as access ways to and in buildings, in response to recommendations from the National Bureau of Standards, new slipping and falling hazards have been introduced. This study investigated differences in the relationship of objective measures and subjective perceptions of postural instability associated with walking on ramps under exposure to environmental and workplace factors in older workers. Ninety-five healthy subjects between the ages of 45 and 75 participated. Kinematic and kinetic data were recorded while subjects walked up and down ramp angles of 0, 10, 15, and 20 degrees. Handrail usage, observed slips and falls, perceived exertion, and perceived sense of slip/fall were also recorded during walking, under various conditions of dry and slippery surface, good and poor lighting, and two shoe types (hard-soled and soft-soled). Postural instability showed a significant increasing trend from 0 to 20° ($p < 0.0001$). As was expected, subjective measures of exertion ($p < 0.0001$) and sense of slip/fall ($p < 0.0001$) also increased as ramp angle increased. Mediolateral movement of whole body center of pressure increased while wearing soft-soled shoes ($p < 0.0001$), as did perceived exertion and sense of slip/fall ($p < 0.0001$). Increased instability was detected while subjects traveled down the ramp ($p < 0.0001$), corresponding with an increase in perceived sense of slip/fall ($p = 0.0012$). Handrail usage was significantly associated with poor lighting ($p < 0.0001$), wearing soft-soled shoes ($p < 0.0001$), and when walking on a slippery surface ($p < 0.0001$). Specific risk factors were identified in this study that may cause slips/falls if not corrected in the workplace employing older workers. A reduction in these risk factors could help prevent fall-related injuries and fatalities, as well as help increase productivity by reducing lost workdays, disability, and medical costs.

64

FATIGUE FAILURE OF LUMBAR MOTION SEGMENTS IN A SAMPLE OF WORKING AGE SPECIMENS.
S. Gallagher, NIOSH, Pittsburgh, PA; W. Marras, A. Litsky, D. Burr, The Ohio State University, Columbus, OH.

Eighteen working age cadaveric lumbar motion segments (average age 49 years ± 17 SD) were subjected to a fatigue loading regimen simulating lumbar loads when lifting a 9-kg box in three angles of torso flexion (0, 22.5, and 45 degrees). Bone mineral content and bone mineral density were obtained from L1-L2 and L3-L4 motion segments each spine. Motion segments were loaded every three seconds using a loading profile (compression, shear, and load rate) appropriate for each torso flexion angle, up to a maximum of 10,020 cycles. Bone mineral density for these specimens was 1.00 g/cm^2 (± 0.25) and the average bone mineral content was 30.7 g (± 11.1). Spinal loads associated with lifting in different torso flexion angles affected the fatigue life of the motion segments, with all specimens in the neutral posture lasting the entire 10,020 cycles, while specimens exposed to the 22.5 degree torso flexion conditions lasted an average of 6824 cycles, and those exposed to the 45 degree conditions lasted an average of 4209 cycles. Compared to an earlier investigation with older specimens (reported at last year's conference), these young specimens had higher bone mineral content and density and longer fatigue life compared to the older sample (which averaged 80 years of age). Lumbar level did not affect the number of cycles to fatigue failure. Results of this study suggest that spinal tissues will fatigue fail more quickly when lifting a given load in a flexed torso posture as opposed to a neutral torso posture.

65

A RISK ASSESSMENT TOOL FOR EXPOSURES TO ADVERSE MECHANICAL STRESS. D. Goddard, K. Neufeld, S. Chervak, U.S. Army CHPPM, Aberdeen Proving Ground, MD.

Due to the fact that the mechanical stresses involved in performing body movements are internal, they cannot be measured using standard industrial hygiene procedures. This constraint complicates efforts to characterize risk of injury to musculoskeletal tissues associated with motor tasks. Since many workplace activities expose workers to significant levels of adverse mechanical stress that can result in injury, it is important to implement an appropriate screening mechanism to characterize ergonomic risks and prioritize interventions. The Adverse Mechanical Stress Risk Assessment Tool (AMSRAT) was designed to help evaluate workplace ergonomic factors that are related to forceful exertions, awkward postures, and repetitive motions that arise from lifting, pushing, pulling, and using tools. Maximum allowable lifts/exertions proposed in MIL-STD 1472F (Department of Defense Design Criteria Standard: Human Engineering, 23 August 1999) are used as the basis for the assessment of these physical work activities. This tool guides users to select risk scores for each exertion or lift using a ratio of the number of pounds of force demanded by the work activity divided by the maximum allowable force determined by the tool. Awkward posture is evaluated by a visual scoring system that challenges users to assign risk scores based on the amount of deviation from neutral posture for each joint under scrutiny. The tool incorporates hand-arm vibration assessment using the threshold limit values proposed by The American Conference of Governmental Industrial Hygienists and whole-body vibration assessment in accordance with ISO 2631-1:1997. At the completion of the presentation attendees will understand the rationale behind the assessment strategy used in the AMSRAT and how the tool can be used to characterize risk of musculoskeletal injury from exposure to adverse mechanical stress.

66

USING METRICS TO DRIVE ERGONOMIC IMPROVEMENTS. W. Rostykus, Humantech Inc., Ann Arbor, MI.

A clear, measurable improvement goal with focused measures is critical to the success of an ergonomic improvement process or safety program, and to an organization's ability to sustain the process or program over time. This session provides recommended methods and a model for planning and maintaining an ergonomics process. It examines several critical elements including: effective metrics for driving and tracking progress; steps to establish an ergonomic improvement process; demonstrating return on investment; value of employee reports of discomfort; and methods for planning, monitoring, and tracking progress. The approach and methods are based on successful practices from Fortune 500 companies, and can be applied to improve an organization's productivity, safety, and bottom line.

67

USING SYNCHRONIZED SURFACE ELECTROMYOGRAPHY AND VIDEOTAPE IN MANUFACTURING. M. Lau, M. Ebersole, T. Armstrong, C. Woolley, University of Michigan, Ann Arbor, MI.

Surface electromyography (EMG) is a widely used method for assessing internal muscle forces in the laboratory and clinical settings. The usage of EMG in industry is not as widespread because it tends to be difficult to conduct in work settings, often constrained by many factors, including adverse environments and time pressures. In the past, EMG has been used to collect muscle activity data over long periods of time to get an overall average level via an amplitude probability distribution function, but less so at a task-specific level. This presentation discusses how telemetric surface EMG was used in conjunction with two synchronized digital video cameras to evaluate hand forces of workers performing flexible hose insertions and other manual assembly duties at a North American automobile manufacturing plant. Bilateral EMG was collected from the flexor digitorum superficialis and extensor digitorum of each participant. The duration of set-up, calibration, and clean-up was about 40 minutes. Actual data collection was performed for 10 minutes, but could be continued for longer periods. By having synchronized videotape, it was possible to see exactly what a worker was doing at a particular moment of interest in the EMG data. The difficulties with this type of data collection lay in two major areas: (1) the coordination of replacement personnel for the time the worker has to be taken off the line for EMG setup, and (2) the initial setup and calibration of the EMG for each worker. There was significant post-processing time associated with each trial as task times had to be isolated from the video and matched to corresponding EMG data. The major benefit of this method lies in the ability to match EMG and force data with specific tasks performed.

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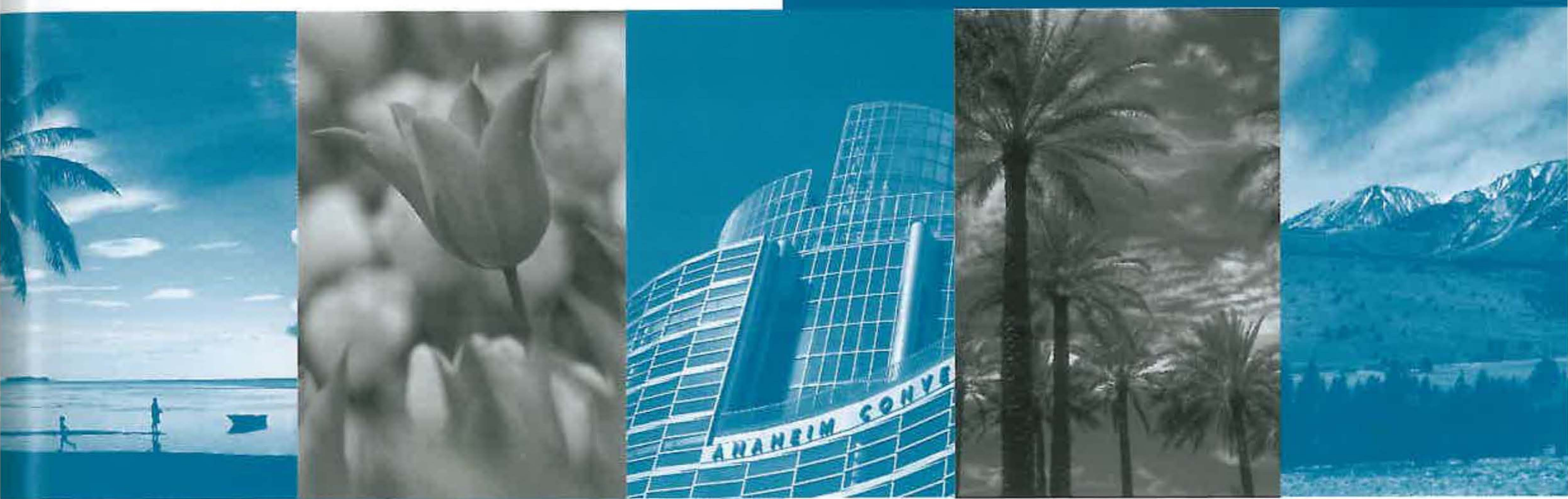

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