(9%), bench work/assembly (9%), managerial (8%) and others (11%).

The case-crossover design uses cases as their own controls to assess the change in risk of a sudden-onset event during a brief "hazard" period (e.g. 10 minutes before the injury) as compared to an earlier "control" period. The control period selected for this analysis was the average exposure (frequency times duration) in the work-month prior to the injury. We found relative risks and 95% CIs as follows: using malfunctioning equipment or materials RR=12.0, (10.2-14.1), doing a task using an unusual work method, RR=11.1, (9.2-13.4), doing an unusual task RR=6.6, (5.6-7.8), being distracted RR=5.4, (4.7-6.2), rushing RR=2.4, (2.1-2.8) and glove use, RR=0.6, (0.5-0.7). The case-crossover design perfectly controlled for differences between subjects like age, gender, and occupation.

These results suggest that certain work equipment, practices and environment factors significantly increase the risk of a hand injury and glove use significantly protects against hand injury.

C3.4 Temporal Factors and the Risk of Occupational Acute Hand Injury—Lombardi DA, Sorock GS, Eisen EA, Herrick RF, Hauser RB, Racine R, Mittleman MA

Both mental and physical fatigue have been considered potential risk factors in studies of fatal and non-fatal injuries in the workplace. To evaluate associations between traumatic injuries to the hand and potentially modifiable risk factors, we enrolled 1,128 patients in a case-crossover study of occupational hand injuries. Patients were recruited over two years from 24 occupational health clinics in New England. Four temporal factors were evaluated. These factors included 1) the time of day of the injury, 2) the time since start of shift, 3) working overtime, and 4) hours of sleep before the injury relative to usual number of hours of sleep.

The median age of the subjects was 36 years and 77.5% were male. The majority of hand injuries occurred in the morning between 09:00-12:00 (43.2%), peaking from 10:00-12:00 (29.8%). The median time of injury was 3.5 hours into the work shift. The average hours worked per month was 193, including 22.5 hours of overtime, representing 11.7% of the total person-time at risk. In contrast, only 4.0% of injuries occurred while working overtime. The mean and median difference in sleep time (hours) was -0.1 and 0, respectively.

Hand injuries tend to occur early into the workday and sleep time does not appear to be a risk factor. The apparent lowered risk during overtime requires further evaluation of worker schedules and the availability of health care clinics used for data ascertainment during that time period. Alternatively, work tasks may be different during overtime as compared with regular working hours. Additional analyses are also needed to determine if these findings are modified by workplace, individual factors, or break periods during the work day.

Session: C4.0
Title: Mining
Category: Injury surveillance
Moderator(s): Lisa J. Steiner

C4.1 An Analysis of Serious Injuries to Dozer Operators at US Mining Sites—Wiehagen WJ, Mayton AG, Jaspal JS, Turin FE

This paper is concerned with serious injuries occurring to bulldozer operators working at domestic coal, metal and nonmetal mines. Injury data collected by the Mine Safety and Health Administration is summarized for dozer operators that incurred serious injuries while operating the equipment over a ten-year period (1988-1997).

An injury classification system was developed to code a set of fatal and nonfatal injuries. We categorize the data by activity (task being performed), result (what apparently happened to the dozer) and operator impact (how was the operator injured). Where information is available, contributing factors are identified.

The results of the study indicate that the number of serious injuries to dozer operators has declined by 30% over the time period. The reduction in serious injuries resulted in a matching reduction in days lost. This was found for all classes of dozer operator injuries: incidents due to jolts and jars, fall over / roll over, sprains and strains, struck against, and struck by.

Further reductions in injury risk will require: more widespread use of seat belts, field and laboratory research interventions to better assess the effect of alternative engineering (e.g., seat and seat suspension) designs to dampen or isolate the effects of shock and vibration, and continued attention on hazard awareness, recognition and response. Although the number of incidents have decreased, dozer operators being jolted and jarred accounts for the largest percentage (70% of the incidents) and severity (75% of the workdays lost) of serious injuries while operating the equipment.

C4.2 Haulage Truck Dump-Site Safety—Turin FC, Wiehagen WJ, Jaspal JS, Mayton AG

Dump-site injuries occur at all major mineral industries. Working in elevated areas near an edge is a common hazard for operators of off-highway mobile mining equipment. This report will examine serious injuries involving haulage trucks working at dump-sites for the period 1988 to 1997. Data were acquired from injury reports gathered by the Mine Safety and Health Administration (MSHA). This work is organized into three primary sections. The first presents an overview

of the frequency and severity of injuries. The second analyzes injury characteristics using MSHA defined data fields and author defined injury classifications. Key findings are discussed in the third section. In summary, 370 serious injuries were identified, 26 of these were fatalities. Although haulage truck dump-site activities resulted in a small proportion of surface mining injuries, these injuries were much more likely to result in death or significant lost time than most other surface mining injuries. The findings of this report support that haulage truck dump-site activities are worthy of continued study by those interested in improving the health and safety of workers at surface mines.

C4.3 Evaluating Safety Interventions in the U.S. Mining Industry—Coleman PJ, Kerkering JC

Traumatic injury prevention in the workplace is an ongoing challenge, particularly in high-risk industries such as mining. When a safety program is changed, or a new emphasis added, how can it be evaluated? What works and what doesn't? We outline one approach to this problem here.

In mining companies as in other industries, accidents often occur as events that can be modeled by a Poisson process. When safety program improvements are made, the expected reduction in accidents can also be modeled as a change in the process parameter. From a practical standpoint, if a reduction in accidents is observed over some time period, the hypothesis of a significant change in the underlying parameter can be tested using tail sums of binomials. Alternatively, confidence intervals for two observed accident counts in non-overlapping intervals can be compared. For typical mining companies wishing to assess whether changes in safety procedures have had a significant impact on injury rates, these comparisons are easily done but the power of such tests depends on the numbers of accidents being compared, or on the length of observation periods.

We used Mine Safety and Health Administration (MSHA) reported injury and illness databases to determine average values of reported accident counts for mining companies. Employment data for mines was also analyzed to obtain baseline values and variability over time. To facilitate the use of statistical tests to compare the effects of a safety intervention, tables were constructed based on the comparison of two Poisson rates. These provide confidence intervals for observed event counts from pre- and post-intervention periods. Methods were also developed to account for changes in employment or hours worked during the observation periods. We discuss ways in which these techniques can be used by employers, unions, and researchers to improve safety and health.

C4.4 Alternate Measures of Risk for Communicating Study Results: Comparisons of Injury and Chronic Disease Mortality in the NIOSH Colorado Uranium Miners Cohort—Park R, Stayner L, Bailer J, Gilbert S, Halperin W

Traditional measures of relative risk such as SMRs, Rate Ratios, and attributable risks or fractions, are often not meaningful or intuitive for many audiences. Using simple lifetable (SMR) and more powerful Poisson regression methods, we produced estimates of SMRs, attributable risk fraction, attributable years of potential life lost, and excess lifetime risk for both chronic disease outcomes (lung cancer, nonmalignant respiratory disease) and fatal injuries. These results provide stark summaries of the magnitude of work-related mortality among uranium miners. For example, for every year employed, miners on average lost almost 4 months of life expectancy just due to risk of subsequent work-related lung cancer. Although work-related chronic disease deaths dominated (due to radon, silica and probably other exposures), more years of life were lost on average, per individual injury death (37 yrs), than for a lung cancer death (20 yrs). In deriving meaningful statements on injury risk, it is especially important to describe consequences in terms of years of life lost due to hazards on the job as well as other epidemiological measures of risk.

Session: C5.0
Title: Intervention and Risk Factor Research
Category: Intervention Evaluation
Moderator(s): Linda Goldenhar

C5.1 Evidence on the Effectiveness of Measures Recommended to Prevent Workplace Homicide—Loomis D, Wolf S, Runyan CW, Marshall S, Butts JD

Government agencies have recommended that employers adopt measures to reduce the risk of homicide on the job. Their recommendations include both environmental design modifications and administrative actions. To investigate the value of recommended preventive measures, we analyzed data from a case-control study of homicide in North Carolina workplaces in 1994-98. Workplaces were the units of analysis: case workplaces were those where a worker's death resulted from homicide during the study period (n=105); control workplaces were an incidence-density sample of the study base, matched by industry sector (n=210). Data on safety measures and other workplace characteristics were collected by telephone interview. Conditional logistic regression was used to estimate the exposure odds ratio (OR) as an indicator of association. Among 13 environmental interventions examined, only the presence of a barrier between workers and the public (OR 0.5, 95% CI 0.2-1.2) was associated with a noteworthy reduction in risk. Keeping entrances closed during working hours (OR 0.5, 95% CI 0.2-1.1), special arrangements with a law enforcement agency (OR 0.4, 95% CI 0.2-0.8), pre-employment psychological screening (OR 0.5,

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ABSTRACTS

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