchitis. Welding in confined spaces was also found to be associated with a higher prevalence of reporting respiratory symptoms[294] (Table 3.30).

An extension of the same study looked at lung function (FEV_1) across a work shift, and found an increased decrement in lung function across a work shift in welders compared to non-welders, and in welders not using local exhaust ventilation compared to those that do use local exhaust ventilation[316]. These changes in lung function were found to be related to exposure to workplace fumes, with a fall in FEV_1 of at least 5% after 15 minutes of work being related to measured aluminium exposure in the personal breathing zones of workers. Respiratory symptoms were also related to measured nickel exposure in the personal breathing zones of workers[296].

A two-year follow-up study of this welder and non-welder group found, for smokers, that welders had a greater annual decline in lung function (FEV_1) than non-welders. Welders without respiratory protection or local exhaust ventilation had a larger annual decline in lung function (FEV_1) than welders with such respiratory protection[295]. Of the six (of eight) worksites involved that did not have local exhaust ventilation at the beginning of the study, four still did not have it two years later, despite the results of the initial study being reported to management, study participants and the media[317].

An unrelated survey of the degree of compliance with health and safety legislation of businesses in which welding occurred found that fume control was adequate in only 10% of small employers and 14% of large employers, and that no processes were ventilated in 22%[318].

An earlier study of 16 welders found respiratory symptoms in 67% of welders, and chronic bronchitis symptoms in 38%[319].

New Zealand was also included in a recent international study investigating COPD in young persons that found that occupational exposures were only associated with the mildest form of the disease[320].

New Zealand exposures

One brief report noted raised blood levels of manganese in welders[321]. There are no comprehensive New Zealand data available on relevant exposures, but most of the occupations identified as leading to an increased risk of COPD and chronic bronchitis are undertaken in New Zealand.

TABLE 3.30 Published estimates of increased risk of COPD and chronic bronchitis in selected occupational groups – New Zealand-based studies only

WORK GROUP	RR	95% CI	RISK MEASURE AND STUDY DETAILS	YEAR AND SOURCE
Food processors other than bakers	2.8	1.3 – 6.3	OR[1,2,3]: XS[4], mid-1990s	Fishwick, 1997[293]
Bakers	25.5	3.9 – 168.5	OR[1,2,5]: XS[4], mid-1990s	Fishwick, 1997[293]
Chemical processors	18.84	3.7 – 95.6	OR[1,2,3]: XS[4], mid-1990s	Fishwick, 1997[293]
Other metal and electrical workers	1.7	0.9 – 3.1	OR[1,2,3]: XS[4], mid-1990s	Fishwick, 1997[293]
Spray painters	14.4	2.9 – 72.7	OR[1,2,5]: XS[4], mid-1990s	Fishwick, 1997[293]
Welding				
- exposure to fumes for 10 years+	9.5	1.3 – 86.9	OR[3,6,7]: XS[4], mid-1990s	Bradshaw, 1998[294]
- exposure to fumes for 10 years+	3.0	0.9 – 10.5	OR[6,7,8]: XS[4], mid-1990s	Bradshaw, 1998[294]
- exposure to fumes in confined space	2.8	1.0 – 8.3	OR[8,9,10]: XS[4], mid-1990s	Bradshaw, 1998[294]
Farming				
- horse	1.6	1.1 – 2.5	OR[3,11,12]: XS[4], mid-1990s	Kimbell-Dunn, 2001[315]
- grain	1.5	1.0 – 2.2	OR[3,11,12]: XS[4], mid-1990s	Kimbell-Dunn, 2001[315]
- oats	2.1	1.2 – 3.8	OR[3,11,12]: XS[4], mid-1990s	Kimbell-Dunn, 2001[315]
- barley	1.8	1.1 – 2.9	OR[3,11,12]: XS[4], mid-1990s	Kimbell-Dunn, 2001[315]
- hay handling	1.6	1.1 – 2.3	OR[3,11,12]: XS[4], mid-1990s	Kimbell-Dunn, 2001[315]

1: Prevalence odds ratio, adjusted for age, sex and smoking status
2: Compared to "the remaining professional, clerical and administrative workers"
3: Based on chronic bronchitis
4: Cross-sectional study
5: Based on chronic bronchitis and airways obstruction
6: Prevalence odds ratio, adjusted for age, sex, smoking status and time spent confined space welding
7: Compared to workers with zero or low exposure to welding fumes
8: Based on work-related respiratory symptoms
9: Prevalence odds ratio, adjusted for age, sex, smoking status and total exposure to welding fumes
10: Compared to workers with zero or low time spent confined space welding
11: Prevalence odds ratio, adjusted for smoking status and sex (where appropriate)
12: Compared to farmers not working with pigs, poultry, stored grain or grain

PNEUMOCONIOSES

Summary Pneumoconioses are fibrotic lung diseases caused only by occupational exposure to specific mineral dusts. The most important of these are silicosis, asbestosis and coal workers' pneumoconiosis, which are caused by exposure to silica, asbestos and coal dust respectively. There are numerous other pneumoconioses of relevance to specific industries and occupations, but cases are rare. There are no New Zealand-based studies of pneumoconiosis. Silica and asbestos exposure in the New Zealand workplace occurs primarily in construction and manufacturing occupations. Coal exposure occurs through coal mining.

Introduction

Pneumoconioses are fibrotic lung diseases caused only by occupational exposure to specific mineral dusts. The most important of these are silicosis, asbestosis and coal workers' pneumoconiosis.

Exposures

Silicosis is caused by exposure to silica, asbestosis by exposure to asbestos and coal workers' pneumoconiosis by exposure to coal. The silica and asbestos exposure can occur in a variety of mining, manufacturing and construction occupations. The coal exposure comes exclusively from coal mining[313, 322-329]. There are numerous other pneumoconioses of relevance to specific industries and occupations, but cases are rare[330].

International studies of risk

The occupation-AFs for the pneumoconioses due to silica, asbestos and coal dust exposure are essentially 100%, as significant exposure only occurs in an occupational setting.

New Zealand studies of risk

There are no New Zealand-based studies of pneumoconiosis.

New Zealand exposures

Silica and asbestos exposure in the New Zealand workplace occurs primarily in construction and manufacturing occupations. Coal exposure occurs through coal mining.

OTHER RESPIRATORY DISORDERS

Introduction

This section describes other New Zealand papers relevant to work-related respiratory disorders that do not fit under any of the major headings in the respiratory section.

New Zealand studies of risk

One New Zealand paper briefly addressed sick building syndrome, presenting the findings from a survey of a general office working environment in 1992. Thirty-nine randomly selected workplaces with natural ventilation were included (308 workers participated). The most commonly reported respiratory symptoms were itchy nose (25%), sore throat (25%), runny nose (17%) and cough (17%). Headache (42%), tiredness (26%) and dry skin (26%) were the most commonly reported symptoms overall. No prevalences from a comparison population were presented[331].

3.7 HEPATIC DISEASE

Summary There are a variety of liver disorders that may be related to occupation. These include acute hepatitis, chronic active hepatitis, and hepatic cirrhosis. Acute hepatitis in an occupational setting is due to exposure to certain hazardous substances and to hepatitis A, hepatitis B (HBV) and hepatitis C (HCV). Chronic active hepatitis is due to exposure to HBV and HCV. The strongest connection between occupational exposures and hepatic cirrhosis is to HBV, HCV and to organic solvents. Typical exposure situations for organic solvents include metal degreasing, dry cleaning and the manufacture and use of paints. It has also been connected to alcohol intake, but there is much debate as to the role of occupation in affecting alcohol intake. All the occupations at significant risk of exposure to organic solvents and HBV and HCV occur in New Zealand.

Introduction

There are a variety of liver disorders that may be related to occupation. These include acute hepatitis (inflammation of liver cells), chronic active hepatitis, and hepatic cirrhosis. Cirrhosis a disorder of the liver involving damage to liver cells, resulting in irreversible fibrosis. Liver cancer is considered in Section 3.2.

Exposures

Acute hepatitis in an occupational setting is most commonly due to exposure to certain hazardous substances (particularly organic solvents) and to hepatitis B (HBV) and hepatitis C (HCV). Typical exposure situations for organic solvents include metal degreasing, dry cleaning and the manufacture and use of paints. Occupational exposures related to HBV and HCV are covered earlier in the section on viral hepatitis. Chronic active hepatitis is due to exposure to HBV and HCV. The strongest connection between occupational exposures and hepatic cirrhosis is to HBV and HCV. It has also been connected to alcohol intake, a known cause of hepatic cirrhosis, but there is much debate as to the role of occupation in affecting alcohol intake. There is also evidence of a synergistic effect on liver damage between some of these exposures[332-338].

New Zealand studies of risk

There are no New Zealand-based studies of acute, chronic or cirrhotic liver disease. Studies relevant to HBV and HCV are covered earlier in the section on viral hepatitis.

New Zealand exposures

All the occupations at significant risk of exposure to organic solvents and HBV and HCV occur in New Zealand.

3.8 DISEASES OF THE GENITOURINARY SYSTEM

CHRONIC RENAL FAILURE

Summary Chronic renal failure is a disorder of the kidney characterised by permanent damage to the filtration tissues. The strongest connection between occupational exposures and chronic renal failure is with metals such as lead, cadmium, chromium, copper and mercury, including via welding fumes. Other exposures for which there is some evidence include organic solvents, grain dust and silicon-containing compounds. There are no New Zealand-based studies of chronic renal failure in relation to occupational exposures. There are no useful measures of occupational exposures identified as leading to an increased risk of chronic renal failure. However, most of the relevant exposures and work tasks occur in the New Zealand workforce.

Introduction

Chronic renal failure is a disorder of the kidney characterised by permanent damage to the filtration tissues. In the occupational setting, the nephritic syndrome is probably the most important type of chronic renal failure.

Exposures

The strongest connection between occupational exposures and chronic renal failure is with metals such as lead, cadmium, chromium, copper and mercury, including via welding fumes. Other exposures for which there is some evidence include organic solvents, grain dust and silicon-containing compounds[339-341].

International studies of risk

Recent estimates of attributable fraction of chronic renal failure due to work have been 8.2% to 15% in the United States[2], and 18% in males and 2.3% in females in Finland[1].

New Zealand studies of risk

There are no New Zealand-based studies of chronic renal failure in relation to occupational exposures.

New Zealand exposures

There are no useful measures of occupational exposures identified as leading to an increased risk of chronic renal failure. However, most of the relevant exposures and work tasks occur in the New Zealand workforce.

3.9 NON-CANCEROUS SKIN CONDITIONS

Summary The main non-malignant skin diseases in an occupational context are irritant and allergic contact dermatitis. These conditions are a very common cause of ill-health related to occupation. The main risk factor for irritant contact dermatitis is wet work, and work that involves exposure to a combination of different chemicals, especially cutting fluids and solvents. High-risk exposures for allergic contact dermatitis include rubber chemicals, rubber latex, nickel, chromate and epoxy resin. A wide range of occupations has been identified to be at high risk, including hairdressing, food handling (bakers, caterers, cooks and confectioners), health workers (especially nurses), construction industry workers, leather and shoe manufacturers, florists, gardeners and metal workers. Several papers address aspects of work-related dermatitis, including in boat builders, persons exposed to epoxy resin, farmers and poultry-processing workers. From March 1992 to June 1998 there were 311 notifications to NODS for occupational skin disease, and there were another 79 notifications in the subsequent two years. Most of the problem exposures leading to irritant and allergic contact dermatitis occur in the New Zealand workforce.

Introduction

The main non-malignant skin diseases in an occupational context are irritant and allergic contact dermatitis. These conditions are a very common cause of ill-health related to occupation. The hands are the predominant problem area.

Exposures

The main risk factor for irritant contact dermatitis is wet work, and work that involves exposure to a combination of different chemicals, especially cutting fluids and solvents. High-risk exposures for allergic contact dermatitis include rubber chemicals, rubber latex, nickel, chromate and epoxy resin. Occupations identified to be at high risk include hairdressing, food handling (bakers, caterers, cooks and confectioners), health workers (especially nurses), construction industry workers, leather and shoe manufacturers, florists, gardeners and metal workers[342-344].

New Zealand studies of risk

Several papers address aspects of work-related dermatitis. A survey of a randomly selected group of boat builders in New Zealand found that 26% had some form of dermatitis, but that only about one quarter of these cases met the criteria for occupational causation. Relevant exposures were to solvents and epoxy resins[257].

One paper presented a case series of 16 New Zealand male workers with occupational contact dermatitis due to epoxy resin. They worked as house builders (two), plasterers (two), engineers (two), windscreen repairers (two), and one each as a concrete worker, boat builder, powder coater, boat painter, timber yard worker, car yard worker, farm worker and cane furniture salesman. The main causative exposure was epoxy adhesives, with some cases due to epoxy paints[345].

The same author described the results of patch testing 46 New Zealand farmers with contact dermatitis. Patch testing suggested that 20 of the subjects had an occupational cause for the dermatitis, with the common allergens being pesticides, rubber, and sunscreen[346].

One author described the characteristics of occupational skin disease cases that presented to a private New Zealand dermatology practice between 1987 and 1993. The main involved occupations were hairdressing, food and health care, and 70% of the cases were contact dermatitis[347].

A 1987 paper reported an outbreak of dermatosis in the New Zealand army from contact with the blister beetle, an insect endemic to New Zealand. Seventy-four personnel were affected by the occurrence of blisters[348].

A cross-sectional study of workers at a poultry processing plant found that 44% of subjects had developed wart-like lesions after they had started working in the plant. The presence of warts was confirmed in nearly all the subjects who reported having the warts at the time of the study. Workers who often handled raw, unfrozen, dead chickens were three times more likely to have warts than other workers, and warts were 5.6 times more likely in people who had ever handled raw chicken[349].

A study of meat workers and textile workers found a high prevalence of warts on the hands of workers who slaughtered cattle (72%) and pigs 60%), with the rates being much higher than the prevalence for other meat workers (27%) and textile workers (22%)[350].

A ten-year study of presentations to a rural dermatological practice for chilblains in milkers identified ten cases, with three workers changing occupation as a result of the lesions[351]; and a case report presented information on chloracne that developed in a weedsprayer exposed to organochlorines and herbicides[352].

From March 1992 to June 1998 there were 311 notifications to NODS for occupational skin disease (including burns)[16]. In the subsequent two years there were another 79 notifications[44].

For the period July 1994 to June 2003, there were 587 to 589 (the actual number was not given for privacy reasons) new paid entitlement claims to ACC for occupational dermatitis[17].

New Zealand exposures

Most of the problem exposures leading to irritant and allergic contact dermatitis occur in the New Zealand workforce.

3.10 MUSCULOSKELETAL CONDITIONS

UPPER LIMB DISORDERS

Summary There is a range of upper limb musculoskeletal disorders associated with work. Some have clear clinical and pathological diagnostic criteria. In addition, there are many cases of upper limb pain without associated objective signs. These cases have been given many labels, including repetitive strain injury, occupational overuse syndrome and regional pain syndrome. A wide range of occupations, tasks and workplace organisational and psychosocial factors has been associated with one or more of these upper limb disorders and syndromes. There has been particular controversy in New Zealand relating to the problem of upper limb pain without associated objective signs. Debate has covered the approach to such cases taken by ACC and the appropriate terminology to use. One New Zealand-based cross-sectional study looked at the prevalences of self-reported and diagnosed "upper extremity musculoskeletal strains" in clerical workers. Virtually all the occupations, tasks and exposures associated with upper limb disorders occur in the New Zealand workforce.

Introduction

There is a range of upper limb musculoskeletal disorders associated with work. Some have clear clinical and pathological diagnostic criteria. These include rotator cuff syndrome, lateral epicondylitis, medial epicondylitis, ulnar nerve entrapment, radial nerve entrapment, tendonitis in the hand and fingers, Raynaud's phenomenon or peripheral neuropathy related to upper limb vibration, De Quervain's tenosynovitis and carpal tunnel syndrome. In addition, there are many cases of upper limb pain without associated objective signs. These cases have been given many labels, including repetitive strain injury, occupational overuse syndrome (OOS) and non-specific musculoskeletal disorder of the upper limb[353]. Usage in New Zealand ACC review and appeal cases has favoured the term "regional pain syndrome".

Exposures

A wide range of occupations, tasks and workplace organisational and psychosocial factors has been associated with one or more of these upper limb disorders and syndromes. These include the use of hand tools; working with raised arms; vibration; the combination of repetition, force and posture; and low job control, low social support, perceived monotonous work and other causes of job "strain"[354-359].

New Zealand studies of risk

There has been particular controversy in New Zealand relating to the problem of upper limb pain without associated objective signs. Debate has covered the approach to such cases taken by ACC[360-368] and the appropriate diagnostic criteria, terminology and management approach to use[368-376].

In his recent review, Dodwell argued the term "occupational overuse syndrome" should not be used in New Zealand. He favoured establishing a verifiable physiological/pathological diagnosis where possible[370].

One New Zealand-based cross-sectional study looked at the prevalences of self-reported and diagnosed "upper extremity musculoskeletal strains" in clerical workers. Keyboard operators were compared to non-keyboard operators. The study found upper limb weakness was more commonly reported by keyboard operators, but pain and constant pain were reported with similar frequency. Strains were slightly more commonly reported in the keyboard group, but were common in both (non-keyboard = 42%; keyboard = 48%). All symptoms were most common in the neck and shoulder, but pain was also commonly reported in the wrists, hands and fingers[377].

Another study looked at the occupations of patients with various types of conditions resulting in upper limb pain. "Pain syndrome or OOS" was more common in the clerical occupational group, further analysis showing that this was confined to particular clerical sub-groups (word processor operators, data entry operators and mail sorters)[378].

From March 1992 to June 1998 there were 3,128 notifications to NODS for upper limb pain identified as OOS[16].

For the period July 1994 to June 2003, ACC recorded 11,294 new paid entitlement claims for "occupational overuse syndrome", with 23 new claims being recorded for 2002/3. Between July 1998 and June 2003, there were 88 new paid entitlement claims for work-related "pain syndromes", with 17 being reported for 2002/3. For the period July 1994 to June 2003, there were 5,224 new paid entitlement claims for work-related "localised inflammation" (such as epicondylitis, tendonitis), and in 2002/3 there were another 1,840. For the same period, there were 2,463 to 2,465 (the exact number was not given for privacy reasons) new paid entitlement claims for work-related "compression syndromes" (such as carpal tunnel syndrome), and in 2002/3 there were another 828[17].

New Zealand exposures

Virtually all the occupations, tasks and exposures associated with upper limb disorders occur in the New Zealand workforce.

Summary Low back pain is one of the most common musculoskeletal disorders related to work. The connection between symptoms, disability and demonstrable pathology is often not clear or requires very focused investigation. A wide range of occupations, work tasks, workplace factors and psychological factors has been associated with low back pain, with heavy lifting the task most commonly associated, but there is debate regarding the validity of much of the evidence. Several New Zealand studies have considered aspects of work-related back pain. These include a study that investigated factors that affected the likelihood of the low back pain becoming chronic; a review of all work-related ACC claims over a period of three months in 1984 for back "strains or sprains"; a random population survey in Auckland conducted via telephone to investigate the incidence of low back pain in the general community; and a cross-sectional study of public sector nurses in Auckland in 1992. Virtually all the occupations, tasks and exposures associated with low back pain occur in the New Zealand workforce.

Introduction

Low back pain is one of the most common musculoskeletal disorders related to work. Chronic low back pain, in particular, is a major cause of disability and cost.

Exposures

Like many other work-related musculoskeletal conditions, the connection between symptoms, disability and demonstrable pathology is often not clear or requires very focused investigation. A wide range of occupations, work tasks, workplace factors and psychological factors has been associated with low back pain, with heavy lifting the task most commonly associated, but there is debate regarding the validity of much of the evidence[372, 379-389].

New Zealand studies of risk

Several New Zealand studies have considered aspects of work-related back pain. One study followed workers who had made an ACC compensation claim for work-related back pain, and investigated factors that affected the likelihood of the pain becoming chronic (defined as still receiving payment three months after the initial claim). When other factors were taken into account, having to lift for three quarters or more of the working day doubled the risk of the pain progressing from chronic to acute (OR = 1.98, 95% CI 1.30 – 3.04)[390] (Table 3.31).

Another study considered all work-related ACC claims over a period of three months in 1984 for back "strains or sprains" in persons less than 60 years of age (the disorders were described both as "back injury" and "back pain"). Data were received for 80% of eligible claims. The rates were highest in labourers, coal miners, freezing workers and railway workers, all of whom had rates above 300 per 10,000 workers, compared to the average rate of 82 per 10,000, and a rate of 13 per 10,000 for managers and professionals. Fifty-five per cent of incidents occurred during lifting. Eighty-two per cent of persons had fewer than four weeks off work[391].

A random population survey in Auckland was conducted via telephone to investigate the incidence of low back pain in the general community. The incidence of back pain over a year was 64%, but no correlation with reported work posture was identified[392].

A cross-sectional study of public sector nurses in Auckland in 1992 obtained information via self-administered questionnaire. A response was received for 83% of the nurses, and 79% of the responses were deemed eligible for inclusion (persons working or on sick leave). The lifetime prevalence of back pain related to nursing was 62%, with an annual prevalence of 37% and a point prevalence of 37%. The annual and point prevelances were highest in Pacific Island nurses. The annual prevalence was highest in nurses from orthopaedic (54%), geriatric (48%) and medical (44%) wards, and the point prevalence was highest in nurses from geriatric (19%) and medical (14%) wards. Current back pain related to nursing was reported by 12%. Raised relative risks, adjusted for the other predictor variables, were found for back pain in Pacific Island nurses compared to Caucasian nurses (OR = 1.71, 95% CI 1.18 – 2.49), non-registered nurses compared with registered nurses (OR = 1.49, 95% CI 1.16 – 1.91), and persons with a body mass index (BMI) greater than 30 kg/m^2 (OR = 1.86, 95% CI 1.18 – 2.93)[393, 394] (Table 3.31).

A general review of the health of a sample of New Zealand farmers found that 55% reported an episode of low back pain in the previous 12 months, although not all of these episodes were necessarily related to work[395].

New Zealand exposures

Virtually all the occupations, tasks and exposures associated with low back pain occur in the New Zealand workforce.

TABLE 3.31 Published estimates of increased risk of low back pain in selected occupational groups – New Zealand-based studies only

WORK GROUP	RR	95% CI	RISK MEASURE AND STUDY DETAILS	YEAR AND SOURCE
Lifting[1]	1.98	1.30 – 3.04	OR[2]: XS[3], 1992	Norton, 1995[394]
Pacific Island nurses	1.71	1.18 – 2.49	OR[4]: XS[3], 1992	Norton, 1995[394]
Non-registered nurses	1.49	1.16 – 1.91	OR[5]: XS[3], 1992	Norton, 1995[394]
BMI > 30 kg/m^2	1.86	1.18 – 2.93	OR[6]: XS[3], 1992	Norton, 1995[394]

1: Lifting for three quarters or more of the working day
2: Compared to nurses who spend less than three quarters of the working day lifting, adjusted for other predictor variables
3: Compared to European nurses, adjusted for other predictor variables
4: Cross-sectional study
5: Compared to registered nurses, adjusted for other predictor variables
6: Compared to nurses with a BMI (body mass index) less than or equal to 30 kg/m^2, adjusted for other predictor variables

OCCUPATIONAL OSTEOARTHRITIS

Summary Osteoarthritis is a chronic degenerative disorder of joints characterised by damage to and loss of articular cartilage. Heavy physical loading probably predisposes to the development of osteoarthritis in an occupational context, with recurrent kneeling or squatting being a particular problem. Occupations such as farmer, miner and wharf labourer have been associated with increased risk of lower limb osteoarthritis. There are no New Zealand studies of osteoarthritis in relation to work. Occupations and tasks associated with an increased risk of developing osteoarthritis are common in New Zealand.

Introduction

Osteoarthritis is a chronic degenerative disorder of joints characterised by damage to and loss of articular cartilage.

Exposures

Heavy physical loading probably predisposes to the development of osteoarthritis in an occupational context, with recurrent kneeling or squatting being a particular problem. Occupations such as farmer, miner and wharf labourer have been associated with increased risk of lower limb osteoarthritis, but most studies had considerable potential for methodological problems[396-400].

New Zealand studies of risk

There are no New Zealand studies of osteoarthritis in relation to work, although one case report describes an accepted ACC claim for osteoarthritis of the fingers[401].

New Zealand exposures

Occupations and tasks associated with an increased risk of developing osteoarthritis are common in New Zealand.

SCLERODERMA

Summary Scleroderma is a rare autoimmune disorder involving the connective tissue and damage to microvessels. A variety of occupational exposures have been linked to scleroderma, with the evidence strongest, but not definite, for silica. Other implicated exposures include hand-arm vibration, organic solvents and other hydrocarbons. There are no New Zealand studies of scleroderma in relation to work. Most exposures and occupations associated with an increased risk of developing scleroderma are common in New Zealand.

Introduction

Scleroderma, also known as progressive systemis sclerosis, is a rare autoimmune disorder involving the connective tissue and damage to microvessels. It is characterised by fibrosis of the skin and sometimes the internal organs.

Exposures

A variety of occupational exposures have been linked to scleroderma, with the evidence strongest, but not definite, for silica. Other implicated exposures include hand-arm vibration, organic solvents and other hydrocarbons. Female teachers and female textile workers were associated with an increased risk of scleroderma in a recent Italian case-control study, but the significance of this association is not clear[402, 403].

New Zealand studies of risk

There are no New Zealand studies of scleroderma in relation to work.

New Zealand exposures

Most exposures and occupations associated with an increased risk of developing scleroderma are common in New Zealand.

3.11 NOISE-INDUCED HEARING LOSS

Summary Noise-induced hearing loss is a permanent, degenerative condition of the inner ear characterised by loss of auditory acuity, particularly in the high frequency range. This particularly affects voice recognition. The cause of noise-induced hearing loss is loud noise. This occurs in many occupational contexts, but particularly in primary industries such as farming and mining, and in manufacturing and construction. Noise-induced hearing loss is a major cause of disability and compensation in working populations. A cross-sectional study of a random sample of farmers and farm workers found high noise exposures, and that driving tractors without cabs and metal working posed particular risk. From March 1992 to June 1998 there were 2,411 validated cases (95% male) of noise-induced hearing loss notified to NODS, and in the subsequent two years there were 709 notifications. Most of the relevant work tasks associated with high noise levels occur in the New Zealand workforce.

Introduction

Noise-induced hearing loss is a permanent, degenerative condition of the inner ear characterised by loss of auditory acuity, particularly in the high frequency range. This particularly affects voice recognition.

Exposures

The cause of noise-induced hearing loss is loud noise. This occurs in many occupational contexts, but particularly in primary industries such as farming and mining, and in manufacturing and construction. Noise above 85dB(A) is generally considered excessive. Noise-induced hearing loss is a major cause of disability and compensation in working populations[404-407].

New Zealand studies of risk

There is only one New Zealand-based study of noise-induced hearing loss in relation to occupational exposures. This was a cross-sectional study of a random sample of farmers and farm workers in which 65% of eligible persons participated. This study found high noise exposures (85 to 87dB(A)), and that driving tractors without cabs, and metal working, posed particular risk[408].

A general review of the health of a sample of New Zealand farmers found 29% of persons 45 years or older had noise-induced hearing loss[395].

Noise-induced hearing loss is a priority condition under NODS. In the 1980s there were estimated to be 86,000 prevalent cases of noise-induced hearing loss in New Zealand[405]. From March 1992 to June 1998 there were 2,411 validated cases (95% male) of noise-induced hearing loss notified to NODS[16]. In the subsequent two years there were another 709 notifications[44]. One New Zealand-based brief review, and a letter in response, focused on the role of ACC and on approaches to prevention[405, 409].

Between July 1994 and June 2003, there were 17,687 new paid entitlement claims for "industrial deafness" recorded by ACC, of which 2,629 were recorded for 2002/3[17].

New Zealand exposures

There are no useful measures of occupational exposure to excessive noise in New Zealand. However, most of the relevant work tasks occur in the New Zealand workforce.

3.12 VIBRATION DISORDERS

Summary Vibration has been associated with lower back pain and several upper limb pain disorders, including secondary Raynaud's phenomenon (vibration white finger), carpal tunnel syndrome and scleroderma. Lower back pain is associated with whole-body vibration, but the relationship is not certain. Upper limb disorders are associated with increased levels of hand-transmitted vibration. A common cause of increased levels of whole-body vibration is vehicle operating, especially forklifts, tractors, loaders, trucks and buses. Common causes of increased levels of hand-transmitted vibration are hammer drills, hand-held portable grinders and jigsaws. There are no New Zealand-based studies of occupational disorders associated with whole-body vibration or hand-transmitted vibration. Most of the relevant work tasks associated with vibration occur in the New Zealand workforce.

Introduction

Vibration has been associated with lower back pain and several upper limb pain disorders, including secondary Raynaud's phenomenon (vibration white finger), carpal tunnel syndrome and scleroderma.

Exposures

Lower back pain is associated with whole-body vibration, but the relationship is not certain. Upper limb disorders are associated with increased levels of hand-transmitted vibration. A common cause of increased levels of whole-body vibration is vehicle operating, especially forklifts, tractors, loaders, trucks and buses. Occupations with highest exposures include forklift operators, farmers and farm workers, and truck drivers. Common causes of increased levels of hand-transmitted vibration are hammer drills, hand-held portable grinders and jigsaws. Occupations with the highest exposure seem to be bricklayers, brick masons, motor mechanics, gardeners, groundsmen, carpenters and joiners, electricians, builders and labourers[388, 410-415]. Carpal tunnel syndrome and scleroderma were dealt with in earlier sections.

New Zealand studies of risk

There are no New Zealand-based studies of occupational disorders associated with whole-body vibration or hand-transmitted vibration.

New Zealand exposures

There are no useful measures of occupational exposure to vibration in New Zealand. However, most of the relevant work tasks occur in the New Zealand workforce.

3.13 CHEMICAL POISONING/TOXICITY

Summary Work-related acute and chronic poisoning covers a range of disorders characterised by systemic abnormalities of metabolic processes due to contact with one or more industrial chemicals. There is a wide range of workplace chemicals that can cause abnormalities in metabolic processes. They include heavy metals such as lead, cadmium and mercury; organic solvents such as toluene, styrene and n-hexane; pesticides and herbicides; and gases such as carbon monoxide, nitrogen dioxide, sulphur dioxide, methane, methylene chloride and formaldehyde. Exposures occur in a wide variety of circumstances, including welding, metal degreasing, dry cleaning, pesticide use, mobile equipment operation, and many aspects of manufacturing and construction. Data on work-related poisoning in New Zealand studies come from routine published data, specific studies and case reports. From March 1992 to June 1998, 154 confirmed cases of "occupational disease due to chemical exposure" were reported to NODS, with the main substances involved being "chemicals in hospital X-ray departments", lead, "chemical fumes" and solvents. From 1990 to 1998, there were 5,340 calls to the New Zealand Poisons Centre for work-related poisoning, with the main chemicals involved being agricultural chemicals. The main relevant exposure information available for the New Zealand workforce concerns lead. A wide range of the New Zealand workforce is potentially exposed to hazardous chemicals.

Introduction

Work-related acute and chronic poisoning covers a range of disorders characterised by systemic abnormalities of metabolic processes due to contact with one or more industrial chemicals. The abnormalities may affect any body system, but most commonly affect the respiratory, nervous or cardiovascular systems. Most of the chronic effects are considered in other sections (e.g. asthma and chronic solvent-induced encephalopathy). This section focuses on acute or short-term chemical-related problems and the exposures leading to them. It also considers the systemic problems arising from exposure to metals.

Exposures

There is a wide range of workplace chemicals that can cause abnormalities in metabolic processes. A detailed description is beyond the scope of this document, but most of the key exposures are mentioned here. They include heavy metals such as lead, cadmium and mercury; organic solvents such as toluene, styrene and n-hexane; pesticides and herbicides; and gases such as carbon monoxide, nitrogen dioxide, sulphur dioxide, methane, methylene chloride and formaldehyde. Exposures occur in a wide variety of circumstances, including welding, metal degreasing, dry cleaning, pesticide use, mobile equipment operation, and many aspects of manufacturing and construction[416, 417].

New Zealand studies of risk

In the first six years of operation of NODS (March 1992 to June 1998), 542 cases of "occupational disease due to chemical exposure" were notified, of which 154 were confirmed as being work related. The main substances involved were "chemicals in hospital X-ray departments", lead, "chemical fumes" and solvents (Table 3.32). The primary cause of lead poisoning was paint stripping, with radiator repair work and foundry work the next most common[16].

In the subsequent two years, another 138 cases were notified[44].

TABLE 3.32 Confirmed cases of work-related poisoning as reported to NODS. New Zealand. March 1992 to June 1998[1]

EXPOSURE	NUMBER	PER CENT
Metals		
- lead	46	24.5
- mercury	4	2.1
- arsenic	2	1.1
- cadmium	1	0.5
Metal fumes	10	5.3
Chemicals in hospital X-ray and photographic departments	48	25.5
Chemical fumes[2]	23	12.2
Chemicals in agriculture and silviculture	14	7.4
Solvents	10	5.3
Other	30	16.0
Total	**188**	**100.0**

1: Based on Table 4 from OSH, 1999[16]
2: Includes ammonia, phosgene, isocyanates, chlorine, hydrogen sulphide, methylene chloride, formaldehyde and styrene
3: Note that the total confirmed cases was 154. The reason for the discrepancy between this number and the total for this table is not known

Calls to the New Zealand Poisons Centre from 1990 to 1998 for work-related poisoning (of persons 13 years of age or more) were investigated in one study. There were 5,340 work-related calls, at an average rate of 3.9/10,000 employed person-years. This rate increased consistently (from 1.3/10,000 to 6.3/10,000) until the last year of the study (5.8/10,000). Seventy-four per cent of the cases involved males. The main chemicals involved were agricultural chemicals (herbicides, insecticides and animal vaccines and remedies), which were the subject of 40% of enquiries. Other groups to be involved in 5% or more of enquiries were solvents; detergents and other cleaners; acrylics, paints and glues; and ammonia and chloride. The main routes of exposure were inhalation and skin exposure (Table 3.33). Information on the age, occupation and industry of the affected person was not collected[418].

Two significant events possibly resulting in work-related poisoning were described in a paper considering New Zealand's no-fault insurance system. A large fire in a warehouse of a chemical manufacturer probably exposed hundreds of fire fighters to a mixture of chemicals, most of which were not known. However, the extent, nature and pathological basis of subsequent ill-health were widely debated, despite the establishment of an inquiry into the incident. The second event related to pentachlorophenol (PCP) exposure in timber mill workers[419, 420].

PCP is used as an anti-fungal agent (against sapstain) to treat freshly cut timber. Absorption is mainly via the skin and lung. PCP can cause a variety of symptoms, including fever, weight loss, fatigue, nausea and, possibly, neuropsychological problems[421]. Assessment is complicated because PCP often contains impurities, including dioxins, that can cause many similar symptoms. PCP has been the subject of several other studies. The most

detailed of these was conducted in 1995 and 1996, and used a volunteer sample of sawmill employees exposed to PCP. Information was obtained via questionnaire. An exposure score was calculated on the basis of length of exposure, intensity of exposure, type of PCP vehicle (water or oil), job task and use of personal protective equipment. The study identified a dose-response between exposure score and reported symptoms consistent with the PCP exposure category[422].

A cross-sectional study of a random sample of 586 farmers and farm workers in Southland found that 24% of men and 11% of women had reported a "chemical-related illness" in the previous 12 months. No further information on these episodes was reported. Routes of exposure were primarily inhalation and dermal absorption[395].

Two studies considered exposure in radiology departments, particularly exposure to chemical fumes[423, 424].

A survey of dairy farmers and maize farmers examined the use of and knowledge about agrichemicals. The response rate was just over 50%. Virtually all respondents used such substances, with 70% of dairy farmers using 10 to 100 litres of agrichemicals each year, and 68% of maize growers using more than 100 litres per year[425].

There have been many case reports extending back to the 1940s of poisoning in New Zealand workplaces. They have been reviewed already[426], and those prior to the early 1980s are not included here. More recent brief reports have covered congenital defects in offspring of persons exposed to 2,4,5-T[427]; the herbicide glyphosate[428]; and carbon monoxide[429]. The approach to diagnosing work-related poisoning has also been debated[302, 303, 430].

For the period July 1994 to June 2003, ACC recorded 99 to 104 (the actual number was not given for privacy reasons) new paid entitlement claims for work-related "toxic/adverse effect". There were no such claims for 2002/3[17].

TABLE 3.33 Routes of exposure for work-related calls to the New Zealand National Poisons Centre. 1990 to 1998[1]

ROUTE OF EXPOSURE	NUMBER	PER CENT
Inhalation	2,073	38.8
Dermal absorption	1,196	22.4
Eye	883	16.5
Ingestion	592	11.1
Injection	269	5.0
Bite/sting	34	0.6
Not known	293	5.5
Total	**5,340**	**100.0**

1: Based on Table 4 from Firth et al, 2000[418]

New Zealand exposures

A wide range of the New Zealand workforce is potentially exposed to hazardous chemicals.

Several publications describe levels of lead in New Zealand workers in the 1980s. The most recent considered 1,425 workers exposed to lead in the course of their work, with samples taken in 1988 and 1999. This showed a wide range of occupations with significant blood lead levels. Forty-four per cent of the workers had red cell lead levels about the reference range for the general population (1.9 micromoles/L), and 5% had levels above the recommended action level (5.0 micromoles/L for males; 3.8 micromoles/L for females). Occupations with the highest lead levels (all above 3.0 micromoles/L) were radiator repairer, smelter/furnaceman, muffler repairer, scrap metal worker, foundryman and metal moulder[431-433].

A survey of 21-year-olds in Dunedin found that the geometric mean blood lead levels were 6.0 mcg/dl (95% CI 5.4 – 6.7) in persons with high risk of occupational exposure, compared to 4.1 mcg/dl (95% CI 3.9 – 4.3) in persons with a low risk of occupational exposure[434].

A study of lead-exposed workers at a factory found that lead levels had fallen considerably over a decade, in line with prevention efforts[435].

3.14 REPRODUCTIVE RISKS

Summary Reproductive disorders cover problems with fertility and congenital abnormalities. Both males and females can be affected. A wide range of exposures and tasks has been associated with an increased risk of reproductive disorders in females, males or both. Exposures strongly implicated in adversely affecting reproduction in both males and females are lead, mercury, multiple chemical and pesticide exposures, organic solvents (particularly carbon disulphide and 2-bromopropane), and ionising radiation. The only New Zealand study that examined the role of reproductive disorders related to work was a survey of persons who sprayed 2,4,5-T and a comparison group of agricultural contractors. No increased risk of congenital defects or miscarriages was identified. Most of the exposures and occupations associated with an increased risk of reproductive disorders occur in the New Zealand workforce.

Introduction

Reproductive disorders cover problems with fertility and congenital abnormalities. Both males and females can be affected.

Exposures

Occupational exposures and occupations that have been strongly implicated in adversely affecting reproduction in both males and females are lead, mercury, multiple chemical and pesticide exposures, organic solvents (particularly carbon disulphide and 2-bromopropane), and ionising radiation. Other exposures implicated as being of concern specifically to females include ethylene glycol, toluene and shift work. Exposures implicated as being of concern specifically to males include the pesticides 1,2-dibromo-3-chloro-propane (DBCP), carbaryl and 2,4-dichloro phenoxy acetic acid (2-4 D); chromium; heat; microwave radiation; ethylene dibromide; and styrene. Implicated occupations are those involving the manufacture or use of bio-persistent chemicals (such as gardening or farming leading to exposure to pesticides); occupations involving exposure to excessive radiation, organic solvents or heavy metals; and work as a dentist, anaesthetist, metal worker/welder, rubber factory worker, painter/varnisher, and transport worker[436-441].

New Zealand studies of risk

The only New Zealand study examining the role of reproductive disorders related to work was a survey of persons who sprayed 2,4,5-T and a comparison group of agricultural contractors. No increased risk of congenital defects or miscarriages was identified[427].

New Zealand exposures

Most of the exposures and occupations associated with an increased risk of reproductive disorders occur in the New Zealand workforce.

3.15 MULTIPLE CHEMICAL SENSITIVITY

Summary Multiple chemical sensitivity is a syndrome characterised by an abnormal, multi-organ sensitivity following chemical exposures. There is lack of agreement as to what the underlying pathological mechanisms are and whether multiple chemical sensitivity should be viewed as a separate clinical entity. There are no occupational exposures clearly related to the development of multiple chemical sensitivity. Occupational exposures reported to precipitate typical symptoms in persons who are said to be chemically sensitive include adhesives, industrial air contaminants, fumigants, photocopy toner, smoke, soldering fumes, solvents, sulphur residues, utility gas and paint vapour. There are no New Zealand studies of multiple chemical sensitivity in relation to work. All the implicated exposures occur in the New Zealand workforce.

Introduction

Multiple chemical sensitivity is a syndrome characterised by an abnormal, multi-organ sensitivity following chemical exposures. There is lack of agreement as to what the underlying pathological mechanisms are and whether multiple chemical sensitivity should be viewed as a separate clinical entity. However, there are diagnostic criteria that are generally accepted[442-445].

Exposures

There are no occupational exposures clearly related to the development of multiple chemical sensitivity. Occupational exposures reported to precipitate typical symptoms in persons who are said to be chemically sensitive include adhesives, industrial air contaminants, fumigants, photocopy toner, smoke, soldering fumes, solvents, sulphur residues, utility gas and paint vapour[442, 444, 445].

New Zealand studies of risk

There are no New Zealand studies of multiple chemical sensitivity in relation to work.

New Zealand exposures

There are no occupational exposures clearly related to the development or exacerbation of multiple chemical sensitivity. However, all the implicated exposures occur in the New Zealand workforce.

3.16 FATAL INJURY

UNINTENTIONAL FATAL INJURY

Summary From 1985 to 1994, there were 741 workplace deaths of workers and 241 work-related traffic deaths of workers. Another 192 commuters were killed in traffic incidents. Two major studies describe work-related fatal injuries in New Zealand. Information for both studies came from Coroners' records. The first study covered the years 1975 to 1984. The second covered 1985 to 1994. An extension of this second study, focusing on work-related road deaths, extended the coverage to 1998. There is a wide range of more specific studies that have investigated various aspects of fatal work-related injury. Most of these were based on one of the two major studies. The focus has been on worker characteristics, work groups, injury types, involved equipment or a combination of these. All occupations identified as being at increased risk of fatal injury occur in the New Zealand workforce.

Introduction

Work-related fatal injuries are an important cause of unintentional injury in most countries.

Exposures

Fatal injury is an important cause of deaths associated with many occupations and tasks. Injury risk varies considerably between occupations and industries. Injury risk is generally higher in industrial pilots, commercial fishermen, loggers, miners, truck drivers, farmers and certain construction tradesmen. Fishing, logging, mining, road transport, agriculture and construction are the industries usually found to have the highest injury rates[446-448].

New Zealand studies of risk

Two major studies describe work-related fatal injuries in New Zealand. Information for both studies came from Coroners' records. The first study covered the years 1975 to 1984[449]. The second covered 1985 to 1994[450]. An extension of this second study, focusing on work-related road deaths, extended the coverage to 1998[451]. Both studies gave rise to specific analyses in many areas. An overview of the results from the main studies and the more specific papers is provided below. Other relevant studies are also described.

All workers

The first major study of work-related fatal injuries in New Zealand identified 986 deaths that occurred in the ten-year period 1975 to 1984, at a rate of 7.2 deaths per 100,000 person-years. The average rate for the second half of the study period was less than that for the first half of the study period. Male rates were 20 times higher than female rates, and higher rates were observed for Māori workers (12 per 100,000 person-years) and Pacific Island workers (ten per 100,000 person-years) compared to other workers (seven per 100,000 worker-years), but none of these comparisons took into account differences in occupation distribution. Occupations with the highest rates (of those with ten or more deaths) were helicopter and agriculture pilots, shooters, fishermen, airline and aircraft pilots, and earthmoving machinery and material handling operators. The highest number of deaths were of

farmers, fishery workers and forestry workers. Rates were highest for the youngest and oldest age groups. The study excluded fatal traffic-related incidents that occurred on public roads, volunteer workers and bystanders[449].

The more recent study identified 741 deaths of workers over the ten-year period 1985 to 1994, at a rate of 5.0 (95% CI 4.7 – 5.4) deaths per 100,000 person-years. The death rate showed an inconsistent decline over the study period. Male rates were 30 times higher than female rates, but this comparison did not take into account differences in occupation distribution. Occupations with the highest rates were helicopter and agriculture pilots, forestry workers and fishery workers. The highest number of deaths were of farmers, forestry workers and fishery workers. Rates were highest for the oldest age groups, and similar for the other ages. In addition to the worker deaths, deaths of nine volunteers and 67 bystanders were identified[450].

The recent study of work-related traffic deaths identified 241 working deaths (workers travelling as part of their work duties), 192 deaths of commuters (workers travelling to or from work) and 1,447 deaths of bystanders. The rate of worker death was 1.1 (95% CI 1.0 – 1.2) per 100,000 person-years, and that for commuters was 0.9 (95% CI 0.8 – 1.0) per 100,000 person-years, with no trends apparent over the period of the study. Separate rates for males and females were not reported. The rate for workers showed a gentle increase with age until the oldest age group, which had a much higher rate than younger workers. Rates for commuters were the reverse of this, with the highest for younger workers and a gentle decrease for older age groups. The highest rates by industry for workers were for road freight transportation, milk vending and road and bridge construction. The main contributing factors identified were excessive speed, lack of occupant restraints, and fatigue of the vehicle operator[451].

A study in the early 1980s of deaths from electricity found 52% of the deaths were work related[452].

Agriculture

Arising from the first work-related fatalities study, 237 work-related injury deaths that occurred on New Zealand farms between 1975 and 1984 were identified. Sixty-five per cent involved vehicles, with just over half of these vehicles being tractors. Tractors were also involved in another 15 deaths. The majority of tractor deaths involved rollovers. Nineteen deaths involved tree-felling, and 13 were due to electrocution[453]. In a later editorial, one of the authors noted that there were many other injury deaths that occurred on farms or to farmers, with suicide and road traffic deaths, neither of which were included in the main study, accounting for about three times as many deaths as documented in the study[454].

Based on the second study, 159 work-related injury deaths that occurred on New Zealand farms between 1985 and 1994 were identified. Only seven female deaths were identified. The rate for males was 21.2 deaths per 100,000 person-years, and increased consistently with age, with a big jump in the oldest age group. Rates were much higher in the services to agriculture sector compared to the agricultural production sector. Incidents involving machinery were the most common circumstance in both sectors, but the involvement of aircraft was just as common in the services to agriculture sector. Incidents involving motor vehicles were the next most common circumstance in both sectors. Multiple injuries were the most common cause of death in both sectors[455].

Māori work-related fatal injury

A study of Māori work-related fatal injury, based on the second major fatalities study, identified 89 Māori deaths (12%) in the 741 worker deaths. Various approaches to defining ethnicity were used[456], but most results used the identification obtained from the death registration information, augmented by information in the Coroner's file. Comparisons were directly standardised for age, major occupation and major industry, and most only included males because of the low number of females. The crude rates were higher for Māori compared to non-Māori (RR = 1.32, 95% CI 1.06 – 1.65), and the difference was even greater when age-adjusted rates were compared (RR = 1.56, 95% CI 1.22 – 1.98). However, when rates were separately adjusted for industry (RR = 1.19, 95% CI 0.95 –

1.50) or occupation (RR = 1.10, 95% CI 0.86 – 1.41), the difference was less apparent. Using capture-recapture methods in an attempt to allow for under-estimation of Māori cases, the RR were higher – industry (RR = 1.37, 95% CI 1.11 – 1.70); occupation (RR = 1.23, 95% CI 0.99 – 1.53). These adjustments could only be done at the broad occupation and industry level, and so do not take into account differences in more specific occupations and tasks. Rates for Māori did not decline over the ten years covered by the study, in contrast to the rates for non-Māori. The authors concluded that the difference in crude rates was probably largely due to differences in employment patterns[457].

Children

Work-related deaths of children (persons under the age of 15 years) were investigated using the data collected for the second fatalities study. Eighty-seven deaths were identified, nearly all of whom were workplace bystanders rather than workers. One third of the deaths occurred in relation to the agriculture industry[458].

Motorcycle/ATV crashes on farms

One study examined fatal (and serious non-fatal) injury associated with two-, three- and four-wheel motorcycles, including all-terrain vehicles (ATVs) on farms. Information for fatal injuries came from the period 1980 to 1989. Twelve deaths were identified, and no further analysis of these was presented[459].

Commercial fishermen

A study of fatal work-related injury in commercial fishermen, based on data collected in the first major study, identified 79 deaths and a very high rate of fatal injury – 260 deaths per 100,000 person-years (95% CI 210 – 330). There were no obvious associations of age with fatal injury rate. Nearly all the deaths were due to drowning[460].

Forestry workers

Several studies have investigated work-related injury in forestry workers in New Zealand. Most were undertaken by the same research team. Fatal injuries that occurred between 1975 and 1988 were examined using data from the National Health Statistics Centre's hospital discharge data collection, ACC, the Logging Industry Research Association's Accident Reporting Scheme, Department of Labour Bush Inspectorate reports, Coroners' records, and data from the first major work-related fatal injury study. Non-fatal injuries were also included. Ninety-one deaths were identified – 81 in loggers and ten in silviculture workers. The average fatality rate was 86/100,000 person-years (95% CI 70 – 106), with rates of 203/100,000 person-years (95% CI 165 – 252) for loggers, and 15/100,000 person-years for silviculture workers (95% CI 80 – 280). There was no consistent trend in rates over the study period. Felling was the most common task at the time of the fatal incident, and being struck by a falling tree the most common mechanism. Being struck by rolling logs, being struck by a tree or part of a tree not being felled at the time, and being crushed by machinery were the next most common mechanisms. Identified "unsafe acts" associated with the fatal events were most commonly problems with the felling technique and "being in the danger zone of working" (i.e. too close to a tree being felled, down-slope of logs or trees, or too close to machinery during hauling or loading)[493, 494, 495].

Trends in the rate of work-related fatal (and non-fatal) injury in forestry workers were investigated using compensation data covering the years 1949 to 1973, and multiple data sources (as described in the previous paragraph) for the period 1979 to 1988. One hundred and forty-one deaths were identified for the period 1949 to 1973. The rate of fatal injury over the period covered by the study appeared to remain stable for loggers. There were too few deaths to consider trends in silviculture workers. The mean fatal injury rate was 205/100,000 person-years for loggers and 70/100,000 person-years for silviculture workers. Separate fatal injury rates were not presented for the period 1979 to 1988[490].

Another study investigated injuries to loggers involved in work on ski sites. Data came from the Forest Industry Accident Reporting Scheme and covered the period 1995 to 1999. Two hundred and forty-two injuries were

included. The most common injuries involved workers being struck by logs (41%) or branches (6%); slips, trips and falls on the same level (18%); and being struck by chainsaws (16%). Vehicles most commonly involved in these incidents were loaders, skidders and haulers[461].

A brief study of fatal injuries in forestry workers used information from the Department of Health to obtain information on the 143 forestry workers who had been killed over a ten-year period from 1965 to 1975 (non-fatal hospitalised fatal injuries were also investigated but are described elsewhere). The main circumstances of death were being hit by a falling tree, a falling log or a falling branch, or being crushed by machinery. The main pathological causes of death were head injuries, multiple injuries, asphyxia and crushed chest[462].

Comparison to other countries

Several recent papers have been based on a collaboration between investigators from New Zealand, the United States and Australia that has compared aspects of work-related fatal injury in the three countries. Data from the three countries were standardised as much as possible, and rates adjusted for industry distribution, to maximise the validity of the comparisons. Unadjusted rates were highest in New Zealand, but after adjustment for industry, New Zealand rates were only 10% to 15% higher than the other two countries. Other results were similar in the three countries, apart from a much higher incidence of intentional fatal injury in the United States[463]. Related studies of the role of narrative analysis[464] and the assessment of the classification of work-relatedness in the three countries have also been published[465]. These showed that the most common mechanisms of injury were similar in the three countries, although drowning was more common in New Zealand, and that comparison between the data from the three countries could be made with confidence in terms of the application of definitions.

New Zealand exposures

New Zealand and international data indicate that many New Zealand occupations have a high risk of work-related fatal unintentional injury.

Summary Work-related homicide is death due to fatal injury deliberately caused by another person and sustained in the course of work. It has been associated with a range of occupations. Jobs that require contact with the public, working alone, exchange of money or working at night have been noted to increase the risk, as have working as a taxi driver, law enforcement officer, security guard and working at a convenience store, bar, nightclub or petrol station. The only information on work-related homicide in New Zealand comes from an analysis of data from the second major work-related fatal injury study, which covered the years 1985 to 1994. Between 3% and 4% of deaths were due to intentional injury by other persons, about half due to being shot, and the remaining deaths were evenly distributed between being stabbed and being assaulted with another weapon. All occupations identified as being at increased risk of work-related homicide occur in the New Zealand workforce.

Introduction

Work-related homicide is death due to fatal injury deliberately caused by another person and sustained in the course of work.

Exposures

Work-related homicide has been associated with a range of occupations. Jobs that require contact with the public, working alone, exchange of money or working at night have been noted to increase the risk, as have working as a taxi driver, law enforcement officer or security guard, and working at a convenience store, bar, nightclub or petrol station[466-470].

New Zealand studies of risk

The only New Zealand information on work-related homicide comes from an analysis of data, as part of a consideration of the use of text narratives in comparing data from different countries. The original New Zealand information came from the second major work-related fatal injury study. Information from that study was obtained from Coroners' records and covered the years 1985 to 1994[450]. Between 3% and 4% of deaths were due to intentional injury by other persons, about half due to being shot, and the remaining deaths evenly distributed between being stabbed and being assaulted with another weapon[464].

New Zealand exposures

All occupations identified as being at increased risk of work-related homicide occur in the New Zealand workforce.

Summary Work-related suicide is intentional self-harm, which intentionally results in death, resulting from work-related exposures or effects. It is a controversial concept because of debate over the extent and nature of connections that demonstrate a link to work. Work-related suicide has been associated with a range of exposures, occupations and industries, but the available information is not highly consistent. These may entail a dangerous combination of triggers for depression, such as work strain, and access to the means to carry out the suicidal act. Implicated factors include work as a labourer, farmer, law enforcement officer or medical practitioner; and work in mining, business and repair services, professional and related services, and trade. Only two studies provide information on work-related suicide in New Zealand. The main study identified high levels of suicide, adjusting for age and sex, in trades workers; agriculture and fishery workers; building frame and related trades workers; writers, artists and associated workers; and building finishers and related trades workers. All occupations identified as being at increased risk of work-related suicide occur in the New Zealand workforce.

Introduction

Work-related suicide is intentional self-harm, which intentionally results in death, resulting from work-related exposures or effects. It is a controversial concept because of debate over the extent and nature of connections that demonstrate a link to work.

Exposures

Work-related suicide has been associated with a range of exposures, occupations and industries, but the available information is not highly consistent. These may entail a dangerous combination of triggers for depression, such as work strain, and access to the means to carry out the suicidal act. Implicated factors include work as a labourer, farmer, law enforcement officer or medical practitioner; and work in mining, business and repair services, professional and related services, and trade[471-473].

International studies of risk

The attributable fraction of suicide for work was estimated as 0.4% (males) and 0.3% (females) in the recent Finnish study[1].

New Zealand studies of risk

Only two studies provide information on work-related suicide in New Zealand. The main information comes from a study of deaths from 1991 to 1996. Only persons aged 15 to 64 years were included, and rates were adjusted for age and sex. The highest rates were in trades workers (27/100,000 person-years; 95% CI 22 – 32) and agriculture and fishery workers (23/100,000 person-years; 95% CI 21 – 27). Focusing on groups with enough deaths to allow reasonably precise rates to be estimated, more specific analyses identified high rates in building frame and

related trades workers (41/100,000 person-years; 95% CI 25 – 60), writers, artists and associated workers (40/100,000 person-years; 95% CI 27 – 52), and building finishers and related trades workers (29/100,000 person-years; 95% CI 22 – 36)[474].

An earlier study, covering deaths in 1984, identified high suicide rates in the production, transport and labourers group, and in farmers[475].

New Zealand exposures

All occupations identified as being at increased risk of work-related suicide occur in the New Zealand workforce.

3.17 NON-FATAL INJURY

UNINTENTIONAL NON-FATAL INJURY

Summary In 2001/2, there were 229,489 compensated work-related injuries in New Zealand. The total cost for these injuries was $129 million by the end of September 2002, and could be expected to have increased by about 50% by September 2003. There is a wide range of New Zealand studies that have investigated various aspects of non-fatal work-related injury. Cases have been obtained from hospital discharges, emergency department presentations, general practitioner presentations, compensation data and workplace data sets. The focus has been on worker characteristics, work groups, injury types, involved equipment or a combination of these. All occupations identified as being at increased risk of non-fatal injury occur in the New Zealand workforce.

Introduction

Work-related non-fatal injuries are an important cause of unintentional injury in most countries.

Exposures

Non-fatal injury is an important cause of morbidity associated with many occupations and tasks. Injury risk varies considerably between occupations and industries. Injury risk is generally higher in manual workers, trades persons and machine operators than for professional and para-professional workers. Mining, fishing, agriculture, manufacturing and construction are the industries usually found to have the highest injury rates[476].

New Zealand studies of risk

In 2001/2, there were 229,489 compensated work-related injuries in New Zealand. Key aspects of these injuries are that 74% were of males and males had twice the injury rate of females; the highest rates were in the youngest and oldest workers; higher rates in Māori were probably due to their involvement in higher risk occupations; self-employed persons had twice the rate of employed persons; and manufacturing, agriculture and trade accounted for the highest number of injuries, but mining, agriculture and construction had the highest rate of injury. The most common injury type was sprain/strain and open wounds, and the hand and wrist was the most common region affected. The most common mechanism was falling, tripping or slipping. The total cost for these injuries was $129 million by the end of September 2002, and could be expected to have increased by about 50% by September 2003[477].

There is a wide range of New Zealand studies that have investigated various aspects of non-fatal work-related injury. Cases have been obtained from hospital discharges, emergency department presentations, general practitioner presentations, compensation data and workplace data sets. The focus has been on worker characteristics, work groups, injury types, involved equipment or a combination of these. A review of work-related injury in New Zealand was published in 1995[478].

All workers

All work-related injuries presenting to a city emergency department over a ten-week period were investigated in one study. Six hundred and fifty-five workers presented for treatment. The main injury types were laceration, sprain/strain, contusion and foreign body in the eye, and machinery was the commonest external cause. Men had four times the injury rate of women, and younger workers had a higher injury rate than older workers. Finger and hand injuries accounted for 39% of presentations. Production workers and agricultural workers had the highest rates based on occupation, and agriculture and building and construction were the industries with the highest rates[479].

Using compensation data, non-fatal work-related injury from 1988 to 1994 was described in another study. Using 1991 data, rates were found to be 2.5 times higher in males compared to females; to decline with age; to be highest in "plant and machine operators and assemblers", elementary occupations, armed forces personnel, "agriculture and fishery workers", and trades workers; and to be highest in the manufacturing, "mining and quarrying", "electricity, gas and water", construction, and "agriculture, forestry, fishing and hunting" industries. Costs were highest on an industry basis in the manufacturing; agriculture, forestry, fishing and hunting; community, social and personal services; and construction industries. On an occupation basis, costs were highest in plant and machine operators and assemblers; elementary occupations; agriculture and fishery workers; and trades workers[480].

A study of injury presentations to a general practice over one month in 1986 found 36% of injuries were work-related. No further details were provided about the work-related injuries[481].

A survey of occupational health and safety in small businesses in the late 1990s found a rate of occupational injury requiring health intervention of 39 per 1,000 person-years, but this was based on only eight cases[482].

A study of injuries at an industrial plant found that back injury was the biggest single problem and one third of back injuries occurred during heavy manual work[483].

Young workers

Occupational injuries of adolescents in a New Zealand city were investigated using emergency department data covering four years (1990 to 1993 inclusive), during which time 1,361 such injuries were treated. Rates were four times higher in males than females. The rate of injury was highest in labourers, machine operators, precision production workers and service workers. On an industry basis, the highest rates were seen in the construction, transport and communication, manufacturing, and business and repair services industries. The main types of injury involved the hand, eyes and lower limb, and the main injury type was laceration, sprain/strain and foreign body in the eye[484].

Another study investigated occupational injury in young adults. Data came from a specific, ongoing investigation of the health of a cohort of young New Zealanders. Information for this came from structured face-to-face interviews. Employed persons were those who had worked for at least one month in the previous three years. Differences between rates for males and females disappeared once occupation, industry and other relevant factors were taken into account. Plant and machine operators and assemblers; professionals; technicians and associate professionals; elementary occupations; and trades workers had the highest rates of injuries. The highest rates on an industry basis were in the electricity, gas and water; manufacturing; and transport and storage industries[485].

Hand and lower arm injuries

One study considered work-related hand and lower arm injuries that required hospitalisation. The study identified 9,714 such injuries (37% of all hand and lower arm injuries that required hospitalisation) that occurred from 1979 to 1988. Highest rates of injury were seen in machine operators, sawmill workers, forestry workers, meat workers and sheet metal workers, and the most common external causes, as identified by the External Cause code, were cutting or piercing instruments, machinery and being caught in and between objects. Open wounds (70%) and fractures (23%) were the most common injury types[486].

A related study by the same authors focused on hand and lower arm injuries in meat workers. The same data source was used, as well as injury case records from 1987 to 1993 from three freezing works. The rate of injury increased from 3.3 per 1,000 person-years to 5.3 per 1,000 person-years over the study period. Cutting and piercing instruments accounted for 72% of cases, and machinery for another 20%. Eighty-eight per cent of cases involved open wounds. The consideration of injury case records showed that 65% of injury presentations were for injuries to the hand and lower arm, 60% of these involved injury to the fingers, and that the main types of injury were lacerations (42%) and sprains and strains (32%)[487].

Another study found that hand injuries were an important occupational health and safety problem in Australian and New Zealand hand therapists[488].

A survey by ACC estimated that 19% of all motor vehicle crashes for which persons made a claim to the Corporation involved persons travelling for work-related purposes. This was in addition to the 12% of incidents reported to have occurred during commuting (K McLea, personal communication).

Chainsaw injuries

Two studies investigated chainsaw injuries using hospital discharge information. An early study used hospital admissions information to investigate 47 patients (one of whom was dead on arrival) who had sustained severe chainsaw injuries from 1970 to 1976. It is likely that most of these were related to work, but the paper did not provide definitive information on this. Two thirds of the injuries involved the upper limb (mainly the hand), and most of the rest involved the lower limb. Compound fractures and deep lacerations were the main injury types[489].

A later study examined chainsaw injuries in forestry workers that occurred from 1979 to 1988 and that resulted in hospitalisation. Rates were much higher in loggers (12.8 per 1,000 person-years; 95% CI 11.5 – 14.2) compared to silviculture workers (2.2 per 1,000 person-years; 95% CI 1.8 – 2.6), and increased inconsistently over the study period. The hand, leg, foot and arm were the most common sites of injury[490].

Firearm injuries

A study of non-fatal firearm injuries from 1979 to 1992 found the highest occupational rates in the agriculture, animal husbandry, forestry workers, fishermen and hunters group (9.8/100,000; 95% CI 8.5 – 11.3) and the production workers, transport workers and labourers group (5.2/100,000; 95% CI 4.7 – 5.8), compared with a rate of 1.7/100,000 (95% CI 1.4 – 1.9) in all other occupations. Occupation information was missing for 40% of persons. Twelve per cent of injuries occurred on farms[491].

Motorcycle/ATV crashes on farms

One study examined serious non-fatal (and fatal) injuries associated with two-, three- and four-wheel motorcycles, including all-terrain vehicles (ATVs) on farms. Information for non-fatal injuries came from national hospitalisation in-patient files for the period 1980 to 1989. Injury rates (based on population, not time using motorcycles) were highest for persons aged 15 to 19 years, the rate for whom was twice that of the group with the next highest rate. Male rates were about eight times higher than female rates. The vast majority of the injuries (88%) involved the operator of the motorcycle. There was little information on the circumstances of the incident, but most seemed to occur when the injured person fell from the vehicle, or collided with an object. The most common injuries were fracture of a limb (41%) and head injury (23%)[459].

Commercial fishermen

A study of work-related injury in commercial fishermen found high rates of non-fatal (and fatal) injury. Information for the 461 non-fatal injuries came from the National Health Statistics Centre for hospitalised cases and from ACC. There were no obvious associations of age with injury rate, although the lowest rates were for the oldest age group (55 to 64 years). The most common site of injury was the hand and fingers, commonly due to handling ropes, cables or chains or using winches, machinery and knives; and the back, due to heavy lifting. Falls were also a common cause of injury[460].

Meat workers

Injuries in meat workers were investigated as part of a pilot project in the New Zealand meat industry to reduce injuries and promote injury prevention. The study found decreases in injury rates in the three plants included, but much of this decrease appeared to have occurred before the pilot project had been in place long enough to have had an effect[492].

Farmers

A general review of the health of a sample of New Zealand farmers found that 17% reported at least one injury in the previous 12 months, with about half of these reported to have arisen in relation to work[395].

Forestry workers

Several studies have investigated work-related injury in forestry workers in New Zealand. Most were undertaken by the same research team. Injuries resulting in hospitalisation and other non-fatal injuries involving one or more days off work and that occurred between 1975 and 1988 were examined using data from the National Health Statistics Centre's hospital discharge data collection, ACC, and the Logging Industry Research Association's Accident Reporting Scheme. Fatal injuries were also included. Hospitalisation injury rates were four times higher in loggers than silviculture workers (39 per 1,000 person-years compared to ten per 1,000 person-years). The rate of injuries (non-fatal and fatal) decreased with increasing years of experience. The most common injury circumstances were contact with a chainsaw; being struck by falling trees; being struck by rolling logs; and falls, slips and trips[493, 494].

Trends in the rate of work-related injury in forestry workers were investigated using compensation data covering the years 1949 to 1973 and 1979 to 1988. Non-fatal injury rates for loggers declined from the 1940s to the 1970s, and again in the 1980s. Non-fatal injury rates for silviculture workers increased from the 1950s to the early 1980s, and then declined. The average rate for both groups of workers was very high – 332 per 1,000 person-years for loggers and 109 per 1,000 person-years for silviculture[495].

Another study investigated injuries to loggers involved in work on ski sites. Data came from the Forest Industry Accident Reporting Scheme and covered the period 1995 to 1999. Two hundred and forty-two injuries were included. The most common injuries involved workers being struck by logs (41%) or branches (6%); slips, trips and falls on the same level (18%); and being struck by chainsaws (16%). Vehicles most commonly involved in these incidents were loaders, skidders and haulers[461].

A brief study of non-fatal injuries in forestry workers used information from the medical records of 155 workers admitted to hospital for injury over a ten-year period from 1965 to 1975 (fatal injuries were also investigated but are described elsewhere). There was little information provided about the injuries, but the main types appear to have been fracture, severe soft tissue injury and other chainsaw injuries[462].

New Zealand exposures

New Zealand and international data indicate that many New Zealand occupations have a high risk of work-related non-fatal injury.

Summary Work-related non-fatal assault is non-fatal injury deliberately caused by another person and sustained in the course of work. Non-fatal assaults have similar risk factors to work-related homicide. Health care workers, public safety workers, teachers, social service workers and transportation workers appear to be particularly at risk, as are females in comparison to men. Night-time work is probably also an important risk factor. There are no New Zealand studies specifically considering non-fatal deliberate injury (i.e. assault) related to work, but two studies provide relevant information. Most occupations associated with an increased risk of non-fatal assault are common in New Zealand.

Introduction

Work-related non-fatal assault is non-fatal injury deliberately caused by another person and sustained in the course of work.

Exposures

Non-fatal assaults have similar risk factors to work-related homicide (described above). Health care workers, public safety workers, teachers, social service workers, sex workers and transportation workers appear to be particularly at risk, as are females in comparison to men. Night-time work is probably also an important risk factor[53, 496-498].

New Zealand studies of risk

There are no New Zealand studies specifically considering non-fatal deliberate injury (i.e. assault) related to work, but two studies provide relevant information.

One study of sex workers found that 83% reported at least one adverse or violent event. Forty-one per cent of street workers and 21% of indoor workers reported having been physically assaulted, and 27% of street workers and 8% of indoor workers had been raped[53].

A survey of nurses in their first year of practice found that 29% were subject to work-related physical intimidation, and 13% had experienced this more than once. Four per cent of subjects had sustained assault requiring medical intervention. Mental health nurses were much more likely to be assaulted, with 19% having sustained a physical assault requiring medical intervention[232].

A published letter considered the safety of doctors on home visits in light of official occupational health and safety policies[499].

New Zealand exposures

Most occupations associated with an increased risk of non-fatal assault are common in New Zealand.

MILD TRAUMATIC BRAIN INJURY/POST-CONCUSSION SYNDROME

Summary Mild traumatic brain injury, also known as post-concussive syndrome, is a vaguely defined condition characterised by physical, cognitive and/or psychosocial disability that follows from a significant blow to the head without obvious physical injury to the brain. Any occupational exposure that predisposes to head trauma increases the risk of sustaining mild traumatic brain injury. There are no New Zealand studies of mild traumatic brain injury in relation to work. The occupations that predispose to head trauma occur in the New Zealand workforce.

Introduction

Mild traumatic brain injury, also known as post-concussive syndrome, is a vaguely defined condition characterised by physical, cognitive and/or psychosocial disability that follows from a significant blow to the head without obvious physical injury to the brain[500].

Exposures

Any occupational exposure that predisposes to head trauma increases the risk of sustaining mild traumatic brain injury. This includes professional sportspeople[500].

New Zealand studies of risk

There are no New Zealand studies of mild traumatic brain injury in relation to work.

For the period July 1994 to June 2003, ACC recorded 862 new paid entitlement claims for "concussion/brain injury", of which 169 were recorded for 2002/3[17].

New Zealand exposures

The occupations that predispose to head trauma occur in the New Zealand workforce.

SECTION FOUR

OTHER ASPECTS OF WORKPLACE HAZARDS

4

4.1 SHIFT WORK

Summary Shift work is work that forces sleep to be displaced, with most research focused on night work and rotating shift systems. Shift work has been associated with a range of work-related disorders. The main one of these is sleep disturbance, from which other health problems can flow. Other health effects of shift work, for which there are varying degrees of evidence, include peptic ulceration, ischaemic heart disease, female reproductive disorders, obesity, diabetes mellitus, hypertension, disorders of the immune system and a range of psychological and relationship disorders. Several other disorders are hampered in terms of treatment or symptom control, but not necessarily caused by shift work. Only one New Zealand study provides evidence of a link between shift work and ill-health. This recent study provides evidence of a relationship between night work and sleep disorders. This study also estimated that 15.8% of Māori worked nights compared to 10.5% of non-Māori, and that women had a lower prevalence of night work than men (9.7% versus 15.2%). A paper from the Department of Labour estimated that 6.8% of current workers performed night work. Many New Zealand occupations involve working shift work.

Introduction

Shift work is work that forces sleep to be displaced.

Conditions

Shift work has been associated with a range of work-related disorders. The main one of these is sleep disturbance, from which other health problems can flow. Shift work sleep disorder is defined as symptoms and signs of insomnia or excessive sleepiness that occur as transient phenomena in relation to work schedules. Additional problems can be reduced alertness and problems with personal relationships away from work. An associated condition is irregular sleep-wake patterns, characterised by temporally disorganised and variable episodes of sleeping and waking behaviour[501]. Sleep disorders are also associated with a work week often longer than 48 hours, exposure to vibrations and various psychosocial factors[502].

Other health effects of shift work, for which there are varying degrees of evidence, include peptic ulceration, ischaemic heart disease, female reproductive disorders, obesity, diabetes mellitus, hypertension, disorders of the immune system and a range of psychological and relationship disorders. Several other disorders are hampered in terms of treatment or symptom control, but not necessarily caused by shift work. These include diabetes mellitus, epilepsy, and disorders of the thyroid, respiratory system and kidney. Another emerging issue is the possible exacerbating effect that shift work may have on the toxic effect of certain hazardous substances, due to the possible influence on circadian metabolic functions[503-505].

New Zealand studies of risk

Only one New Zealand study provides evidence of a link between shift work and ill-health. This recent study provides evidence of a relationship between night work and sleep disorders. A questionnaire was mailed out to a stratified random sample of Māori and non-Māori persons aged 20 to 59 years. The response rate was 73%. Compared to employed persons not working nights, participating in night work increased the risk of reporting "often/always" having difficulty falling asleep (OR = 1.36, 95% CI 1.03 – 1.81), having a current sleep problem (OR = 1.64, 95% CI 1.24 – 2.18), and having a chronic sleep problem (OR = 1.61, 95% CI 1.20 – 2.17)[506].

New Zealand exposures

The study of night work in New Zealand described above provides an estimate of night work in New Zealand. The study estimated that 15.8% of Māori worked nights (between 0000 and 0500), compared to 10.5% of non-Māori persons. Women had a lower prevalence of night work than men (9.7% versus 15.2%)[506].

A paper from the Department of Labour provides another estimate of the prevalence of shift work in New Zealand, based on the New Zealand Time Use Survey 1998/9. Evening work was defined as work undertaken between 1900 and 2400. Night work was defined as work undertaken between 0000 and 0500. Evening work was undertaken by 24.5% of current workers and night work by 6.8%. Night work was slightly more common for men compared to women (7.9% versus 5.2%) and in Pacific Islanders and Māori compared to Pakeha (14.5%, 10.7% and 6.2% respectively). Night work was also more common in plant and machine operators (16.8%), elementary occupations (14.7%), and service and sales workers (8.4%)[507].

Another study investigated the role of work, rest and recovery in the occurrence of injuries in forest workers, for whom work raised major physical and psychological demands. Seven per cent of 361 subjects reported working night work as part of their normal pattern of work[508].

Many New Zealand occupations involve working shift work.

4.2 ENVIRONMENTAL TOBACCO SMOKE

Summary Environmental tobacco smoke is smoke exhaled by another person or side stream smoke arising from another person's cigarette. Environmental tobacco smoke in the workplace has been associated with a range of work-related disorders. The main ones of these are ischaemic heart disease, lung cancer, pneumococcal disease and asthma. Occupations commonly exposed to significant levels of environmental tobacco smoke include bar worker, restaurant worker, other hospitality workers and a range of other blue collar workers, as well as office workers in workplaces where smoking is not banned. Several New Zealand studies have considered the risk of ill-health related to work-related environmental tobacco smoke. Two studies examined the role of passive smoking and estimated that in 1985 there were 152 deaths from ischaemic heart disease and 30 from lung cancer, and in 1997 there were 48 deaths from ischaemic heart disease, six from lung cancer and 47 from stroke, arising from exposure to workplace tobacco smoke. Several New Zealand studies have produced estimates of the prevalence of environmental tobacco smoke exposure in the workplace in New Zealand. These estimates range from 23% to 83%. Many New Zealand occupations involve exposure to environmental tobacco smoke, with those in the hospitality industry being the main ones.

Introduction

Environmental tobacco smoke is smoke exhaled by another person or side stream smoke arising from another person's cigarette. It has become of increasing concern in the last two decades, although paradoxically this has coincided with widespread measures to decrease exposure to environmental tobacco smoke in most workplaces.

Conditions

Environmental tobacco smoke in the workplace has been associated with a range of work-related disorders. The main ones are ischaemic heart disease, lung cancer and pneumococcal disease, with some evidence also for asthma, other respiratory symptoms, cerebrovascular disease and low-birth-weight babies[12, 13, 95, 97-99, 268, 269, 509-514].

Occupations commonly exposed to significant levels of environmental tobacco smoke include bar worker, restaurant worker, other hospitality workers and a range of other blue collar workers, as well as office workers in workplaces where smoking is not banned[12, 13, 514, 515].

Recent estimates of AFs of various conditions from occupational exposure to environmental tobacco smoke are shown in Table 4.1.

TABLE 4.1	Published estimates (%) of occupational attributable risk of various conditions from exposure to environmental tobacco smoke[1, 2]		
DISEASE	**COMBINED**	**MALE**	**FEMALE**
Ischaemic heart disease	4.2 – 6.8	2.2	1.5
Lung cancer	0.6	3.0	2.0
COPD		1.2	0.9
Pneumonia		15.6	10.9
Asthma		5.8	3.9

1: Steenland, 2003[2]
2: Nurminen, 2001[1]

New Zealand studies of risk

Several New Zealand studies have considered the risk of ill-health related to work-related environmental tobacco smoke. One study examined the role of passive smoking in the development of ischaemic heart disease and lung cancer. The study used pooled risk estimates to estimate the number of deaths related to environmental and workplace environmental tobacco smoke in 1985. There were estimated to be 152 deaths (95% CI 62 – 274) from ischaemic heart disease arising from workplace tobacco smoke[102] (Table 4.2).

A more recent study, using a similar but more sophisticated approach, estimated current deaths due to previous exposure and future deaths from current exposures. Relative risks and exposure prevalences were derived from published results to produce a population attributable risk for each condition, which was then applied to national deaths data to produce estimates of current deaths. This study estimated that there was a total of 101 deaths (48 from ischaemic heart disease, six from lung cancer and 47 from stroke) in New Zealand in 1997 due to occupational exposure to environmental tobacco smoke[103] (Table 4.2). These numbers were also used in a recent review[516]. Slightly different numbers were presented in an earlier report by the same authors[104]. A related study on morbidity states that admissions to hospital after heart attack include 190 events each year that would not occur if there were no workplace exposure to environmental tobacco smoke[278].

A population-based case-control study investigated the role of passive smoking in stroke. Exposure at home or at work was included, but separate results for occupational exposure were not presented. An increased risk of stroke was found after adjusting for all the main confounders[509] (Table 4.2).

A survey of restaurant and bar workers found 53% of those surveyed reported irritation of their throat or lungs at least some of the time at work[517]. A similar survey found hospitality workers in establishments that allowed smoking had a higher prevalence of reporting frequent phlegm and shortness of breath, but other symptoms were similar between the two groups, and the use of asthma medication was less likely in the exposed workers (possibly due to self-selection into non-exposed jobs)[518, 519].

Finally, two relevant letters have been published, one arguing the case for all workplaces to be free of environmental tobacco smoke[520], and another encouraging the use of the compensation system for claims relating to illness arising from work-related exposure to environmental tobacco smoke[521].

TABLE 4.2 Relative risk, population attributable risk and predicted number of deaths arising from occupational exposure to environmental tobacco smoke – New Zealand-based studies only

WORK GROUP	RR	95% CI	PAR	DEATHS	YEAR AND SOURCE
Ischaemic heart disease					
- male (1985)	2.3	1.4 – 3.4			Kawachi, 1989[102]
- male (1997)	1.21	1.04 – 1.41	0.057	42.0	Woodward, 2001[103]
- female (1985)	1.9	1.4 – 2.5			Kawachi, 1989[102]
- female (1997)	1.21	1.04 – 1.41	0.037	5.9	Woodward, 2001[103]
- combined (1985)				152	Kawachi, 1989[102]
Lung cancer					
- male (1985)	2.2	1.4 – 3.0			Kawachi, 1989[102]
- male (1997)	1.24	1.13 – 1.36	0.075	4.2	Woodward, 2001[103]
- female (1985)	2.2	1.4 – 3.0			Kawachi, 1989[102]
- female (1997)	1.24	1.13 – 1.36	0.053	1.4	Woodward, 2001[103]
Stroke					
- male (1997)	2.10	1.33 – 3.32	0.239	37.6	Woodward, 2001[103]
- female (1997)	1.66	1.07 – 2.57	0.109	9.7	Woodward, 2001[103]
- combined (1991-1992)	1.82	1.34 – 2.49			Bonita, 1999[509]

New Zealand exposures

There are several estimates of the prevalence of environmental tobacco smoke exposure in the workplace in New Zealand. These are summarised in Table 4.3. Estimates range from 23% to 83%. A recent review article estimated a prevalence of over 30%[516]. Exposure has been found to be highest in hospitality workers working in establishments in which customers are allowed to smoke freely.

The most detailed study examined serum cotinine levels (which are directly related to exposure to tobacco smoke) in hospitality workers and office workers. Exposure was found to be much higher in hospitality workers working in establishments that allowed customers to smoke compared to those in establishments that had smoke-free policies, and the prevalence of smoking was highest in persons working in establishments with no restrictions on smoking, moderate in those where smoking was restricted to designated areas, and low in workplaces designated as smoke-free[518, 519].

Another measure of exposure to tobacco smoke, nicotine levels in hair, was found to vary depending on the approach of the workplace to smoking in bars and restaurants. Levels were highest in workers at establishments with no restrictions on smoking, lowest in establishments where smoking was not allowed, and intermediate in establishments where there were designated smoking areas[523] (Table 4.3).

Several studies examined exposure to environmental tobacco smoke in workers, but did not provide separate results for workplace and home exposure, although the authors stated that much of the exposure came from the workplace[509, 522] (Table 4.3).

TABLE 4.3 Published estimates of prevalence (%) of exposure to environmental tobacco smoke in the workplace – New Zealand-based studies only

WORK GROUP	COMBINED	MALE	FEMALE	YEAR OF STUDY	YEAR AND SOURCE
All workers		34	23	1985	Kawachi, 1989[102]
All workers[1]	52			1992-1993	Whitlock, 1998[522]
- males[1]	49			1992-1993	Whitlock, 1998[522]
- females[1]	33			1992-1993	Whitlock, 1998[522]
- Māori[1]	60			1992-1993	Whitlock, 1998[522]
- Pacific Islanders[1]	56			1992-1993	Whitlock, 1998[522]
- European[1]	43			1992-1993	Whitlock, 1998[522]
- highest socio-economic status[1]	33			1992-1993	Whitlock, 1998[522]
- lowest socio-economic status[1]	55			1992-1993	Whitlock, 1998[522]
All workers[1]	37			1993-1994	Bonita, 1999[509]
Indoor workers					
Bar and restaurant	59			1999-2000	Jones, 2001[517]
- licensed	77			1999-2000	Jones, 2001[517]
- non-licensed	34			1999-2000	Jones, 2001[517]
Hospitality workers					
- smoking allowed	83			2000	Bates, 2002[518]
- designated areas only	40			2000	Bates, 2002[518]
- no smoking	13			2000	Bates, 2002[518]

1: The prevalence is for home and/or work exposure

Many New Zealand occupations involve exposure to environmental tobacco smoke, with those in the hospitality industry being the main ones.

4.3 JOB STRAIN AND JOB CONTROL

Summary Job strain describes the extent to which the worker is exposed to any of a range of work factors such as excessive workload, unreasonable leadership/management style, professional conflict, excessive emotional demands of the job, and lack of job security. Job strain is also associated and interrelated with job control. Job strain (and/or job control) has been associated with a range of work-related disorders, including anxiety, depression and related psychological disorders; ischaemic heart disease; upper limb musculoskeletal disorders; and suicide. Virtually any occupation can have associated job strain issues at some stage, and personal factors also play an important role in determining whether a particular factor or factors gives rise to symptoms of strain-related conditions in an individual worker. The only New Zealand studies considering work-related disorders arising from job strain relate to psychological disorders. There are no useful measures of factors leading to increased occupational stress in New Zealand. However, most of the relevant factors occur in the New Zealand workforce.

Introduction

Job strain describes the extent to which the worker is exposed to any of a range of work factors such as excessive workload, unreasonable leadership/management style, professional conflict, excessive emotional demands of the job, and lack of job security. The term "workplace stress" is sometimes used synonymously with "job strain", but job strain is preferable because stress is also used to describe a psychological disorder that might arise from excessive job strain. Job strain is also associated and interrelated with job control (the extent to which the worker has latitude with decision-making at work), and the effects of the two factors can be difficult to disentangle.

Conditions

Job strain (and/or low job control) has been associated with a range of work-related disorders. These include anxiety, depression and related psychological disorders; ischaemic heart disease (particularly related to low job control); upper limb musculoskeletal disorders; and suicide[2, 226, 228, 263, 264, 270, 273, 358, 471, 524].

Virtually any occupation can have associated job strain issues at some stage, and personal factors also play an important role in determining whether a particular factor or factors gives rise to symptoms of strain-related conditions in an individual worker[225-228].

New Zealand studies of risk

The only New Zealand studies considering work-related disorders arising from job strain relate to psychological disorders. These have been considered earlier, and are only summarised here.

The studies have shown increased levels of stress arising from issues of job scope in males, job pressure in administrative workers, and rapport with management in workers of Pacific Island ethnicity[229]; self-reported "stress" by 8% of a sample of workers[230]; "stress-related disease" being responsible for 15% of sickness absence in a study of workers in the meat freezing industry[48]; 6% of first-year nurses reporting adverse psychological consequences

resulting from threats and violent behaviour connected to work[232]; and 8% to 10% of the workforce estimated to have stress (presumably work-related stress) at any one time[231]. Other New Zealand papers considered occupational stress in medical interns, rehabilitation providers, nurses and air traffic controllers[233-240].

New Zealand exposures

There is no useful information on the prevalence of factors leading to increased occupational stress in New Zealand. However, most of the relevant factors occur in the New Zealand workforce.

4.4 NOISE

Summary Noise is unwanted sound perceived as an environmental stressor and nuisance. The main health effect of work-related noise is noise-induced hearing loss. Other health effects associated with noise include sleep disturbance, hypertension, general symptoms such as headache and nausea, and psychological symptoms such as anxiety and change in mood. In an occupational setting, noise exposure has consistently been found to be associated with noise-induced hearing loss and hypertension. Excessive noise levels occur in many occupational contexts, but particularly in primary industries such as farming and mining, and in manufacturing and construction. There are no New Zealand studies considering work-related disorders arising from excessive noise apart from noise-induced hearing loss, nor any estimates of attributable fraction. There are no useful measures of occupational exposure to excessive noise in New Zealand. However, most of the relevant work tasks occur in the New Zealand workforce.

Introduction

Noise is unwanted sound perceived as an environmental stressor and nuisance[525].

Conditions

The main health effect of work-related noise is noise-induced hearing loss. This is considered in Section 3.11. Other health effects associated with noise include sleep disturbance, hypertension, general symptoms such as headache and nausea, and psychological symptoms such as anxiety and change in mood. In an occupational setting, noise exposure has consistently been found to be associated with noise-induced hearing loss and hypertension. The effect on hypertension is probably mediated through changes in stress hormones such as adrenaline, noradrenaline and cortisol. Hypertension is associated with increased risks of cardiovascular, cerebrovascular and renal disease, but evidence of direct associations between these three conditions and noise is inconclusive[271, 277, 525, 526].

Excessive noise levels occur in many occupational contexts, but particularly in primary industries such as farming and mining, and in manufacturing and construction.

New Zealand studies of risk

There are no New Zealand studies considering work-related disorders arising from excessive noise apart from noise-induced hearing loss (which is covered in Section 3.11), nor any estimates of attributable fraction.

New Zealand exposures

There are no useful measures of occupational exposure to excessive noise in New Zealand. However, most of the relevant work tasks occur in the New Zealand workforce.

4.5 OCCUPATIONAL DISEASE/INJURY IN MĀORI

Introduction

Māori currently comprise about 10% of the New Zealand labour force. There is limited information, however, about the extent of occupational ill-health within the Māori population. This lack of information is partly due to the difficulty of calculating accurate estimates because of undercounting of Māori cases within official datasets and inconsistent ethnicity definitions used between Government agencies and over time[527-529]. Another possibility is that there have been insufficient numbers of Māori cases to enable meaningful analysis for many conditions, particularly disease, even after taking the issues of undercounting into consideration.

Work-related injury

A study of work-related fatalities for the period 1985-1994 (presented in greater detail in Section 3.16) found that 89 of the 741 worker deaths were Māori[457]. The crude Māori fatality rate was found to be significantly higher than that found for non-Māori. However, separate adjustment for differences in occupation and industry distribution reduced the difference between ethnic groups to non-significant levels.

A similar pattern was found for non-fatal injury[530]. For the 2001/2 financial year, 23,603 new work-related claims were made by Māori workers at a rate of 13.8 per 100 workers (95% CI 13.6 – 14.0). This rate was significantly higher than that found for the NZ European/Pakeha ethnic group (10.1 per 100 workers 95% CI 10.0 – 10.2). The crude relative risk of 1.37 was reduced to 1.11 following adjustment for differences in occupational distribution between groups. More than 70% of the gap between Māori and non-Māori non-fatal injury rates can therefore be explained by the difference in employment concentration.

Occupational disease

There are no overall estimates of occupationally related disease available for Māori. Instead a few studies have separately analysed the Māori cases within their occupationally relevant investigations. Two studies have identified that the overall Māori population and certain occupations are at greater risk of cancer of the stomach[67] and cancer of the brain, cranial-nerves and cranial meninges[531]. In both studies, however, further analysis was not undertaken to establish if the elevated Māori rate could be the result of Māori workers being disproportionately located within occupations that had an elevated cancer risk. Another study found that Māori police and customs personnel had a significantly higher prevalence ratio of hepatitis B, being 5.26 times that of their NZ European colleagues[34]. Again, the study did not seek to establish if this difference could be explained by the other risk factors such as being stationed in geographic areas that were high or medium risks for hepatitis B.

Summary

The different employment patterns between Māori and the rest of the New Zealand population have been shown to contribute to the increased rate of fatal and non-fatal injury experienced by Māori relative to the rest of the population. There is no published information about the overall extent of occupational disease amongst the Māori workforce. If Māori are disproportionately employed in occupations more susceptible to occupational disease, it is conceivable that the rate of occupational disease for Māori would be higher than the general population.

4.6 THE CHANGING NATURE OF WORK

Summary The changing nature of work describes changes to the hazards, organisational structure and employment arrangements. Exposure to "traditional" occupational hazards, such as physical and chemical hazards, is likely to decrease over time as the workforce moves away from primary industry and basic manufacturing to service industries and more refined manufacturing products and processes. Many problem exposures still occur, but the number of workers exposed, the levels to which they are exposed, and the associated risks can be expected to decrease over time. However, these hazards are replaced by different hazards associated with the new types of work and new ways of working. There are no specific conditions associated with the changing nature of work. The relevant conditions and exposures are considered in earlier sections, and to the extent that the relevant exposures decline or increase, the associated health problems will do likewise. The impacts of changes to the work environment and workforce structures in New Zealand have been the subject of a recent review.

Introduction

The changing nature of work describes changes to the hazards, organisational structure and employment arrangements. Exposure to "traditional" occupational hazards, such as physical and chemical hazards, is likely to decrease over time as the workforce moves away from primary industry and basic manufacturing to service industries and more refined manufacturing products and processes. Many problem exposures still occur, but the number of workers exposed, the levels to which they are exposed, and the associated risks can be expected to decrease over time. However, these hazards are replaced by different hazards associated with the new types of work and new ways of working.

Conditions

There are no specific conditions associated with the changing nature of work. The relevant conditions and exposures are considered in earlier sections, and to the extent that the relevant exposures decline or increase, the associated health problems will do likewise. Relevant specific changes are considered below for the specific New Zealand context, based on a recent review document.

New Zealand studies of risk

The impacts of changes to the work environment and workforce structures have been the subject of a recent review that focused on New Zealand (and, to a lesser extent, Australia). Key changes to the structure and conditions of employment involve flexibility in hours of work (loss of standard working hours, changes in the length of work shifts), an increase in part-time and casual work, a decrease in unionisation, and increases in unemployment[532].

The authors identified several health effects that can be expected to arise from these changes. Work-related injury has been reported to be more common in workers on contingency employment arrangements, with

financial insecurity, less union protection, lack of access to standard working conditions such as sick leave and annual leave, and less access to health and safety information and resources all contributing to a less safe working environment.

Increased flexibility has also led to more night work and longer hours of work, both of which have been shown to lead to a range of health problems (see Section 4.1). Job insecurity, which is associated with flexible working arrangements and contingency work, provides an increased sense of vulnerability and decreased sense of control. This has in turn been associated with several adverse health outcomes, particularly cardiovascular disease, anxiety and upper limb disorders (see Section 4.3). Each of these conditions can be expected to become more common in a work-related context in coming years.

The extent of change, and the resulting health effects, are likely to impact differently on different sections of the community in New Zealand. For example, the proportion of female workers doing part-time work was three times that of male workers in 1999, and women were less likely to have access to penalty rates. Māori and Pacific Islanders were much more likely to be unemployed than Europeans.

Some of these issues were considered in a recent detailed study of the economic determinants of health in New Zealand[533].

New Zealand exposures

The nature of changes to physical, organisational and structural aspects of the New Zealand workplace and workforce has been considered above. The detail is beyond the scope of this document, but is described in the review document cited[532].

4.7 LATENCY

Summary Disease latency is the period between first exposure and the onset of detectable disease. Latency is important for many work-related disorders, but particularly for malignancies, cardiovascular disease and pneumoconioses. For other work-related disorders, such as non-malignant skin disorders, asthma, most chemical poisoning and most musculoskeletal disorders, the latency is typically in the order of days, weeks or months, rather than years. For injuries, the physical damage usually follows immediately after the causative exposure. The importance of this concept is that most current conditions reflect exposures from five, ten, 20 or more years ago. Similarly, disorders arising from most current exposures will not be evident for many years. The only relevant New Zealand study estimated deaths resulting from exposure to environmental tobacco smoke, and considered both current deaths arising from previous exposures and future deaths arising from current exposures. There are no detailed published New Zealand estimates of changes in workforce exposures and associated latency issues.

Introduction

Disease latency is the period between first exposure and the onset of detectable disease.

Conditions

Latency is important for many work-related disorders, but particularly for malignancies. Most cancers probably have a latency of at least ten years, and for some, such as malignant mesothelioma, the latency may be up to 50 or 60 years[127]. Cardiovascular changes and pneumoconioses can also be expected to have a lengthy latency between exposure and the identification of any clinical abnormalities. For other work-related disorders, such as non-malignant skin disorders, asthma, most chemical poisoning and most musculoskeletal disorders, the latency is typically in the order of days, weeks or months, rather than years. For injuries, the physical damage usually follows immediately after the causative exposure.

The importance of this concept is that most current conditions reflect exposures from five, ten, 20 or more years ago. Similarly, disorders arising from most current exposures will not be evident for many years. In addition, current studies need information on past exposures, and unless there are comprehensive contemporaneous records, exposure assessments can be the subject of considerable error[534, 535].

New Zealand studies of risk

The only New Zealand study of risk that considers these latency issues is the paper considered in Section 4.2 that considered deaths resulting from exposure to environmental tobacco smoke. In addition to current deaths arising from previous exposures, future deaths arising from current exposures were estimated[104].

New Zealand exposures

There are no detailed published New Zealand estimates of changes in workforce exposures and associated latency issues.

4.8 COSTS

Summary One of the aims of the project was to assess the economic and social costs associated with work-related disease and injury in New Zealand. There is little information on the costs of work-related injury and/or diseases in New Zealand. A joint project of the Department of Labour and ACC provided a case study approach to a number of aspects of work-related injury and disease. They documented costs of $1.2 million for the 15 cases considered in the report, and projected costs, taking into account ongoing payments for some of the cases, of almost $4 million. The authors also cited an estimate of between $4.3 thousand million and $8.7 thousand million for the year ending 31 March 2002, based on a percentage of Gross Domestic Product. An earlier estimate for 1995 was direct costs of $913 million, and indirect costs of $315 million, due to occupational disorders in New Zealand. Claims to ACC for the 12-month period July 2002 to June 2003 for work-related disorders, the vast majority of which were injuries, amounted to $143,487,000 for new claims and $275,950,000 for ongoing claims.

Introduction

One of the aims of the project was to assess the economic and social costs associated with work-related disease and injury in New Zealand.

International studies of cost

There have been several attempts in other countries to assess costs arising from work-related disorders. All have significant assumptions underlying their approach, and there are many different approaches that can be used. Some studies have focused on total costs from all disorders[536, 537], and others on costs arising from particular conditions[538-541] or on cost-effectiveness analyses[542].

New Zealand studies of cost

There is little information on the costs of work-related injury and/or diseases in New Zealand. Some specific estimates have been included in the relevant parts of Section 3. Some overall cost information is presented here.

A joint project of the Department of Labour and ACC provided a case study approach to a number of aspects of work-related injury and disease. Through detailed consideration of a number of cases of work-related injury (and disease), the authors illustrated the range of factors that result in costs to the employee, the employer and the community. These included costs to replace an injured employee (hiring, training), rehabilitation costs, costs from lost production, costs to repair or replace damaged equipment, fines, increased compensation costs, legal costs, loss of goodwill from bad publicity, and intangible costs such as loss of morale (and presumed consequent drop in productivity). They documented costs of $1.2 million for the 15 cases considered in the report, and projected costs, taking into account ongoing payments for some of the cases, of almost $4 million[543].

The authors also cited an estimate of between $4.3 thousand million and $8.7 thousand million for the year ending 31 March 2002, based on a percentage of Gross Domestic Product[543].

An earlier publication estimated direct costs of $913 million, and indirect costs of $315 million, due to occupational disorders in New Zealand in 1995[544].

Work-related claims information is available from the ACC web site. This shows that for the 12-month period July 2002 to June 2003, the cost for new claims was $143,487,000 and for ongoing claims was $275,950,000. The vast majority of these claims were for injuries of some sort[17].

SECTION FIVE

ESTIMATES OF

BURDEN

5

5.1 INTRODUCTION

This chapter provides quantitative estimates of:

- the annual number of deaths from occupational disease and injury in New Zealand
- the annual number of new cases of work-related disease and injury.

In relation to the number of deaths, the use of estimates reflects a lack of robust data in New Zealand. Recent data on deaths from occupational injury is imprecise[183], and that on deaths from occupational disease even more so.

With this in mind, this chapter presents a range of estimates based on a variety of assumptions, rather than one "best" estimate. Nevertheless, the findings are striking, particularly given the fact that the estimates are likely to understate the true situation, and that even major changes in the assumptions would not affect the results significantly.

The estimates are that each year in New Zealand there are:

- about 700-1,000 deaths from occupational disease
- about 100 deaths from occupational injury
- 17,000-20,000 new cases of work-related disease
- about 200,000 occupational injuries resulting in ACC claims.

This clearly represents a major burden to New Zealand in terms of death, disease and injury.

5.2 DEATHS DUE TO WORK-RELATED DISEASE IN NEW ZEALAND

Key messages

- The annual number of deaths due to work-related disease is estimated at 700 to 1,000.
- About 80% of these deaths occur in men.
- About 30%-40% of these deaths are due to occupational cancer.
- Other occupational diseases representing a high burden include ischaemic heart disease and respiratory diseases.

This section estimates the number of deaths in New Zealand each year from occupational and work-related disease. It is based on mortality data from 1999, the most recent year for which complete statistics were available.

Although valid information was available on the number of deaths from each cause, the proportions that were work related could not be directly estimated. However, recently published estimates for Finland (Nurminen[1]) and the United States (Steenland[2]) have helped in this work. The Finnish and American estimates were based on AFs and national mortality statistics for selected causes of death. The AF represents the proportion by which the disease's mortality would be reduced if occupational exposures were eliminated. AFs can be calculated using estimates of the relative risk and the prevalence of occupational risk factors in the population.

Methods

Choosing occupational and work-related diseases

The first step in the estimation process involved choosing the diseases to include.

- The Steenland causes of death comprised only those with the most well established links to occupation. This list was used to obtain a conservative, or lower-bound, estimate (List A).
- Nurminen used a more extensive list that included causes of death for which the occupational link was less established. This was used for the upper-bound estimate (List A+B).

Estimation of AFs

The AF represents the proportion by which the disease's mortality would be reduced if occupational exposures were eliminated. They are often represented by a percentage rather than a proportion, and this is the approach used here unless specifically stated otherwise (i.e. an AF of 3.5 means that 3.5% of the cases of that condition are estimated to be due to occupational exposures). For New Zealand, there is very little information on risk factor prevalence, and relative risk information derived specifically for New Zealand populations is only available for a limited number of conditions. Therefore, specific AF estimates based on the New Zealand population are not available. Instead, the Nurminen sex-specific estimates were used. If appropriate estimates were not obtainable from Nurminen, others were used; these are noted in the following for each cause of death. The International Classification of Disease (ICD-9) is included in brackets.

Cancer of the Oral Cavity (141-145). AFs taken from Nurminen. Occupational exposures considered: PAHs and hydrocarbon solvents.

Cancer of the Pharynx (146-148). AFs taken from Nurminen. Occupational exposures considered: welding fumes and hydrocarbon solvents.

Cancer of the Oesophagus (150). AFs taken from Nurminen. Occupational exposures considered: PAHs and hydrocarbon solvents.

Cancer of the Stomach (151). AFs taken from Nurminen. Occupational exposures considered: grain dust, animal contact, herbicides, diesel fumes.

Cancer of the Colon (153). AFs taken from Nurminen. Occupational exposures considered: asbestos, welding fumes, soldering fumes and gases.

Cancer of Rectum, Rectosigmoid Junction and Anus (154). AFs taken from Nurminen. Occupational exposures considered: asbestos and styrene.

Cancer of the Liver, specified as primary (155). AFs of 3.5 for men and 5.3 for women taken from Nurminen. Occupational exposures considered were inorganic dust (mainly silica) and aflatoxins from crops used by the livestock feed processing industry. One per cent was added to account for occupational hepatitis B and C infection (e.g. in health care workers) as a potential cause for hepatocellular carcinoma.

Cancer of the Gallbladder (1560). AFs taken from Nurminen. Occupational exposures considered: hydrocarbon solvents.

Cancer of the Pancreas (157). AFs taken from Nurminen. Occupational exposures considered: PAHs, organic solvents, inorganic dust containing crystalline silica, rubber chemicals including acrylonitrile, ionising radiation, pesticides, nickel.

Cancer of Nasal Cavities, Middle Ear and Accessory (160). AFs taken from Nurminen. It is noted that the Steenland AFs are higher (33%-46% versus 24% for men and 6% for women in Nurminen). Occupational exposures considered: wood dust, leather dust, hexavalent chromium, nickel.

Cancer of Larynx (161). AFs taken from Nurminen. It is noted that Steenland AFs are similar (1%-20%). Occupational exposures considered: asbestos, welding fumes.

Cancer of Trachea Bronchus and Lung (162). Gender-specific AFs taken from Steenland, with AF for chemical exposures 6.1-17.3 for men and 2 for women, for environmental tobacco smoke 0.6% for both men and women. Occupational exposures considered: arsenic, asbestos, beryllium, cadmium, chromium, diesel fumes, nickel, silica, environmental tobacco smoke.

Mesothelioma. AFs taken from Nurminen. Occupational exposure considered: asbestos.

Cancer of Bone and Articular Cartilage (170). AFs taken from Nurminen. Occupational exposure considered: ionising radiation in air carrier personnel.

Melanoma of Skin (172). AFs taken from Nurminen. Occupational exposures considered: diesel engine exhaust in warehouse clerks, sunburn in seafarers, cosmic radiation in airline pilots.

Other Malignant Neoplasm of Skin (173). AFs taken from Nurminen. Occupational exposure considered: UV radiation from outdoor work.

Female Breast Cancer (174). AFs taken from Nurminen. Occupational exposures considered: ionising radiation in postmenopausal women and hair dyes in hairdressers.

Cancer of Cervix Uteri (180). AFs taken from Nurminen. Occupational exposures considered: aromatic hydrocarbon solvents.

Cancer of Uterus (179,182). AFs taken from Nurminen. Occupational exposure considered: sedentary work.

Cancer of Ovary and Other Uterine Adnexa (183). AFs taken from Nurminen. Occupational exposures considered: aromatic hydrocarbon solvents, asbestos, leather dust, diesel or gasoline engine exhaust, hair dyes in hairdressers.

Cancer of Prostate (185). AFs taken from Nurminen. Occupational exposures considered: metal dust, especially cadmium dust, herbicides.

Cancer of Bladder (188). AFs for men taken from Nurminen. The AF for women in Nurminen (0.7) was considered too low in light of two large studies of European and American women[173, 180]. Instead, an AF for women of 7.1% (half of that for men) was used. Occupational exposures considered: textile dyes, paints, pigments, leather, rubber, chlorinated hydrocarbon solvents, PAHs.

Cancer of Kidney and Other Unspecified Urinary (189). AFs taken from Nurminen. Occupational exposures considered: gasoline, solvents, cadmium, lead.

Cancer of Brain (191). AFs taken from Nurminen. Occupational exposures considered: metal dusts, metal working fluids, lead, aromatic hydrocarbon solvents.

Hodgkin's Disease (201). AFs taken from Nurminen. The AF for women was considered too low, but because of the low number of deaths from this disease, changing the AF for women will not change the estimate. Occupational exposures considered: unspecified farmers' exposures.

Non-Hodgkin's Lymphoma (200, 202). AFs taken from Nurminen. Occupational exposures considered: halogenated hydrocarbon solvents, herbicides, fungicides.

Leukaemia (204-208). AFs taken from Nurminen. Note there was a high AF for men compared with Steenland because Nurminen et al include low-frequency magnetic fields in electrical occupations. Occupational exposures considered: low-frequency magnetic fields from electrical occupations, benzene.

Vascular Dementia in Senile and Pre-senile Organic Psychotic Conditions (290). AFs taken from Nurminen. Occupational exposures considered: pesticides and fertilizers.

Alzheimer's Disease (331). AFs taken from Nurminen. Occupational exposures considered: low-frequency magnetic fields in electrical work.

Parkinson's Disease (332). AFs taken from Nurminen. Occupational exposures considered: pesticides.

Ischaemic Heart Disease (410-414). AFs taken from Nurminen. AFs were comparable with those in Steenland. Occupational exposures considered: work strain from shift work, noise, engine exhausts including carbon monoxide, environmental tobacco smoke.

Cerebrovascular Disease (430-438). AFs taken from Nurminen. Occupational exposures considered: work strain from shift work, environmental tobacco smoke.

Pneumonia (480-486). AFs taken from Nurminen. Occupational exposures considered: welding exposures.

COPD (491, 492 and 496). AFs taken from Nurminen, which are similar to those in Steenland. Occupational exposures considered: organic dust, microbial dust, endotoxins, welding fumes, environmental tobacco smoke.

Asthma (493). AFs taken from Nurminen, which are similar to those in Steenland. Occupational exposures considered: grain dust, hay dust, animal epithelia, hairs or secretions, fodders in agricultural workers,

epoxy resins or paint, isocyanates in spray painters and laquerers, chlorine and acids, solvents, dusts in cleaners, exposures in plastics and rubber industry, flour dust in bakers and pastry makers, welding fumes, textile dust, exposures in hairdressers, environmental tobacco smoke.

Pneumoconiosis (500-505). AFs taken from Nurminen. The AF was 100%, based on the rarity of non-occupational cases of pneumoconiosis. Occupational exposures considered: asbestos, silica, organic dust.

Ulcer of Stomach and Duodenum (531-533). AFs taken from Nurminen. Occupational exposure considered: work strain from shift work.

Nephritis, Nephritic Syndrome and Nephrosis (580-589). AFs taken from Nurminen. Categories within this group considered to have an occupational etiology are glomerulonephritis or hypertensive disease[2]. Therefore, only one third of the deaths occurring in this group (ICD-9 580-589) are counted in the estimate. Occupational exposures considered: lead, chromium, silica, oxygenated hydrocarbons.

Extracting the number of deaths

The number of deaths for each cause in New Zealand during 1999 was extracted from the mortality database of the World Health Organization[545] and *Mortality and Demographic Data 1999*[546]. This database includes official national statistics and lists the "underlying cause of death", according to the rules of the International Classification of Diseases.

Numbers were extracted for the whole of New Zealand, and separated for men and women. An age range was chosen for each cause of death, covering the ages for which occupation could be an attributable factor for the disease. These were deaths occurring at 30 years or older, except for diseases of the circulatory system and ulcers (ages 20-69) and non-malignant diseases of the respiratory system (ages 20 and older).

Estimation of attributable deaths

The annual mortality attributable to occupational exposures was then calculated by multiplying the sex-specific AFs for each cause of death by the sex-specific total number of deaths for each cause.

Findings

Table 5.1 shows the estimated annual burden of work-related disease mortality in New Zealand during 1999.

Overall:

- there are an estimated 700-1,000 deaths per year from occupational and work-related diseases
- about 80% of these deaths occur in men
- about one third of these deaths is due to occupational cancer, particularly lung cancer
- other occupational diseases representing a high burden include ischaemic heart disease and respiratory disease.

In addition:

- of all deaths in people age 20 or older, 2%-4% are estimated to be due to occupational disease (700-1,000 of 27,504). For men this is 4%-6% (581-801 of 13,918); for women 1%-1.5% (111-179 of 13,586)
- of all cancer deaths in people age 30 or older, 3%-6% are estimated to be due to occupational cancer (237-425 of 7,674). For men this is estimated to be 5%-9% (209-360 of 4,039); for women 0.5%-2% (28-65 of 3,594).

TABLE 5.1 Estimated annual burden of work-related disease mortality in New Zealand, using AFs

	DISEASE WITH A: WELL ESTABLISHED LINK WITH OCCUPATION B: LESS ESTABLISHED LINK WITH OCCUPATION	ATTRIBUTABLE FRACTION MEN/WOMEN (%)	ANNUAL TOTAL DEATHS MEN/WOMEN	ANNUAL DEATHS ATTRIBUTABLE TO OCCUPATIONAL EXPOSURES MEN/WOMEN	ANNUAL DEATHS ATTRIBUTABLE TO OCCUPATIONAL EXPOSURES TOTAL
Total					
All occupational diseases					
Lower-bound (conservative) estimate	Only A			581/111	692
Upper-bound estimate	A+B			801/179	980
All occupational cancer					
Lower-bound (conservative) estimate	Only A			209/28	237
Upper-bound estimate	A+B			360/65	425
By disease (ICD-9)					
Malignant neoplasms					
Oral cavity (141-145)	B	1.2/0.3	33/34	0/0	0
Pharynx (146-148)	B	2.0/0.5	32/6	1/0	1
Oesophagus (150)	B	6.4/0.2	113/59	7/0	7
Stomach (151)	B	10.3/5.4	206/127	21/7	28
Colon (153)	B	5.6/0.0	352/398	20/0	20
Rectum, rectosigmoid junction and anus (154)	B	3.1/0.1	226/158	7/0	7
Liver, specified as primary (155)	A	4.5/6.3	62/13	3/1	4
Gallbladder (1560)	B	0.2/0.4	4/23	0/0	0
Pancreas (157)	B	13.4/3.5	149/149	20/5	25
Nasal cavities, middle ear and accessory (160)	A	24/6.7	4/5	1/0	1
Larynx (161)	A	9.3/0.5	23/8	2/0	2
Trachea bronchus and lung (162)	A	12.3/2.6	873/569	107/15	122
Pleura including mesothelioma (163)	A	90/25	47/10	42/3	45
Bone and articular cartilage (170)	B	0.6/0.6	7/8	0/0	0
Melanoma of skin (172)	B	4.3/0.4	144/83	6/0	6
Other malignant neoplasm of skin (173)	A	13.1/3.8	53/22	7/1	8
Female breast (174)	B	-/1.7	0/642	0/11	11
Cervix uteri (180)	B	-/5.9	0/70	0/4	4
Uterus (179, 182)	B	-/1.1	0/73	0/1	1
Ovary and other uterine adnexa (183)	B	-/2.1	0/169	0/4	4
Prostate (185)	B	6.0/ -	552/0	33/0	33
Bladder (188)	A	14.2/7.1	114/54	16/4	20
Kidney and other unspecified urinary (189)	A	4.7/0.8	95/70	4/1	5
Brain (191)	B	10.6/1.3	116/70	12/1	13
Hodgkin's disease (201)	B	3.9/0.0	9/3	0/0	0
Non-Hodgkin's lymphoma (200, 202)	B	13.5/3.1	179/144	24/4	28
Leukaemia (204-208)	A	18.5/2.5	144/102	27/3	30
Mental disorders					
Senile and pre-senile organic psychotic conditions (290)	B	10/1.8	<243/535	<24/10	<34
Nervous system disorders					
Alzheimer's disease (331)	B	3.4/1.8	6/5	0/0	0
Parkinson's disease (332)	B	16/4.9	93/69	15/3	18

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TABLE 5.1 (CONT) Estimated annual burden of work-related disease mortality in New Zealand, using AFs

	DISEASE WITH A: WELL ESTABLISHED LINK WITH OCCUPATION B: LESS ESTABLISHED LINK WITH OCCUPATION	ATTRIBUTABLE FRACTION MEN/WOMEN (%)	ANNUAL TOTAL DEATHS MEN/WOMEN	ANNUAL DEATHS ATTRIBUTABLE TO OCCUPATIONAL EXPOSURES MEN/WOMEN	ANNUAL DEATHS ATTRIBUTABLE TO OCCUPATIONAL EXPOSURES TOTAL
Diseases of circulatory system					
Ischaemic heart disease (410-414)	A	18.9/9.1	1,128/364	213/33	246
Cerebrovascular disease (430-438)	B	12.1/7.8	206/191	25/15	40
Diseases of respiratory system					
Pneumonia (480-486)	B	1.4/0.3	217/396	3/1	4
COPD (491, 492 and 496)	A	14/3.8	884/720	124/27	151
Asthma (493)	A	17.8/18.4	98/118	17/22	39
Asbestosis (501)	A	100/100	10/0	10/0	10
Pneumoconiosis due to other inorganic dust (503)	A	100/100	1/0	1/0	1
Diseases of digestive and genitourinary system					
Ulcer of stomach and duodenum (531-533)	B	29/29	8/6	2/2	4
Nephritis, nephritic syndrome and nephrosis (580-589) 1/3	A	17.6/2.3	42/42	7/1	8

Discussion

It is important to note the limitations of these estimates, as each step in the AF method used is prone to error.

For example:

- the AFs (mainly based on the Finnish population) may not be appropriate for New Zealand, either because the exposure prevalence is not the same or because the risk estimate is not the same due to, for example, different exposure levels
- the evidence on which AF estimates for women are based is often weaker than for men
- the age range for mortality statistics may not be appropriate
- the knowledge on which diseases are work related is still lacking and epidemiologic evidence remains doubtful.

In addition, the estimates of work-related disease mortality will change over time owing to factors such as:

- changes in occupation and industry distribution
- the banning of products and the introduction of new ones
- the introduction of protective measures.

Nevertheless, the findings are of interest and are not inconsistent with findings from other New Zealand studies.

For example, we estimate there are 20 bladder cancer deaths a year due to known occupational causes in New Zealand. A more detailed examination of bladder cancer registrations in New Zealand[183, 184] concluded that 38 cases over a one-year period were due to occupational causes. As these were bladder cancer registrations and not all would have resulted in death, the two estimates are reasonably consistent.

5.3 MORTALITY DUE TO WORK-RELATED INJURY IN NEW ZEALAND

Key messages

- The annual number of work-related fatal injuries in New Zealand is 105.
- 94% of these deaths occur in men.
- The "agriculture, forestry and fishing" industry has the highest number of fatal work-related injuries (39 fatalities a year).
- 30% of all work-related fatal injuries are traffic related and occur while people are working or commuting.

This section gives estimates of the number of deaths due to work-related injury each year in New Zealand.

Injuries are only included if they involve a worker (primary work-related injury). Subsidiary work-related injury (injury that happens to a bystander or a visitor to the workplace) is not covered.

Methods

The main information sources were:

- *Work-Related Fatal Injuries in New Zealand 1985-1994* (the "work-related fatal injuries study", or WRFIS)[547]
- *Work-Related Fatal Traffic Injuries in New Zealand 1985-1998*[548].

The WRFIS identified potential cases of work-related injury deaths from the New Zealand Health Information Service's (NZHIS's) electronic national mortality data files, and reviewed the circumstances of each fatal incident directly from coronial files. It excluded:

- suicide deaths
- deaths of individuals essentially outside working age
- deaths while travelling to or from work
- deaths due to traffic crashes on public roads
- deaths of bystanders.

These estimates are considered more complete than the registries of any individual agency or combination of agencies that register work-related fatalities, such as ACC and OSH[549]. However, Langley et al consider their estimate of 74 work-related deaths to be a minimum[549].

Number of work-related fatal injuries

The annual estimate of workplace deaths used in this document was derived using industry-specific numbers from the WRFIS, divided by 10 (because the study covered ten years). Only industries with more than three deaths over 1985-1994 were reported and included. The sex-specific numbers are also derived from the WRFIS. For estimates by cause of death, we made use of unpublished results of the WRFIS (personal communication Anne-Marie Feyer) that covered the same period (1985-1994).

The estimate of the annual number of work-related fatal traffic injuries (31) comes directly from *Work-Related Fatal Traffic Injuries in New Zealand 1985-1998*[548]. The authors used three data sources to identify potential cases:

- the NZHIS mortality database
- the Land Transport Safety Authority traffic crash report database
- the ACC entitlement claims database.

Potential work-related cases were identified and work-relatedness was determined through coronial files.

The above report describes the numbers and rates of death that occurred while the deceased people were either actively working (working death) or travelling to or from work (commuting death). It defined commuter fatalities as "people who satisfied the worker definition, but died as a result of an incident that occurred while travelling directly from home to work, work to home, or between two jobs. If the incident occurred while the person was travelling in the course of their work duties, the person was not classified as a commuter but as a worker fatality". The estimates exclude bystanders.

The breakdown by industry was calculated using the report's distribution of work-related fatal traffic injury cases by industry over 1985-1998. Meanwhile, the numbers by sex were calculated using the report's sex-specific percentages[548]. Annual numbers were estimated by dividing the study's numbers by 14 (because the study covered 14 years).

The estimate of the total annual number of work-related fatalities was calculated as:

the annual number of work-related fatal injuries (excluding traffic)
+
the annual number of work-related fatal traffic injuries.

Rates of work-related fatal injuries

The estimate of annual rates of work-related fatal injuries (those that occurred in traffic incidents) and the sex-specific estimates were sourced directly from the WRFIS[547]. The rates for work-related fatal injuries were calculated per 100,000 workers per year. This rate counts each individual equally and does not consider differences between part-time and full-time work.

The estimates of the annual rates of work-related fatal traffic injuries came from *Work-Related Fatal Traffic Injuries in New Zealand 1985-1998*[548]. Rates for work-related injuries were calculated per 100,000 workers. The denominator was the number of people of working age and who were employed in the labour force. Information on hours spent driving was not available, but the occupation gives some broad indication of exposure to traffic while at work or when going to and from work.

The sex-specific rates were estimated based on the sex-specific denominators used for the annual rate of work-related fatal injuries (excluding traffic).

The estimate of the total annual rate of work-related fatalities was calculated as:

the annual rate of work-related fatal injuries (excluding traffic)
+
the annual rate of work-related fatal traffic injuries.

Findings

Table 5.2 presents the results. Overall:

- there are an estimated 105 work-related fatal injuries in New Zealand each year
- 30% of all work-related fatal injuries happen in traffic to people while they are working or commuting.

In addition:

- work-related fatal injuries are estimated to account for 7.3% of all external causes of death in people age 20 or older (105 of 1,435), and for 0.4% of all deaths of people age 20 or older (105 of 27,504)
- an estimated 0.7% of all deaths in men age 20 or older are due to work-related fatal injuries (99 of 13,918). The estimate for women is 0.04% (six of 13,586)
- work-related traffic fatalities are estimated to account for 7.9% of all transport fatalities in people age 20 or older (31 of 394)
- work-related fatal injuries (excluding those that occurred in traffic incidents) are estimated to account for 42% of all fatal injuries excluding traffic incidents, suicide, homicide and misadventures during medical care, in people age 20 or older (74 of 177).

TABLE 5.2 Estimated annual burden of work-related fatal injuries in New Zealand, excluding bystanders and suicides

	ANNUAL NUMBER OF WORK-RELATED FATAL INJURIES (EXCLUDING TRAFFIC)	ANNUAL NUMBER OF WORK-RELATED FATAL TRAFFIC INJURIES	PROPORTION WORKING/COMMUTING OF THE ANNUAL NUMBER OF WORK-RELATED TRAFFIC INJURIES	TOTAL ANNUAL NUMBER OF WORK-RELATED FATAL INJURIES	ANNUAL RATE OF WORK-RELATED FATAL INJURIES (EXCLUDING TRAFFIC) (PER 100,000)	ANNUAL RATE OF WORK-RELATED FATAL TRAFFIC INJURIES (PER 100,000)	PROPORTION WORKING/COMMUTING OF THE ANNUAL RATE OF WORK-RELATED TRAFFIC INJURIES (PER 100,000)	TOTAL ANNUAL RATE OF WORK-RELATED FATAL INJURIES (PER 100,000)
Total	**74**	**31**	**(17/14)**	**105**	**5.0**	**2.0**	**(1.1/0.9)**	**7.0**
By sex								
Male	72	27	(16/11)	99	8.6	~3.2	~(1.9/1.3)	11.8
Female	2	4	(1/3)	6	0.3	~0.6	~(0.2/0.4)	0.9
By industry[43]								
Agriculture, forestry and fishing	33.7	5	(2/3)	39	22.5	2.6	(1.1/1.6)	25.1
Mining	2.6	0	(0/0)	3	51.3	-	-	51.3
Manufacturing	6.7	4	(1/3)	11	2.5	1.2	(0.2/1.0)	3.7
Electricity, gas and water supply	1.2	1	(1/0)	2	8.7	4.1	(4.1/ --)	12.8
Construction	10.4	3	(2/1)	13	11.1	2.7	(1.8/0.8)	13.8
Wholesale trade	0.4	1	(1/0)	1	0.5	0.5	(0.4/0.1)	1.0
Retail trade	2.1	2	(1/1)	4	1.2	1.1	(0.6/0.5)	2.3
Accommodation, cafes and restaurants	0.5	1	(0/1)	2	0.9	1.2	(-- /1.2)	2.1
Transport and storage	6.7	9	(8/1)	16	9.6	10.9	(10.1/0.8)	20.5
Communication services	-	1	(1/0)	1	-	4.9	(3.8/1.1)	4.9
Property and business services	1.2	1	(0/1)	2	1.0	0.7	(0.2/0.5)	1.8
Government administration and defence	2.5	1	(0/1)	3	4.1	1.3	(0.7/0.6)	4.4
Education	-	1	(0/1)	1	-	0.6	(0.2/0.5)	0.6
Health, community services	-	1	(0/1)	1	-	0.9	(0.3/0.6)	0.9
Cultural and recreational services	1.8	0	(0/0)	2	6.2	2.1	(1.2/0.9)	8.3
Personal and other services	2.1	0	(0/0)	2	3.3	1.3	(0.8/0.6)	4.6
Not specified	2.0			2	-	-	-	-
By cause of death								
E919 – Accidents caused by machinery	17.0							
E830-8 – Water transport accidents	10.0							
E916 – Struck accidentally by falling object	9.6							
E880-8 – Accidental falls	6.7							
E840-5 – Air and space transport accidents	6.3							
E820-5 – Motor vehicle non-traffic accidents	4.6							
E925 – Accident caused by electric current	2.8							
E960-9 – Homicide and injury purposely inflicted by others	2.7							
E910-5 – Accidents caused by submersion, suffocation and foreign bodies	2.1							
E900-9 – Accidents due to natural and environmental factors	1.7							
E800-7 – Railway accidents	1.4							
Other	6.0							
Not specified	2.7							

Discussion

Other published sources provide further information about work-related fatal injury in New Zealand. The WRFIS is to date the only comprehensive source of information on work-related fatal injuries excluding traffic incidents. Of the agencies responsible for recording work-related fatal injuries:

- ACC was estimated to have the best coverage, although it was only 63%
- OSH had an estimated coverage of 40%
- other agencies had an estimated coverage of 10%[549].

All agencies combined had an estimated coverage of 73%, with agriculture, forestry and fishing having the worst.

The annual rates of work-related fatal injuries have changed over time:

- between 1975 and 1994 there was a steady downward trend in work-related fatal injuries excluding traffic incidents[547]
- the rate for 1985-1994 was 30% lower than the rate in 1975-1984. Changes in occupation and industry distribution were thought to account for more than three-quarters of this decline[547]
- among individual industries, the rate declined between the two periods, with the greatest reductions in the high-risk mining, construction and transport, storage and communication sectors. Agriculture, hunting, forestry and fishing showed only about half the decrease of other high-risk industries. The risk increased in the finance, insurance, real estate and business service sectors, although this involved only a small number of cases[547]
- between 1985 and 1998 there were no particular trends observed in the annual rate of work-related fatal traffic injuries[548].

5.4 INCIDENCE OF WORK-RELATED DISEASE IN NEW ZEALAND

Key messages

- There are an estimated 17,000-20,000 new cases of work-related disease in New Zealand every year.
- There are an estimated 2,500-5,500 new severe cases of work-related disease in New Zealand every year.
- Around 75% of these diseases occur in men.
- The most common occupation-related diseases are musculoskeletal disease, followed by diseases of the ear, skin disorders, chronic respiratory disease, diseases of the digestive system and cancer.

This section estimates the number of new cases of work-related disease in New Zealand every year. Note the total estimate is likely to be imprecise because it depends largely on which diseases are included.

Methods

The estimate was reached using three methods:

1. ACC claims for work-related illness/injury, reported in *Injury Statistics 2001/2002. Work-related injuries*[475].
2. The 1993 age-sex-disease-specific incidence rates of occupational disease in Finland[543].
3. An AF method (to estimate the annual burden of occupational cancer).

1. ACC claims

ACC cover does not include diseases with multiple potential causes not necessarily related to work, such as cancer and chronic respiratory disease. This means that in terms of ACC data, these diseases are under-reported.

This under-report was studied using method 2, where Finnish rates of work-related disease were used to estimate the incidence of work-related disease in New Zealand. However, the Finnish rates are also likely to represent an under-estimate, especially for cancer. For that reason the third estimation method was used, where the incidence of work-related cancer was calculated using an AF method as also used in the estimation of work-related disease mortality.

In 2001/2, 15% of total claims to ACC for work-related illness/disease resulted in weekly compensation payments and the worker taking more than five days off work[475]. This indicates the severity of occupational disease.

2. Finnish information

Estimation method 2 used the number of new cases per year from the age-sex-disease-specific incidence rates of occupational disease in Finland for 1993[(543)]. For asthma we used Finnish data covering 1989-95[561].

These data are considered the best defined, with a distribution similar to that of the other Scandinavian countries (Leigh et al[543]). Leigh et al also used the same rates to estimate the burden of disease for other established market economies.

The Finnish rates represent only those diseases reported by physicians and/or insurance companies to the "Finnish Register of Occupational Diseases". All employees and farmers are covered by the system. A threshold of at least five days' lost time was assumed. However, as the register only covers reported diseases, these rates

are likely to be under-estimates, especially for diseases with potential multiple causes (e.g. cancer). Also, many occupational diseases are not included in the list (e.g. coronary heart disease and infectious diseases).

The approach adopted here uses New Zealand population counts from 1999, extracted from the World Health Organization (age 15-44 years, 838,300 males and 857,700 females; age 45-59 years, 321,500 males and 322,200 females; age 60+ years, 260,600 males and 319,800 females). The rates given by Leigh et al were multiplied by the New Zealand population counts for each age-/sex-/disease stratum. Because the Finnish rates for occupational asthma were expressed per 100,000 working population, we multiplied the sex- and age-specific Finnish annual incidence rate of occupational asthma[561] with the New Zealand working population data for 1999-2000 (age 20-44, 564,000 males and 473,400 females; age 45-64, 315,100 males and 254,300 females).

3. The AF method for cancer

The AF method was used to estimate the annual burden of occupational cancer. It used the same AFs as in Section 5.2 (mortality due to work-related disease in New Zealand), assuming that the AF for cancer incidence is the same as that for cancer mortality.

The average incidence of cancer in people aged 30 years and over in 1999 was extracted from *Cancer New Registrations and Deaths 1999*[551]. As in Section 2, two lists, List A and List A+B, of occupational cancers were developed:

- List A is the list of cancers associated with occupation as used in Steenland et al[2]
- List A+B is the list used by Nurminen et al[1], including causes of death for which the occupational link is less established.

The total number of ACC claims for occupational diseases was taken as a lower-bound estimate for the annual rate of new occupational diseases in New Zealand. This lower-bound estimate plus the highest estimate of methods 2 and 3 were used as the upper-bound estimate, assuming that methods 2 and 3 would give better estimates for those diseases for which ACC claims would represent an under-report.

TABLE 5.3 Estimated annual burden of work-related disease incidence in New Zealand, using different methods

	METHOD 1		METHOD 2	METHOD 3		ESTIMATE INTEGRATING METHODS 1, 2 AND 3***	
	NUMBER OF ACC CLAIMS FOR WORK-RELATED ILLNESS OR DISEASE 2001/2[275]	(RESULTING IN WEEKLY COMPENSATION PAYMENTS AND THEREFORE REPRESENTING SEVERE CASES)	ESTIMATE USING FINNISH OCCUPATIONAL DISEASE RATES APPLIED TO THE NEW ZEALAND POPULATION COUNTS (AGE 15 OR OLDER)[143]	ATTRIBUTABLE FRACTION METHOD USING LIST A (LOWER-BOUND ESTIMATE FOR CANCER)	ATTRIBUTABLE FRACTION METHOD USING LIST A+B (UPPER-BOUND ESTIMATE FOR CANCER)	LOWER-BOUND ESTIMATE REPRESENTED BY NUMBER OF ACC CLAIMS FOR WORK-RELATED ILLNESS OR DISEASE	UPPER-BOUND ESTIMATE REPRESENTED BY THE HIGHEST OF THE LOWER-BOUND ESTIMATE AND THE ESTIMATE OF METHODS 2 AND 3
Total	**17,541**	**(2,609)**	**5,464**			**17,541**	**>20,250**
By sex							
Male	13,184	(1,989)	3,720	388	653	13,184	>15,278
Female	4,357	(620)	1,744	37	120	4,357	>4,974
By disease							
Disease of the eye	316	(9)				316	316
Diseases of digestive system	1,098	(397)				1,098	1,098
Pneumoconiosis	n.a.	n.a.	269			-	269
Chronic respiratory disease	n.a.	n.a.	1,564			-	1,565
Musculoskeletal	*10,413	(2,006)	1,446			10,413	10,413
Cancer	4	(2)	134	325	773	4	773
Mental disorders	n.a.	n.a.	166			-	166
Poisoning	223	(5)	74			223	223
Skin disorders	1,792	(113)	653			1,792	1,792
Diseases of ear and mastoid process	3,354	-	**958			3,354	3,354
Other diseases	341	(82)				341	-
Coronary heart disease	n.a.	n.a.		n.a.	n.a.	n.a.	n.a.
Infectious disease	n.a.	n.a.		n.a.	n.a.	n.a.	n.a.
Asthma	n.a.	n.a.	****281	n.a.	n.a.	n.a.	281

**of which 35% are occupational overuse conditions*
*** only noise-induced hearing loss*
**** to estimate severe cases: for the lower-bound estimate column {2} is taken. For the upper-bound, the highest of the lower-bound estimate and the estimate of methods 2 and 3 is used*
***** covering age 20-64*[561]
n.a.: not available

Findings

- There are an estimated 17,000-20,000 new cases of work-related disease in New Zealand every year.
- Of all cancer cases in people age 30 or older, 2%-5% are estimated to be work related (325 and 773 of 16,294).
- For men this is estimated to be 3%-8% (228-653 of 8,681).
- For women this is estimated to be 0.5%-1.5% (37-120 of 7,613).

Discussion

This total estimate depends largely on the diseases included.

For most diseases, estimates are directly taken from ACC claim statistics, which only include diseases for which ACC received and accepted claims – a likely under-report. The Finnish estimates (method 2) are also likely to represent an under-report, given that only occupational diseases reported by physicians and/or insurance companies are considered. This is illustrated by the low Finnish estimate for work-related cancer incidence (134), compared with the AF estimates of 325-773.

With no data available on the incidence of coronary heart disease and asthma, the AF method could not be used to estimate the number of cases attributable to occupation. Including these diseases would have resulted in a considerably higher estimate.

5.5 INCIDENCE OF WORK-RELATED INJURY IN NEW ZEALAND

- 200,000 occupational injuries result in an ACC claim in New Zealand every year.
- This corresponds to 12 injuries per 100 workers.
- An estimated half of the injuries result in disability, and 6% in permanent disability.
- 74% of the work-related injuries occur in male workers.
- The highest number of work-related injuries occur in the manufacturing industry.
- The mining, agriculture, forestry and fishing, and construction industries have the highest injury rates.

This section estimates the number of work-related injuries occurring each year.

Methods

The main information source for this estimate is the Statistics New Zealand report *Injury Statistics 2001/2002. Work-Related Injuries*[477]. It provides:

- the total work-related injuries that happened between 1 July 2001 and 30 June 2002, and for which ACC received and accepted a claim
- the number of work-related injuries by industry
- the incidence rates (i.e. the number of injuries per 1,000 full-time-equivalent employees (FTEs), as estimated by the Household Labour Force Survey).

The number of work-related injuries by resulting disability are not based on New Zealand data, but are calculated using the disability percentages recorded for the United States[536]. The best New Zealand (although indirect) measure of ongoing disablement associated with injury is the number of people who are long-term ACC entitlement claimants[477].

TABLE 5.4 Estimated annual burden of work-related injuries in New Zealand, excluding bystanders and suicides

(SEE FOOTNOTES FOR DETAILS)	ANNUAL NUMBER OF WORK-RELATED INJURIES THAT RESULTED IN AN ACC CLAIM	ANNUAL RATE OF WORK-RELATED INJURIES (EXCLUDING TRAFFIC) (PER 100 WORKERS)
All	**207,097**	**12.0**
By sex		
Men	153,936	16.3
Women	53,161	6.8
By industry[1]		
Agriculture, forestry and fishing	28,641	19.0
Mining	837	22.6
Manufacturing	47,462	16.6
Electricity, gas and water supply	1,072	10.9
Construction	21,227	19.5
Wholesale and retail trade	26,288	8.6
Accommodation, cafes and restaurants	6,490	8.2
Transport and storage	9,969	14.3
Communication services	2,613	7.6
Finance and insurance	1,307	2.4
Property and business services	10,236	5.6
Education	7,652	6.1
Health, community services	9,788	7.6
Other services	14,602	7.8
Not specified	41,305	
By type of injury		
Sprains and strains	89,750	.
Open wounds	37,674	.
Contusions	19,785	.
Foreign bodies in eyes	12,348	.
More than one type of injury	11,358	.
Fractures	8,019	.
Muscle and tendon injuries	7,047	.
Burns	4,682	.
Other and unspecified injuries	4,283	.
Superficial injuries	3,919	.
Crushing injuries	2,391	.
Eye and orbital injuries	2,228	.
Nerve injuries	1,281	.
Dislocations	963	.
Intracranial injuries	708	.
Traumatic amputations	231	.
Poisoning and toxic effects	223	.
Foreign bodies in ears	71	.
Electrical injuries	61	.
Foreign bodies in other places	45	.
Injury to internal organs	22	.
Injury to blood vessels	8	.
By disability[2]		
No disability	111,832	.
Temporary disability	83,185	.
Permanent partial disability	11,908	.
Permanent total disability	171	.

1: In Injury Statistics 2001/2002. Work-Related Injuries[477] *the claims by industry also include some claims for work-related diseases. The total number of claims when adding up all industries, is therefore about 7% higher than the total of 207,097 claims for work-related injury*

2: Based on US disability rates

Findings

Every year, 207,097 occupational injuries result in ACC claims in New Zealand. Of these injuries, 74% occur in men. Sprains and strains are by far the most frequent injury (90,000 claims), followed by open wounds (37,000 claims). Manufacturing is the industry in which most injuries occur, followed by agriculture/forestry/fishing and wholesale/retail trade. The industry with most injuries per 100,000 workers is mining, followed by agriculture/forestry/fishing and manufacturing. Extrapolating disability rates from the United States, we would expect that about half of the reported injuries do not result in disability. Each year, about 12,000 injuries may result in either partial (n = 11,900) or total (n = 170) permanent disability.

Unfortunately, this estimate cannot be compared with the total number of injuries (work-related and non work-related), as New Zealand's non-fatal injury statistics are only available for counts of injury hospitalisations (stays in hospital of at least one day). The ACC data for work-related injuries used here provides no information on whether injured workers were hospitalised[477].

Discussion

The estimates are based on work-related injuries that happened between 1 July 2001 and 30 June 2002, and for which ACC received and accepted a claim. No national study has estimated the amount of under-report.

These figures are likely to represent an under-report owing to the following factors:

- 14% of the workforce works for companies that have joined the "ACC Partnership Programme", where employers take responsibility for the cost and management of injured employees for a nominated period of one to five years. These "accredited employer" claims are not reported to ACC[477].
- While the ACC claim forms have a field to identify whether an incident is work-related, it is not considered reliable[477].
- Injuries sustained while travelling are included only when travelling to or from work in transport provided by the employer, or when travelling from work to receive treatment for a work-related injury[477]. This means most injuries from traffic incidents when commuting are not included. Work-related traffic fatalities account for 5.3% of all road fatalities. When extrapolating this percentage to non-fatal traffic injuries it is, however, unlikely that a substantial part (≥1%) of all work-related injuries are from traffic incidents while commuting (in contrast to fatal work-related injuries).
- 14,724 work-related injuries treated solely in a hospital accident and emergency department and/or by admission in the hospital were not included in the available information[477].

There is also a quantified source of over-report, in that 7% of reported injuries are actually work-related disease rather than work-related injury[477]. This only applies to the industry-specific number of injuries reported here, and not to the total sex-specific and type-specific number of injuries.

In conclusion, reported estimates are an under-report of the total number of work-related injuries occurring every year in New Zealand. It is currently not possible to quantify the under-report.

Some studies have considered the number of non-fatal injuries in specific sectors, mainly agriculture. These studies are likely to suffer less from under-reporting than ACC claims. For example, a telephone survey of a random sample of 919 farmers revealed that 308 injuries per 1,000 farmers occurred every year[552]. This is 30% higher than the 205 per 1,000 New Zealand farmers with an ACC injury claim, suggesting there may be a 30% under-report for injuries in farming.

Statistics New Zealand has published statistics on work-related injuries for the years 2000/1 and 2001/2[477]. These reveal a 0.7% increase in the absolute number of claims made to ACC (from 227,894 to 229,489) but a drop in the incidence rate from 144 per 1,000 FTEs to 141 per 1,000 FTEs (males 184 to 180; females 87 to 87).

Although data for 1999/2000 is available and has previously been published, it is now thought to be less reliable than that for the succeeding years and can therefore not be used to study time trends.

SECTION SIX

LESSONS FOR

SURVEILLANCE

AND RESEARCH

6

6.1 OVERVIEW OF TYPE AND YEAR OF PUBLICATION OF ARTICLES

Introduction

The basis of this report is the published literature relevant to work-related disease and injury in New Zealand. The focus was articles published from 1984 onwards, with all articles included if published up to and including June 2004 (2004 references were only included if they were already accessible via standard literature databases). Articles were included if the focus of the article was New Zealand, or New Zealand data were included in the data set on which the paper was based (as occurred with some international collaborative studies).

The body of the report is based on a detailed analysis of these articles. However, there is also benefit to be gained by a high-level content analysis of the articles. This can help to identify the areas well covered and poorly covered by research activity, and allows an assessment of changes in research activity over time.

Approach used

Government reports were not included in this total. A high-level content analysis of the papers was performed to provide an insight into the areas that were the focus of research interest and to monitor the intensity of research activity in New Zealand in the last two decades.

The papers were categorised as original studies (involving data collection and analysis), letters to the editor published in a journal, review articles, opinion articles (covering areas such as approaches to coding or surveillance of work-related disorders), and case reports. Each article was classified as being focused on injury, disease, both or on a more general topic related to injury or disease. They were separately classified as to whether the focus was on injury or disease, on exposures, on prevention or on ACC or other aspects of compensation directly related to an injury or disease. Articles focused only on legal aspects or on the overall design of ACC were not included. Articles focusing on disease were categorised as to the disorder that was the focus of the study. Injury articles were categorised as to whether they were focused on fatal, non-fatal or all injuries. Finally, the year of publication was coded. This allowed an assessment of research activity over time. The assessment is focused on the research activity rather than the period of time being considered, as it is based on the year of publication rather than the year(s) that was covered by the study.

Other aspects of the publications could also have been examined (such as sex, ethnicity and age), but the aspects that have been included in the presented analysis appeared to be the ones that would prove the most useful.

Findings

There were 246 articles that met the criteria (i.e. published from 1984 onwards and focused on New Zealand and/or including New Zealand data) published in the general peer-reviewed literature in the last 20 years. Seventy-one per cent of these were focused on disease, 20% on injury, 7% on both disease and injury and 2% were focused on general topics relevant to disease and injury.

Seventy-four per cent of the articles were original studies, 18% letters to the editor, 4% review articles, 3% opinion articles and 1% case reports. This percentage breakdown was similar between disease and injury articles.

Disease and injury

The number of articles varied considerably over time, with peaks in the late 1980s and around 2000 and 2001 (Figure 6.1). Not surprisingly, given the much higher number of disease articles compared to injury articles, these peaks were dominated by disease publications. However, injury publications were most common around the time

of the disease publication peaks. Disease publications were much more common than injury publications for all years except 1990 (Figure 6.2).

Exposures relevant to disease and injury were the main focus of 10% of the publications, with ACC the focus of 9% and prevention the focus of 6%.

FIGURE 6.1 New Zealand publications on work-related disease and injury. January 1984 to June 2004. By year

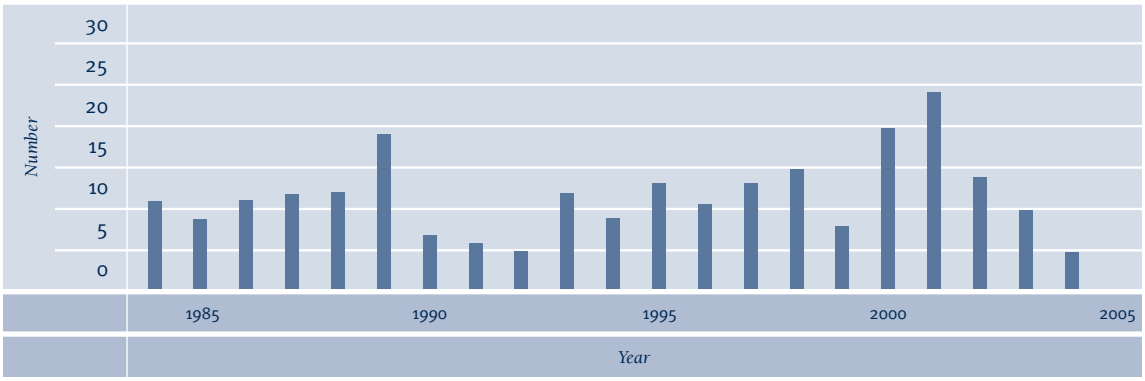
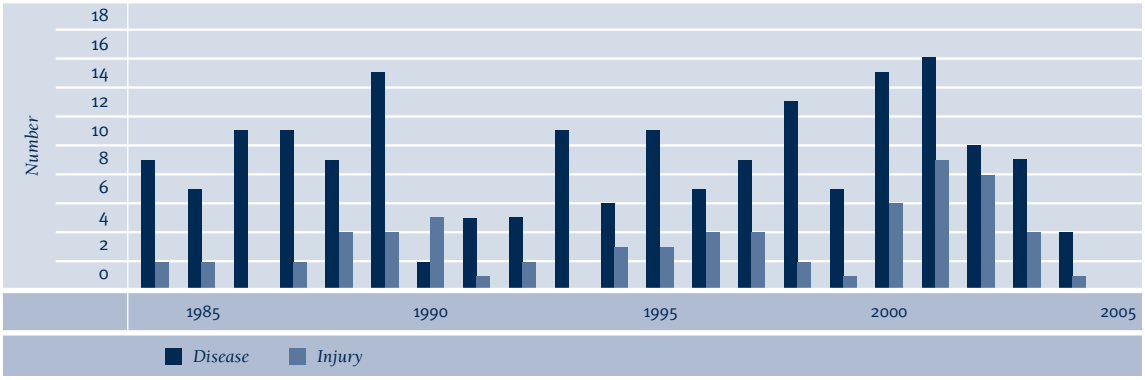


FIGURE 6.2 New Zealand publications on work-related disease and injury. January 1984 to June 2004. Injury versus disease by year



Disease

The main topics covered in disease publications were cancer, infection, respiratory diseases, general topics (i.e. more than one disease) and chemical poisoning. Other topics relevant to occupational disease were the subject of limited research activity (Table 6.1).

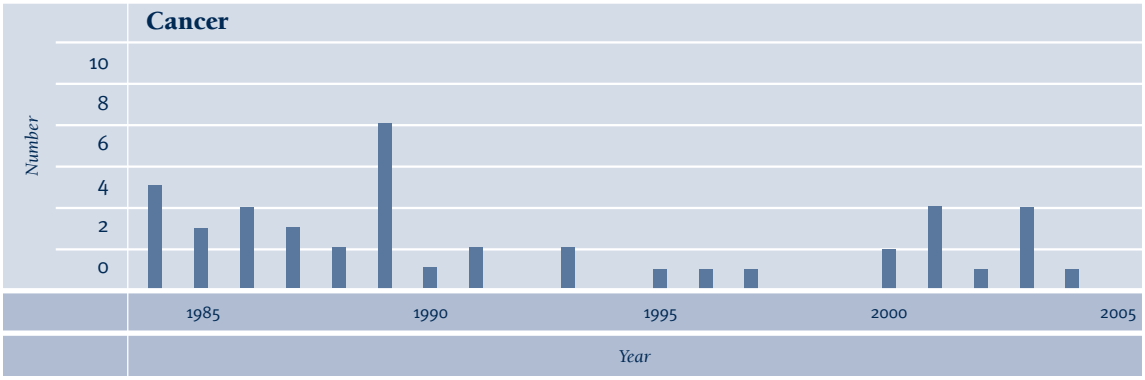
TABLE 6.1 New Zealand publications on work-related disease. January 1984 to June 2004. By topic

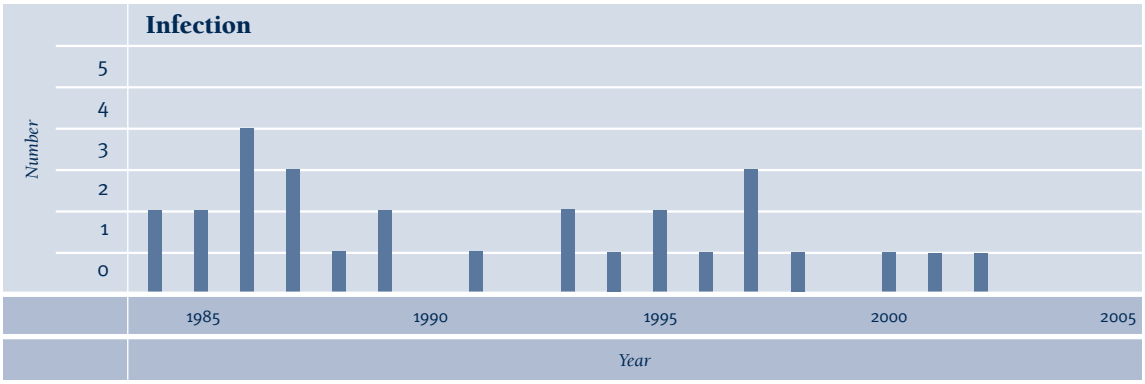
DISEASE	NUMBER	PER CENT
Cancer	45	23.4
Infection	28	14.6
Respiratory	27	14.1
General	22	11.5
Musculoskeletal	21	10.9
Chemical poisoning	15	7.8
Psychiatric	7	3.7
Skin	7	3.7
Environmental tobacco smoke	7	3.7
Neurology	3	1.6
Noise-induced hearing loss	3	1.6
Shift work	2	1.0
Job strain	2	1.0
Vascular	1	1.0
Vibration	1	1.0
Structural change	1	1.0
Total	**192**	**100.0**

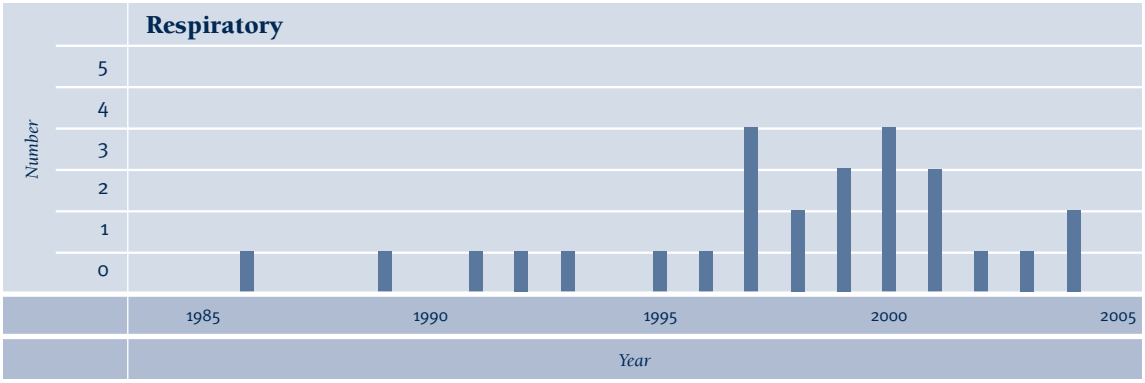
The focus of the research changed considerably over time. Just over half the cancer publications were published before 1990, and another 22% from 2000 onwards. Publications on infection also were most common in the 1980s, with 50% published before 1990, and publications fairly evenly spread since then. In contrast, respiratory publications have been more recent, with 52% published since 1998. Musculoskeletal publications were more common in the 1990s, with 62% of the musculoskeletal publications occurring in the eight years from 1993 to 2000. Chemical publications were spread throughout the two decades (Figure 6.3).

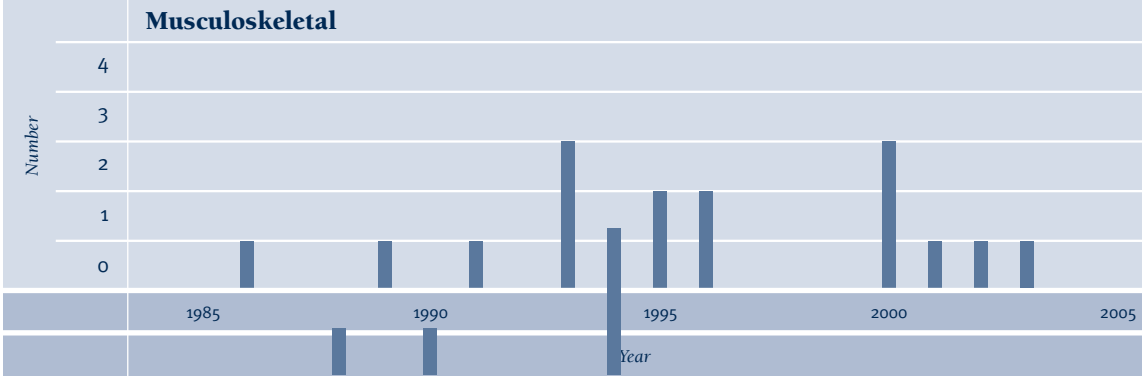
Exposures relevant to disease were the main focus of 11% of the disease publications, with ACC the focus of 10% and prevention the focus of only 3%.

FIGURE 6.3 New Zealand publications on work-related disease and injury. January 1984 to June 2004. Topic by year for selected topics





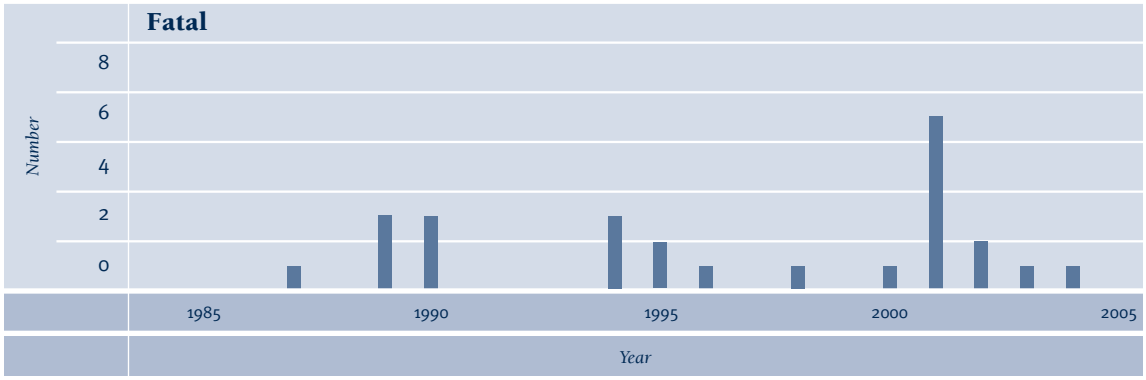


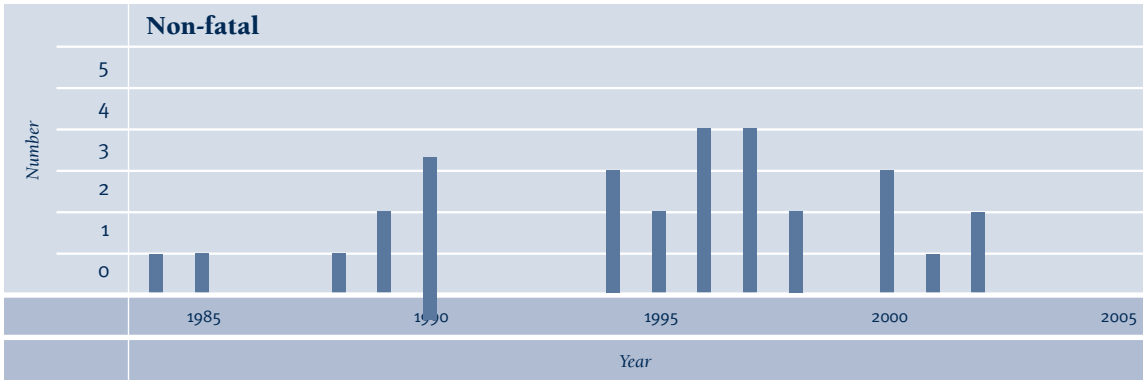


Injury

Of the publications focused on injury, 32% considered fatal injury, 41% considered non-fatal injury, and 27% considered both types of injury. Fatal injury publications were clustered from 1989 to 1995 and around 2001. These years coincide approximately with the years following the completion of the two major fatalities studies in New Zealand (1987 and 2001). Non-fatal injury publications were spread more evenly, but were more common in the 1990s (Figure 6.4).

FIGURE 6.4 New Zealand publications on work-related injury. January 1984 to June 2004. Fatal versus non-fatal by year





6.2 LACK OF INFORMATION ON EXPOSURES

There was little information available on occupational exposures in New Zealand, and the information that was available was rarely comprehensive. Information was available on environmental tobacco smoke, lead and levels of shift work. In addition, routine data collections provide information on the number of persons employed in particular occupations and industries, which can serve as proxy measures of various exposures. However, an increased focus on exposures seems appropriate, especially given the problems raised by diseases of long latency, which comprise many work-related disorders of concern in New Zealand (and elsewhere).

6.3 LACK OF INFORMATION ON GENDER

The vast majority of published research presented information only, or predominantly, on males. The stated reason for this was usually that there was an insufficient number of female cases. This is a common issue in occupational health and safety research. For many conditions, it could be expected that the relative risks for males and females would be the same, as sex would not as a rule be expected to modify the relationship between exposure and disease. There are exceptions to this, of course. In addition, the absolute risk for many conditions can be expected to be different for males and females because the level and type of exposure are different. This leads to different values of occupational population attributable risk for males and females for many disorders. Another important factor to take into account is that the nature and extent of the involvement of women in the workforce are probably changing to a greater extent than men, so the disorders of which they are at risk, and the associated risks, are probably changing more than they are for men[141, 532]. Given those factors, and accepting that for some occupational exposures and conditions the number of women affected is (fortunately) very small, an increased focus in occupational health and safety research on specific problems of women, as well as attempting as much as possible to include women as subjects, and include their data in the presented analysis, would be beneficial.

6.4 LACK OF INFORMATION ON ETHNICITY

There is also a lack of detailed information regarding ethnicity in much of the published research. The reasons for this are similar to those covered earlier for women. The issues are also similar, because Māori and Pacific Islanders have different employment distributions from Europeans, and so can be expected to have different exposures and risks, if not necessarily different relative risks, for many disorders.

6.5 LACK OF INFORMATION ON BYSTANDERS

There was very little New Zealand information on work-related effects on bystanders, persons who are not working but sustain injury or disease as a result of exposure to occupational hazards. Bystanders are considered in a few publications that focused on fatal injury, and are included by implication in some of the information on malignant mesothelioma. However, overall, the research made little reference to bystanders. Bystanders are an important group to consider, especially in some specific work situations such as farming, where there is frequent overlap between the occupational and non-occupational environment and where children are often affected; and on the roads, where there appears to be a high number of deaths (and so presumably also non-fatal injury) each year as a result of traffic crashes involving working persons and non-working persons.

6.6 DIFFICULTY ACCESSING AVAILABLE INFORMATION ON FATAL WORK-RELATED INJURY

The authors of the two major studies on work-related fatal injuries in New Zealand were forced to conduct labour-intensive searches of paper records in order to obtain the required information. Cases could not be identified as being work related without accessing and reading the file. This meant that the research was expensive to conduct and that a considerable period of time elapsed between the period covered by the study and when the research results became available. Most of this information was in Coroners' records.

Two factors would greatly improve the situation. A first step would be to add a work-related "flag" to the deaths' data collection information, an approach already advocated for New Zealand[449]. This would eliminate thousands of Coroners' files from consideration. However, this would require the Coroner to make a formal finding regarding work relatedness.

Secondly, the availability of the information in Coroners' files in electronic form would greatly improve the efficiency of obtaining the information and probably also significantly improve the effectiveness of the research based on Coroners' information. This problem is common to most countries, but the recent establishment of the National Coroners Information System in Australia provides an example of how an electronic system could be established and function[553].

Other approaches to fatal injury surveillance, issues related to broader occupational injury surveillance, in New Zealand have been considered elsewhere[549, 554, 555].

6.7 SURVEILLANCE OF EXPOSURES VERSUS OUTCOMES

Surveillance is "...the ongoing, systematic collection, analysis, interpretation, and dissemination of data regarding a health-related event for use in public health action to reduce morbidity and mortality and to improve health"[556, 557]. In a work-related context, surveillance involves monitoring data on exposures and disorders (injuries and diseases) with the aim of minimising the number and rate of such disorders. Surveillance is often also used to identify and monitor trends over time[558].

Virtually all the available published information on occupational disorders in New Zealand covered outcomes rather than exposures. This raises important issues in terms of surveillance, particularly for work-related diseases. For many work-related diseases, there is a considerable period of time (latency) between exposure and the onset clinical disease. Diseases identified now reflect exposures that occurred in the past, sometimes many years in the past. Studying these diseases can help to identify that harmful exposures have occurred, but in the meantime such exposures may have continued, resulting in more health problems that will become manifest in the future. This is particularly a problem for diseases of long latency, such as most cancers and other conditions such as COPD, pneumoconioses, cardiovascular disease and noise-induced hearing loss.

If the connection between exposure and disease is not known, this situation is hard to avoid. It is appropriate in such circumstances to study the health outcomes of cohorts of workers with known exposures, or study the exposures of persons with known health outcomes. However, when the exposure-disease connection is known, it makes more sense to monitor exposures, and to attempt to minimise or eliminate exposures that are known or suspected to be harmful.

In New Zealand, NODS[16, 44] is an attempt to monitor the more important occupational conditions, but it does not monitor exposures in an ongoing manner. Other examples of occupational health surveillance in New Zealand have been published[559, 560].

6.8 COST INFORMATION

There was very little information available on costs. What information that was available came from ACC, from individual publications and from ad-hoc sources referred to in individual publications. A meaningful assessment of costs arising from occupational health and safety issues can be very difficult to make. The factors to take into account, and the dollar value applied to those factors, is open to wide debate, and global assessments can produce enormous assessments that provide some initial shock value but may not necessarily serve to prioritise activities. Nevertheless, such assessments have been attempted in other countries and, if nothing else, they can serve to focus decision-makers on the size and scope of the problem[536-541]. Even better is cost-effectiveness information[542]. A greater emphasis on research regarding costs in occupational health and safety, particularly using a cost-benefit approach, might be an appropriate response to the current dearth of such activity.

SECTION SEVEN

LESSONS FOR

PREVENTION

7

7.1 EVALUATION

Few (only about 6%) of the New Zealand publications were focused directly on prevention. That is, most papers were focused on describing the nature and extent of problems, and the absolute and relative risks associated with these, but did not specifically examine or test approaches to preventing the exposures or the occurrence of injury or disease. This step of describing the problem, and assessing the absolute and relative importance of the problem, is a necessary step in order for appropriate interventions and prevention activity to be planned, implemented and evaluated. In addition, some of the papers made suggestions regarding what interventions might be appropriate based on the study findings. However, this current focus of research activity appears to be to the exclusion of research examining interventions.

The lack of rigorous evaluation of occupational health and safety prevention programmes is not unusual. In fact, it is not uncommon in most areas of public health. There are many reasons for this. These include lack of recognition of the need for evaluation, lack of funds set aside in intervention projects to conduct proper evaluations, difficulty identifying appropriate methods under which the evaluation could be conducted, and lack of appropriate baseline data that can be used for comparison.

It is important that prevention programmes be properly trialled and evaluated, so that useful measures are implemented more widely, and measures that are not useful are not continued.

7.2 SURVEILLANCE INFORMATION

The earlier discussion about diseases of long latency and the difficulties these raise for recognising emerging and continuing problems is important when considering prevention activity. Monitoring of outcomes (diseases and injuries) remains important, but a comprehensive prevention campaign needs to be informed by surveillance methods aimed at identifying problems as early as possible. This reinforces the potential value of monitoring exposures in some form.

7.3 EARLY INTERVENTION

The findings of the New Zealand-based research reinforce the need to intervene as early as possible when there are work-related hazards that raise significant risk of injury or disease. This is particularly the case for diseases with prolonged latency.

SECTION EIGHT

SUMMARY AND CONCLUSIONS

8

This report summarises what is known about work-related disorders in New Zealand, based on published literature. For each disorder, New Zealand-based information on exposures and relative or absolute risks was sought.

Little information was available for the vast majority of exposures of interest.

There is a particular lack of information on work-related morbidity and mortality in women, Māori, and Pacific people, and on work-related injuries and diseases sustained by bystanders.

Bearing these limitations of the data in mind, it is clear that work-related disease and injury is responsible for considerable morbidity and mortality in New Zealand. For mortality, disease represents a considerably greater (ten-fold) burden than does injury; about one third of the work-related deaths are due to cancer, and substantial proportions are due to respiratory disease and ischaemic heart disease. On the other hand, work-related accidents and injuries represent a greater burden of morbidity. Therefore a balanced approach is required in which both the prevention of work-related disease and the prevention of work-related injury receive appropriate attention and resources.

SECTION NINE

INDEX TO

EXPOSURES

AND OCCUPATIONS

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T

U

V

W

X

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SECTION TEN

REFERENCES

10

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