The Australian Injury Research Collaboration: Workplace Injury in the Mining Industry

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In 1995-96, the estimated cost of injury in Australia attributable to all causes was in excess of $13,304.824 million (NISU, 2001). Of this total, over half of the costs were associated with 15-64 year age groups. Significant health costs are also attributable to injury, accounting for approximately eight per cent of the total direct costs of all diseases annually. In 1993-94 the direct cost of injuries to the health sector was around $2.6 billion. This compares to the total direct cost for cancer of $1.4 billion for the same period (Australian Department of Health and Aged Care, 2001). Injury mechanisms include, but are not exclusive to falls, burns, and asphyxiation, drowning, crushing, or being hit, struck or collided with. Injury is therefore a crucial issue at all stages in the lifespan, with different issues associated with different age groups. Consequently, interventions and investigations must be targeted to specific populations and their associated age groups.

In 1997, injury prevention and control was identified as one of the six National Health Priority Areas (Australian Department of Health and Aged Care, 2001). The other areas chosen were cancer control, mental health, cardiovascular health, diabetes mellitus, and asthma. These areas were selected because they present a high health burden to the community, and offer the potential to achieve significant health gains for the community. In 2000, the Australian Federal Minister for Health outlined an initiative aimed at developing a coordinated approach to injury prevention research in Australia. The Minister also announced funding over a 5-year period by the National Health and Medical Research Council (NH&MRC) towards the support of an all-age, all-injury national research collaboration. Five core partners representing Universities and Industry also contribute to the funding of the research partnership called the Australian Injury Research Collaboration (AIRC). The AIRC is a Health Research Partnership in Injury. The AIRC proposes to facilitate the examination of injury from a multidisciplinary perspective providing a comprehensive, research-based solution to the public health problem of injury. A major objective of the partnership is to identify cost-effective population level intervention programs in five priority injury areas: childhood falls; poisoning and drowning; young adults risk taking behaviour; workplace injury; falls in older persons; and injury among indigenous people. Combining these areas within the consortium, provides considerable potential for cross-fertilisation of ideas between researchers and industry partners, development of comprehensive data sets and transferability of this data.

The AIRC aims to provide a more coordinated approach to injury research to avoid the fragmentation which currently exists. This will involve: collation of existing evidence to form a platform for targeted research activity; establishing decision support systems to allow development, monitoring and evaluation of comprehensive interventions in terms of population health outcomes; and coordination of basic and applied research projects, to inform the intervention programs conducted at the population level.

The focus of the workplace research program of the AIRC is the mining industry. Mining was selected because it is a high risk 24-hour industry that despite considerable improvement in injury rates over the last few years still has significant injury problems, particularly in terms of fatalities. Furthermore, previous research has shown that the balance of environmental and behavioural factors leading to injury is, despite some unique exceptions, not very different in mining compared to other industry sectors such as manufacturing.

Major issues to be addressed include fatigue and stress; contract working versus permanent employee arrangements; ageing workforce and health and safety; and sprain and strain injury. The setting for such research activities will be the Queensland and New South Wales mining industry.

The cost of injury in mining

In 1998-99, the direct workers' compensation cost of injury to the mining industry was $27,846 461. This is a preliminary figure however, and will increase over time. It has been estimated that the indirect costs to the employer such as loss of productivity, incident investigation, rehabilitation, damage to equipment and so on can double the cost of claims. The total cost of injury to the minerals industry therefore would have been in excess of $55 million for 1998-99.

In 1999-2000, 2,294 injuries occurred that required at least one full shift's absence. An injury that resulted in a minimum of one full shift's absence defines a lost time injury (LTI). For each of these injuries, an average of 18 days absence was recorded. A declining trend in the number of LTIs and the frequency rate has been a feature of injuries in mining since 1990. In 1990-91, the industry reported 9,075 lost time injuries, whereas in 1999-2000, only 2,294 injuries were reported.

Although the financial cost of injury in the mining industry is immense, the social costs of injury and fatality in mining are vast and immeasurable. In 1999-2000, one miner died for every 11 million hours worked in the industry, and for every 5,119 workers employed in the industry.

Proposed research activities of the AIRC: Injury in the workplace

Although research priorities may vary over a 5-year period the proposed program of research will address the major injury area of sprains and strains and issues associated with injury in the industry such as, fatigue and stress, contract working versus permanent employee arrangements, and the ageing workforce. A schemata outlining the proposed research program over the 5-year period is shown in Figure 1. The initial phase of the research program will involve a 2-part survey. The initial phase will be used to provide a background of existing information in the mining industry relevant to these issues, to avoid redundancy and to allow the development of more specific priority areas of research on workplace injury leading to a range of research methodologies involving other partners. Information available on injury causation in the mining industry will be updated using existing data from a variety of sources. The strengths and weaknesses of each system will be identified with a view to identifying and reducing gaps and overlaps in injury data recording across the Queensland and New South Wales mining industry.
The second part of this survey will address organisational issues using OHS and Human Resources (HR) data to determine policies, practices and safety outcomes. The areas of investigation in the survey will include the characteristics of the organisation, HR policy and practices, risk management and OHS policy and practices, and rehabilitation policy and practices.

Sprain and strain injury

In 1998-99, sprains and strains accounted for 46% of all injury claims (National Occupational Health and Safety Commission [NOHSC], 2001). In 1997-98, more than half of all the injury claims were due to sprains and strains. The most commonly identified body location of injury or disease according to the NOHSC data set was the upper or lower back. When it is considered that the lowest cost per claim of all sectors in the mining industry in 1998-99 was $5,563, and the highest cost per claim was $20,917 it can be seen that the direct cost of compensation claims is enormous. Significantly, the mining sector with the lowest average number of weeks lost per claim recorded an average of 6.6 weeks lost, while the sector with the highest average recorded 12.59 weeks absent from work. This highlights the incredibly high direct and indirect costs of injury to a company or industry.

The lifetime incidence of low back pain is high, however of even greater concern is the recurrent and persistent nature of the pain. Traditionally, manipulative therapies have been used to alleviate the pain and restore motion in the short term. It is now thought however that stabilisation programmes utilising the muscle system to protect spinal joint structures from repetitive microtrauma, recurrent pain, and degenerative changes, may have a role in addressing low back pain in the long term (Richardson, Jull, Hodges, Hides, 1999). In a clinical trial of stabilisation interventions in chronic low

back pain patients, it was found that after a 10-week specific exercise programme pain was significantly decreased and functional ability was significantly increased in the spinal stabilisation intervention group. No such changes were observed in the control group who were prescribed more traditional rehabilitation programmes. Furthermore, at a 30- month follow up, the intervention group reported lower levels of pain and higher levels of functional capacity than the control group, indicating a long term benefit in stabilisation programmes (O'Sullivan, Twomey, & Allison, 1997; O'Sullivan, Twomey, Allison, & Taylor, 1997).

The research in this section will range from examination of the efficacy of new physical therapies such as spinal stabilisation training programs, to analysis of the barriers in the process of rehabilitation and return to work. Examples of proposed projects include:
Single site clinical trial on physical therapies.
This project will evaluate the effectiveness of physical therapies which re-train motor control patterns rather than muscle strength and endurance for reducing low back pain in mine industry employees. Low back pain has been identified as a major contributor to the injury burden in mining. Concerns have been expressed over the recurrent nature of such complaints and the ongoing high costs of absenteeism, rehabilitation, and repeat treatments. This project will impact on the immediate as well as ongoing costs associated with back pain.

Vocational rehabilitation and return to work in mining.
Vocational rehabilitation processes in a sample of injured mining employees will be examined in order to determine the critical decisions that influence rehabilitation outcomes, and to formulate a critical path model for optimal injury management vocational rehabilitation. The aim is to reduce the currently high duration of absence that is characteristic of the mining industry as a whole, as well as sectors within the industry to varying degrees.

Fatigue and stress
Mining often involves 24-hour operations, 12-hour shifts, and unusual work scheduling practices such as fly in- fly out, and drive in-drive out (Department of Mines and Energy, 1999). It is well known that the need to work long and irregular hours and shift work increases the likelihood of fatigue and stress in employees. This in turn adversely affects a worker's capacity to work safely, and in the longer term, their health status. Twenty-four hour operations involving shiftwork pose distinct challenges to human physiology, particularly when personnel are required to respond in emergency settings. Work outside a normal daytime schedule is commonly characterised by irregular work and sleep patterns. This is an important health issue and it is now well established that such conditions create a high potential for fatigue, decrements in work performance, and increased accident/incident risk. The impact of irregular work patterns on the potential for fatigue and accident risk was recently studied with a group of marine pilots operating in the Great Barrier Reef. Analysis of work and rest schedules and individual monitoring of work and sleep patterns at sea and ashore identified significant risk factors for fatigue and long-term health outcomes for pilots. Extended work hours, particularly at night, was associated with decrements in alertness and increased risk of error and accident.

In a review on shiftwork, productivity and safety, Monk, Folkard and Wedderburn (1996) identified five problem areas: 1) errors, 2) sleep and excessive fatigue, 3) moodiness, irritability and disruptiveness, 4) absence, and 5) off work accidents. A number of studies demonstrated Impairment in performance in a range of tasks during a night shift, with a secondary drop during early afternoon. The biological and societal problems for a shiftworker therefore do produce impairments in performance at night, as more errors are made. Absenteeism in shiftworkers can also contribute to incidents and accidents as if somebody is absent from their work, other staff members are called on to perform the task which may be unfamiliar. Alternatively, workers may be asked to work overtime, or be understaffed for that particular shift. Possible solutions to these problems centre around five areas: the elimination or reduction of night work, the selection of appropriate shiftworkers, the education of shiftworkers, the adoption of correct shift rotation schedules, and the improvement of the working environment.

Research in this area will evaluate work-rest arrangements and the effects of fatigue and stress on work performance. Specifically the project will investigate the effects of a range of aspects of work-rest schedules operating in the mining industry including long and irregular working hours and fly-in fly-out or drive-in drive-out arrangements. The effects of ageing on the capacity to tolerate such hours will also be considered, as well as the possibility of developing methods for pre-employment screening. The outcomes of this particular project will include recommendations on the most

appropriate work-rest scheduling arrangements to optimise the safety and health of employees and validated assessment methods for pre-employment assessment of shiftwork tolerance and readiness for duty testing.

Simulation studies of high-risk systems.
The aim of this investigation is to reduce the injuries that arise from incompatible and inconsistent control systems for equipment with a high potential for injury. This will primarily be achieved by simulating the key aspects of design in laboratory studies and evaluating the implementation of alternative control systems. The applicability of such designs will then be assessed in other industries and occupations. It is anticipated that this study will result in field trials of the alternative designs for the systems identified as possessing the highest risk. Design recommendations will be made for the specific equipment that has been evaluated and redesigned, as well as the design of equipment in general.

Contract working versus permanent employee arrangements
Increasing competition and a need to reduce costs and increase efficiency has necessitated changes in the patterns of employment, contract, casual and part-time work and other non-standard structures. A feature of the mining industry currently is the move to contract labour in place of a permanent employed workforce. There is limited, but growing evidence that the move to contract labour has produced higher incidence of injury, greater difficulties in complying with occupational health and safety (OHS) regulations, and increases in workers compensation claims.

This project provides an opportunity to compare different types of employment arrangements on their OHS and rehabilitation outcomes. Included is a survey of organisational policies, practices and outcomes relating to human resources, OHS and rehabilitation which will provide data on whether and how mines with different employment conditions differ on these dimensions.

The ageing workforce and health and safety
In many industries (including mining) there has been a trend toward an older Australian workforce, due to better health and longevity of the older population, and also because younger people are not entering these industries at the same rate of exit of the older employees. Ageing introduces many challenges with respect to the content and requirements of work. Cross-sectional questionnaire studies indicate that after the age of 40-50 years, the health risks and/or sleep disturbances in shiftwork start to increase. Such declines can be associated with increased absenteeism attributable to sickness, gastrointestinal and cardiovascular diseases, and sleep disturbances. Sleep duration and quality decrease with age, however age and longer shiftwork experience were both independently related to poorer sleep. Interestingly, a study on sleep characteristics in relation to age and different starting times of shifts found that older workers fell asleep easier, slept longer, rated the quality of sleep higher and were significantly less tired than their younger counterparts in the morning shifts (Harma, 1996).

In a review of the status and promotion of work ability, employability and employment of European workers over 45 years of age, areas such as health, education and expertise, values and attitudes, motivation and job satisfaction, and work conditions and demands were considered (Ilmarinen, 1999). It was predicted that a large section of the work force would be over the age of 50 in 2005, necessitating changes in the work organisation structures and retirement management. In the European Union, the largest employer of over-50 year old workers is the service sector, with steep changes in the industrial sector also. Workers are also tending to work longer, with the number of retirees under 45 and between 45 and 54 years of age decreasing, and those over the age of 60 increasing. Work ability, as measured as the sum of individual and work-related factors, changes dynamically with age. The work environment, work content, and the resources of the individual all impact to affect or compromise work ability. As work ability is the foundation for employability, employability can be improved with different support and service systems, work and retirement legislation and changes in values and attitudes. From a health perspective older workers are particularly susceptible to diagnosed musculo-skeletal disease, circulatory disease, as well as multiple illnesses associated with age. The role of occupational health services will therefore be emphasised, in prevention and treatment of diseases, as well in the reduction of the occupational disadvantages caused by illnesses, and prevention of the aggravation of disease (Ilmarinen, 1999).

No similar analysis of Australian workers has been conducted however, and little information is available on the issues associated with ageing workers in the mining industry. This project will therefore investigate the work life of ageing workers in the mining industry in order to obtain comparative data on this workforce and to determine the needs and abilities of ageing workers with respect to both organisational and individual safety problems and solutions. In the initial survey, the age structure, health indicators, accident information, physical work environment, physical and mental demands and work hours in relation to age will also be investigated. In the later stages, specific risk factors for injury in the ageing worker will be investigated in areas such as tolerance to shiftwork, factors which improve or weaken work ability and functional capacity, and the role of individual and environmental factors in injury mechanisms and rehabilitation.

Results from these projects will generate injury prevention and rehabilitation solutions relevant to mining in the first instance and in a greater sense, relevant to industry as a whole. The information and conclusions arising from the four projects will be applied to develop site-specific work practices and to provide guidance to other mine sites in improving injury prevention and management processes.

Summary

The AIRC is a Health Research Partnership in Injury that proposes to facilitate the examination of injury from a multidisciplinary perspective providing a comprehensive, research-based solution to the public health problem of injury. The partnership will facilitate the development of a comprehensive database of injuries sustained in one or more of the five priority areas of injury through the lifetime. A major objective is the identification and development of cost-effective population level intervention programs with mining providing the focus for the workplace injury section of the AIRC. The success of the program will depend on the involvement and cooperation of all sections of the industry and every opportunity will be provided to facilitate communication with the industry throughout the various stages of the research program. This will not only facilitate the identification and examination of priority research problems but also promote application of the results of the research to solving these problems.

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Figure 1- Injury in Working Age Adults: Working Age Injury