Overall agreement also was exceptional (90%). Highest agreement was observed for waist to shoulder lift/lower and carrying tasks, while lowest agreement was found in the shoulder to overhead lift/lower. These results suggest that the OPAS can be used in identifying carpenters gross body work postures while maintaining reliability and validity.

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OFFICE ERGONOMIC RISK FACTORS FOR STUDENTS AT A MULTIFACETED PUBLIC UNIVERSITY. E. Kraft, R. Thomas, Auburn University, Auburn University, AL

It has been documented in the literature that using a poorly designed computer workstation can lead to musculoskeletal injuries of the upper extremities and back. The majority of the research about office ergonomics had focused on the workplace. However, anyone using a poorly designed computer workstation, whether at home, school, or in the workplace is at risk for a cumulative trauma disorder. Students at universities frequently use computers. There have been no studies in the literature to document office ergonomic risk factors at the universities.

A review of 2186 university accident records revealed that the incident rate of student sprains/strains during 1984 to 1994 was 0.01085. Sprains/strains of the lower extremities were the most common, accounting for 81.48% of student sprains/strains. Hence, a review of the accident records did not reveal injuries related to poor office ergonomics. To further assess whether there were office ergonomic risk factors for students at a multifaceted public university, an 80-question survey was administered to 87 students. The questionnaire addressed use of university computers, seating, workstation design, lighting, pain, and previous injuries on campus.

The results of the survey were that 11.8% of the respondents agreed that the chairs in the classrooms were comfortable, 19.5% of the respondents agreed that the chairs in the computer labs were comfortable, and 27.5% of the respondents agreed that the university computer workstations were comfortable. Using university computers to complete homework assignments for at least 1 hour per day was reported by 54.1% of the respondents. Neck pain at least once per week was reported by 37.2% of the respondents and wrist pain at least once per week was reported by 26.8% of the respondents. A chi-squared test showed that neck pain ($p<0.10$) and wrist pain ($p<0.10$) were dependent on using university computers for at least 1 hour.

Based on the results of this study it can be concluded that poor workstation and seating design at universities pose risk factors for students developing cumulative trauma injuries. A university ergonomics program should focus on alleviating these risk factors through proper workstation and seating design.

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ERGONOMIC INTERVENTION HAS A RETURN ON INVESTMENT OF 17 TO 1. G. Wahl, Colorado Compensation Insurance, Denver, CO

This study attempts to justify the cost of ergonomic intervention. Workers' compensation data is used to compare the cost of injuries where an intervention is done to the cost of injuries where no intervention is done. An intervention is a visit to the injured employee's work area. The intervention is done by a loss prevention representative from the workers' compensation carrier. The work area is evaluated and recommendations are made to the employee and employer. The cost of the intervention to the workers' compensation carrier is approximately $100.

The injuries that are included in the study are office-related cumulative trauma injuries treated at a major medical provider in Denver. There were 210 injuries of this type in 1995: 72 received an intervention, and 138 did not. The average cost of injuries with an intervention was $2476. The average cost of injuries without an intervention was $4294. The cost saving per injury is $1818. Eleven percent of the injuries with an intervention were "lost-time" compared with 25 percent for injuries without an intervention. Given a cost of $100 per intervention, and a saving of $1818 per injury, the return on investment is 17 to 1.

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Paper Withdrawn by Author

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Paper Withdrawn by Author

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A SAMPLING METHOD FOR OCCUPATIONAL HAZARD SURVEILLANCE OF WORKER EXPOSURE TO EXTREMELY LOW FREQUENCY (ELF) ELECTROMAGNETIC FIELDS (EMF) IN NONUTILITY INDUSTRIES. M. Methner, NIOSH, Cincinnati, OH

A method was developed to determine the range of potential exposures to ELF magnetic fields in nonutility industries. Industries were selected based on their annual electric power consumption in accordance with the hypothesis that large power consumers would have elevated ambient magnetic fields. A total of 62 industrial facilities within thirteen 2-digit Standard Industrial Classification (SIC) codes participated in the study. Walk-through surveys were conducted with an EMDEX-II magnetic field meter and a MultiWave System II instrument. No correlation existed between electric power consumption and the geometric mean (GM) field magnitudes, which ranged from 0.4 to 16.1 mG. Chemicals and Allied Products (SIC 28) and Primary Metal Products (SIC 33) had the highest GMs. Specific source magnitudes were also highly variable across and within the sampled facilities, where maximum values ranged from 10 to 5300 mG. Data collected with the MultiWave indicated that some sources exhibited nonsinusoidal waveform patterns and frequency harmonics. Difficulty in establishing statistically significant associations between GMs across industries was expected because this study was designed to be range-finding, and because of the high variability of field magnitudes and the small number of replicates. However, the lack of correlation between power consumption and ambient magnetic field magnitudes was surprising, and suggests that other surrogates for potential high exposure (such as source density) are needed. Industry classification was a poor tool for identifying facilities with high ambient magnetic fields, due to the wide variation in industrial processes and source types. Overall, 89% of the facilities had GMs at or below 4 mG, indicating that most facilities are probably within this range. However, facilities with GM field magnitudes above the 4 mG level may represent those with work areas with elevated magnetic fields and are likely candidates for personal monitoring and improved source characterization.

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A COMPREHENSIVE EXPOSURE ASSESSMENT IN A TEXAS BATTERY MANUFACTURING PLANT: EXPOSURE BY MULTIPLE ROUTES, DEFICIENCIES IN A RESPIRATORY PROTECTION PROGRAM, AND "LEAD FOR LUNCH." E. Esswein, M. Boeniger, R. Hall, K. Mead, NIOSH, Cincinnati, OH

The Texas Department of Health requested NIOSH evaluate a battery manufacturing plant to determine if upgrading plant engineering controls would result in an expected reduction in employee exposure to lead (Pb). An initial evaluation showed employee PBZ samples > 50 $\mu g/m^3$, Pb contamination on cafeteria tables, and documented employee hand contamination. The presence of Pb inside respirator facepieces was also confirmed.

An investigation of lead exposure via multiple routes was conducted. PBZ samples in pasting, first assembly, and pouching were in a range of 68 $\mu g/m^3$ to 447 $\mu g/m^3$, 15$\mu g/m^3$ to 418 $\mu g/m^3$, and 50 $\mu g/m^3$ to 77 $\mu g/m^3$, respectively. Lead contamination was found throughout the cafeteria; 14 samples from 7 tables averaged 506 μg Pb/ft^2, 2 samples from hard surfaces in the cafeteria food service line contained 140 and 320 μg Pb/ft^2, knobs on a cafeteria door inside/outside the cafeteria had 90 and 160 μg Pb/wipe. Lead was found on kitchen cutting boards (trace to 130 μg Pb/ft^2). No statistical difference in wipe sample pairs was determined from samples collected on the same cafeteria tables ($p=0.2$). However, hand wipe samples collected before and after employees ate lunch revealed a statistically significant ($p=0.03$) increase of Pb on these employees' hands. Regarding respirators, a close examination of several HEPA filters revealed visible damage (indentations in the filters), which NIOSH traced to respirator "cleaning" practices which involved cartridges being rapped on hard surfaces to dislodge accumulated lead dust so that cartridges could be reused.

This NIOSH investigation provides insight regarding risk factors for multiple routes of exposure to Pb. The study conclusively identifies the fundamental importance of vigilant plant and personal hygiene, the need for good respiratory protection programs, and suggests that changes to engineering controls alone, while judicious, would not have reduced all exposures at this plant.

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