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Liberty Mutual Research Institute for Safety

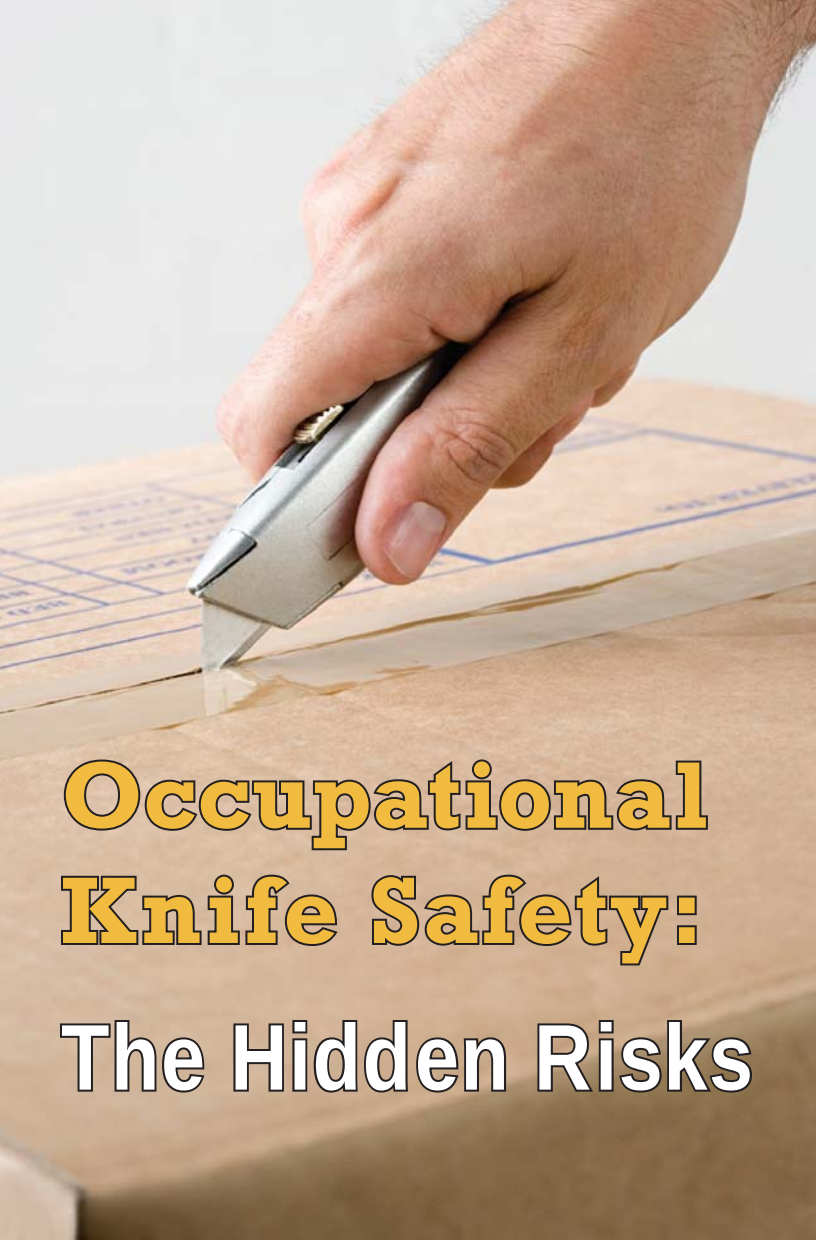
Occupational Knife Safety

Is a Sharper Knife a Safer Knife?
Liberty Mutual Researchers Investigate

Reducing the Strain of Occupational Knife Cutting Tasks

At the Cutting Edge:
Laboratory Studies Use New Technologies to Assess Knife Cutting Exposures

Vol. 11 No. 3



Occupational Knife Safety: The Hidden Risks

When people think of the risks involved in occupational knife use, cuts and lacerations may be the primary injuries that come to mind. However, the statistics show that there is another, less obvious, but highly significant risk associated with these tasks – that of upper-extremity musculoskeletal disorders.

In recent years, the U.S. Bureau of Labor Statistics has reported more than a quarter million disabling upper-extremity injuries annually. Of these, roughly 26 percent occurred as a result of workers being "struck by an object," a category commonly associated with knife cuts and lacerations. However, another 10 percent of these injuries were due to repetitive motion. Repetitive motion injuries – which include strains, sprains and other musculoskeletal disorders – are reported to involve four times as many days away from work as injuries in the "struck by an object" category. For this reason, these injuries are a major concern for industry.

"The costs associated with repetitive motion injuries are significant," states Nils Fallentin, Ph.D., director of the Research Institute's Center for Physical Ergonomics. "According to our most recent Workplace Safety Index [see p. 10], industry paid out two billion dollars in direct costs for repetitive motion injuries in 2006," notes Fallentin, citing lengthy recovery times, corresponding work absences, and the high medical costs associated with treating such injuries as reasons for the high direct costs.

High forces and repetition are the primary exposures that can lead to repetitive motion injuries. Sustained awkward postures are another related exposure. Both of these exposures are typically associated with production-paced occupational knife cutting tasks. "The combination of high forces and repetition at a high work pace can place excessive strain on the hand and arm. Over time, these exposures can contribute to the development of upper-extremity musculoskeletal disorders," states Fallentin. Strains, sprains, carpal tunnel syndrome, and tendonitis of the arms, shoulders, hands, and wrists are examples of common musculoskeletal disorders associated with occupational knife cutting tasks.

Over the years, Research Institute scientists have acquired a unique understanding of the exposures associated with occupational knife cutting and other repetitive hand tool tasks. While much of the current research in this area relies on subjective assessments of exposure, Research Institute scientists have come up with innovative ways to directly measure the forces involved in repetitive knife tasks. "Our ability to observe such tasks as well as quantify the force exposures gives us an important edge in understanding the relationship between various task exposures and conditions and injury risk," says Fallentin. "This understanding has helped to inform other research in this area and has formed the scientific basis for a variety of tools, recommendations, and ergonomic interventions used by industry to help reduce the risk of repetitive motion injuries."

Is a Sharper Knife a Safer Knife?

Liberty Mutual Researchers Investigate

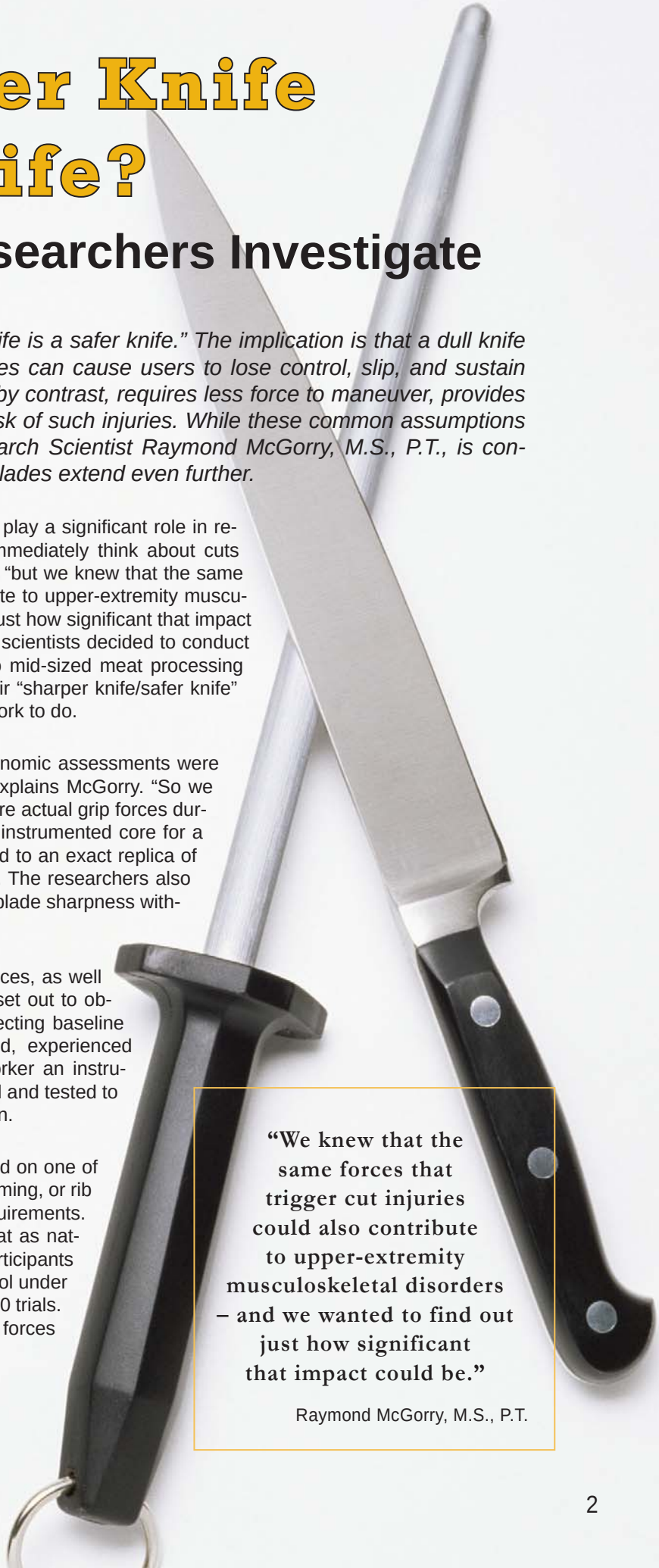
We've all heard the old adage "a sharp knife is a safer knife." The implication is that a dull knife requires excessive forces, and these forces can cause users to lose control, slip, and sustain serious cut or stab injuries. A sharp knife, by contrast, requires less force to maneuver, provides more control, and generally reduces the risk of such injuries. While these common assumptions may be true, Liberty Mutual Senior Research Scientist Raymond McGorry, M.S., P.T., is convinced that the safety benefits of sharper blades extend even further.

McGorry hypothesized that sharper knives could play a significant role in reducing repetitive strain injuries. "Most people immediately think about cuts when they consider knife safety," notes McGorry, "but we knew that the same forces that trigger lacerations could also contribute to upper-extremity musculoskeletal disorders – and we wanted to find out just how significant that impact could be." To test this hypothesis, Liberty Mutual scientists decided to conduct a field study of experienced meat cutters in two mid-sized meat processing plants. But before the researchers could test their "sharper knife/safer knife" theory in the field, they had some development work to do.

"In prior studies, we learned that traditional ergonomic assessments were not great at accurately estimating grip forces," explains McGorry. "So we developed a transducer system that could measure actual grip forces during real-world tasks." The system consists of an instrumented core for a tool handle, with force sensors that could be fitted to an exact replica of the knives used by the meat cutters in the study. The researchers also developed a portable device that could measure blade sharpness without dulling the blades in the process. (see p. 4).

Armed with their newly developed high-tech devices, as well as traditional video equipment, the researchers set out to observe meat cutters at work. They began by collecting baseline grip force measurements from 15 pre-screened, experienced meat cutters. They randomly assigned each worker an instrumented knife with a blade that had been prepared and tested to represent either a dull, medium, or sharp condition.

Study participants used the knives as they worked on one of three production lines – shoulder boning, loin trimming, or rib trimming – selected for their diversity of task requirements. Researchers instructed the participants to work at as natural a pace and technique as possible. The participants performed two trials of each assigned task protocol under three conditions of knife sharpness, for a total of 90 trials. During each trial, researchers recorded hand grip forces



> **"We knew that the same forces that trigger cut injuries could also contribute to upper-extremity musculoskeletal disorders – and we wanted to find out just how significant that impact could be."**
>
> Raymond McGorry, M.S., P.T.

and reactive moments on the blade, and tracked the task time and number of repetitions performed.

The study findings, published in *Applied Ergonomics* (Vol. 24, pp. 375-382), indicated that blade sharpness did indeed have a significant impact on grip and cutting forces (see chart, right). In fact, the researchers found that cutting time, grip force, and cutting moments with a sharp knife were 20 to 30 percent lower than with a dull knife.

These findings strongly suggest two important conclusions: 1) A sharp knife is indeed a safer knife, because it reduces the forces that potentially contribute to repetitive strain injuries; and 2) sharper blades improve efficiency by reducing cutting time. But what do these findings mean for industries in which workers perform repetitive cutting tasks? "Our research suggests that periodic blade sharpening, as part of a company's safety program, can reduce the force exposures that often lead to repetitive strain injuries," states McGorry.

"The reduced cutting time associated with sharper knives also has important safety implications," adds McGorry. "The time saved by using a sharper knife could be applied to longer or more frequent 'micro-breaks', which could help workers recover and rest their muscles between tasks."

Differences Between a Dull and Sharp Blade

	Reduction (%)
Cutting time (sec)	**44%**
Peak cutting moment (Nm)	**26%**
Mean cutting moment (Nm)	**36%**
Peak grip force (N)	**25%**
Mean grip force (N)	**18%**

The measures above show the percent reduction in time and forces when a sharp knife replaces a dull knife during meat cutting tasks.

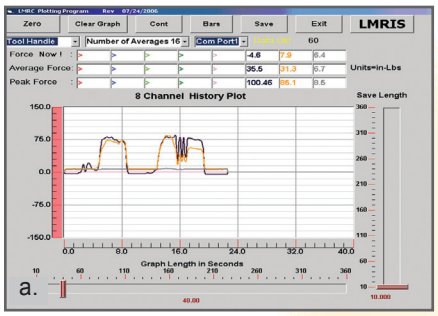
Research Targets Meat Processing Industry

Poultry and fish processors, professional chefs, and even some non-food related jobs such as carpet layers, upholsters, and tile installers, involve repeated knife use. So why did Liberty Mutual researchers target the meat processing industry to study the impact of knife sharpness on safety? "It's true that there are many professions in which repetitive knife cutting tasks could be cause for concern," explains Raymond McGorry, principle researcher on the study. "But the meat processing industry reports up to 30 times the industry average for repetitive strain injuries." According to McGorry, meat processing was the logical starting point because the nature of the work involves very high repetition rates, forceful exertions, and awkward postures. "These are the very risk factors that ergonomists have linked to work-related repetitive strain injuries."

Tools of the Trade

Liberty Mutual Researchers Invent Devices to Collect Measurements

Over the years, the Research Institute has worked on an array of customized tools and devices to facilitate direct measurement of the forces involved in repetitive hand tool tasks, such as industrial knife cutting. Among these are the Musculoskeletal Stress Measurement Kit (MSMK), the Instrumented Knife System, and a knife sharpness tester, developed in conjunction with Anago, Ltd. (New Zealand). All three devices have yielded vital information for understanding force exposures that can lead to upper-extremity musculoskeletal injuries.



a.

Getting a Grip on Hand Tool Forces

The MSMK measures the forces exerted during various industrial hand tool tasks. The device's universal sensor has been fitted to a variety of industrial knives, screwdrivers, and other single-handled tools, and is used by both researchers and loss control specialists to gather data in field settings. The sensor captures grip and applied torque data from the hand and transmits these data to a laptop computer (a).

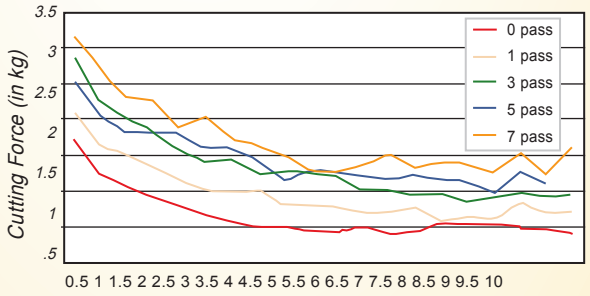
As part of an earlier version of the MSMK, the Instrumented Knife System was specifically designed to capture forces exerted during occupational meat cutting tasks. The device consists of six strain gauges mounted to a fabricated replica of a boning knife handle. The handle is then attached to an actual knife blade (b).


b.


c.

How sharp is that knife, anyway?

The knife sharpness tester (international patent, Anago, Ltd.) measures cutting forces along the knife blade as the blade is mechanically driven downward though a standard mesh material (c). The forces provide a relative measure of blade sharpness (d). Unlike other knife sharpness testers, this one does not dull the blades during the measurement process, making it ideal for repeated field-based measurements.



d.

Measurements of a single knife dulled by passing through sandpaper (0 to 7 passes) show that as a knife blade becomes less sharp, cutting forces increase.

Laboratory Studies Use New Technologies to Assess Knife Cutting Exposures

In addition to field studies aimed at identifying worker exposures (see p. 2 article), the Liberty Mutual Research Institute conducts laboratory experiments to examine the ergonomic and physiological factors associated with occupational knife cutting tasks.

"In the laboratory," explains Liberty Mutual Senior Research Scientist Raymond McGorry, "we're able to apply sophisticated technologies under controlled conditions to measure the different exposures associated with occupational cutting tasks. This approach allows us to identify those job elements that pose the most significant risk, and find ways to reduce that risk."

Force Measurement Systems Yield Insights on Ergonomic Factors

In one experiment, Institute researchers observed 12 study participants as they performed knife cutting tasks in a standardized modeling clay to simulate meat cutting. Specially instrumented knives and wrist goniometers recorded grip forces, cutting forces, and wrist posture data. The participants performed a total of 72 cutting tasks under varying conditions: three work surface orientations (horizontal, tilted 30°, tilted 60°); three work surface heights (low, medium, high); two knife blade angles (bent, straight); and two work paces (self-paced, production-paced).

The study findings, published in the journal *Ergonomics*, (Vol. 47, No. 5), suggest that the interaction between work surface height and orientation had a significant impact on wrist flexion, extension, and displacement. The "best" (i.e., most ergonomically favorable) combinations were: lowest height / 30° tilt; and highest height / 60° tilt. The next most favorable interaction was the 30° tilt at medium height. At all surface heights, the "worst" surface orientation was horizontal, because it caused the greatest wrist flexion and ulnar deviation.

There were also strong interactions between knife blade angle and surface orientation, resulting in large differences in wrist displacement (flexion or extension). The "best" combinations of blade angle and surface orientation were: bent blade / 30° tilt; and straight blade / 60° tilt, because they minimized wrist deviation from a neutral posture.

"The results suggest that providing ergonomic workstations that offer height and work surface angular adjustment would improve wrist posture during meat cutting tasks," says McGorry. "We also found that using an angled blade in conjunction with an adjustable workstation might also improve working wrist postures, but that finding requires further investigation."

Next, the researchers analyzed the force data from self-paced cutting tasks, in which participants selected a work pace they felt they could sustain comfortably, and production-paced tasks, in which they used a faster cutting pace, aimed at maximizing production. As a group, study participants used significantly greater torque and grip force during the production-paced tasks. This finding suggests that they exerted higher forces to achieve greater speed.

However, data also showed that the grip-to-cutting ratio was 7.6 percent greater for the production pace than for the self-selected pace. This finding suggests there may be a trade-off between performance speed and the efficiency of energy transfer from the participant to the clay, because the participant must use greater energy to produce the desired work. The relative increase in grip force suggests that participants felt the need to grip the knives tighter for better control when working at production-paced cutting tasks.

Does this finding mean companies will have to modify the pace of their industrial cutting tasks and accept lower production rates in order to reduce injury exposures? "Not necessarily," says McGorry, who was

A simulated knife cutting task study suggests interaction between work surface height and orientation has a significant impact on wrist flexion and extension.

The bar graph, below right, shows results of the effect of surface orientation and height on flexion and extension of the wrist. Three surface orientations – 0, 30, and 60 degrees, at three surface heights – high (elbow height), medium (elbow height -12.5 cm) and low (elbow height -25 cm) are shown. The "best" combinations were: lowest height / 30° tilt (photo) and highest height / 60° tilt.

principle investigator for the study. According to McGorry, a slower pace would reduce the number of task repetitions per shift, but this reduction could be offset by increased efficiency. "In theory, the worker who is not as rushed will do a better job of cutting and create less waste on the line," says McGorry. "The ideal approach would be for companies to evaluate the extent to which decreasing line speed impacts yield and reported symptoms, and make their decisions based on what they find out."

Researchers Use Medical Technology to Explore Optimal Work:Rest Ratios

Delving deeper into the issue of task pace and injury exposure, Institute researchers recently began a new laboratory study to examine physiological responses to repetitive upper-extremity tasks such as knife cutting. The study is the first of its kind to use near-infrared spectroscopy (NIRS) to measure muscle oxygenation during repetitive upper-extremity tasks (see side article, p. 7), and the findings will be used to help define optimal work-to-rest ratios.

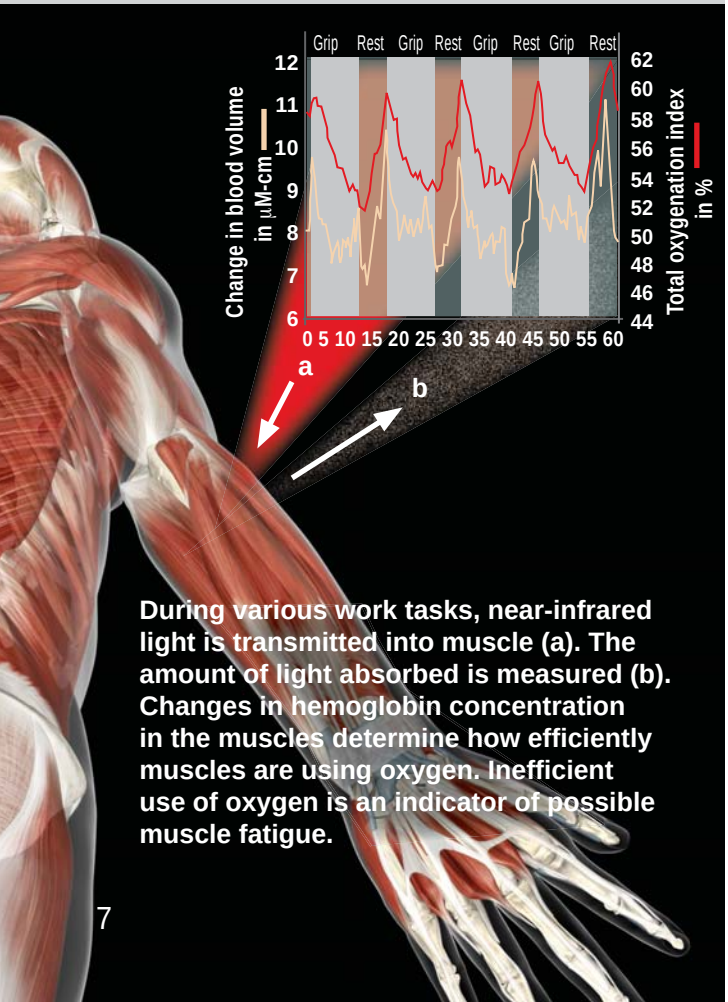
The 19 participants in this study performed nine half-day sessions of repetitive hand-grip tasks at three different work intensities (10, 15, and 25 percent of their maximal effort) and three different work-to-rest intervals. Research Institute scientists used NIRS to measure the participants' muscle oxygenation and blood volume responses in the flexor and extensor muscles during the tasks. They set values for work output and time spent on each task trial according to an established experimental protocol. Before and after

Near-Infrared Spectroscopy: What Is It?

Near-infrared Spectroscopy (NIRS) is a non-invasive diagnostic procedure that measures how efficiently human tissues use oxygen during physical activity. The procedure involves transmitting near-infrared light into the tissue and then measuring the amount of light absorbed by the tissue. An increase in light absorption indicates a high hemoglobin concentration in the tissue region, which means that the tissue is using oxygen efficiently. Inefficient use of oxygen is an early indicator of muscle fatigue.

Scientists at the Research Institute are finding that NIRS, while developed primarily for use in clinical or diagnostic settings, can be instrumental in the study of work-related upper-extremity tasks. In the laboratory, Liberty Mutual researchers apply this state-of-the-art technology to study how efficiently arm muscles (flexor and extensor) use oxygen during simulated upper-extremity repetitive work tasks. By quantifying changes in muscle oxygenation during various work tasks, researchers can compare the measured exposures to different task parameters.

This novel use of NIRS technology provides valuable information that researchers will use to develop recommendations for optimal work-to-rest ratios for high-risk, repetitive upper-extremity tasks.



During various work tasks, near-infrared light is transmitted into muscle (a). The amount of light absorbed is measured (b). Changes in hemoglobin concentration in the muscles determine how efficiently muscles are using oxygen. Inefficient use of oxygen is an indicator of possible muscle fatigue.

each trial, participants were asked to rate their perceived levels of discomfort (if any) in the upper extremity (hand, wrist, or arm).

Researchers are currently analyzing the data to examine how the muscles responded to different work-to-rest ratios, and the extent to which these responses correspond to reports of discomfort.

The application of sophisticated technologies is a cornerstone of the Liberty Mutual Research Institute's efforts to better understand the exposures that can lead to upper-extremity musculoskeletal disorders associated with occupational hand tool tasks. "These technologies give the Research Institute an unparalleled ability to identify and quantify specific exposures. Our findings will ultimately help businesses find ways to reduce the human and business costs associated with high-risk tasks such as industrial knife cutting," says Research Institute Director, Ian Noy, Ph.D.

Georgia Tech Taps Institute Force Measurement Expertise

Researchers at Georgia Tech Research Institute's Agricultural Technology Research Program recently announced the development of new Ergonomic Work Assessment System (EWAS) to identify musculoskeletal exposures associated with poultry cutting tasks. As part of the development process, Georgia Tech involved subject matter experts from the Liberty Mutual Research Institute for Safety and McMaster University, Ontario. The resulting tool integrates a fiber optic position measurement system, EMG sensors, and the Liberty Mutual Instrumented Knife to measure ergonomic factors related to these tasks.

EWAS is unique in that it can simultaneously collect real-time data on arm position, muscle response, and grip force during cutting tasks performed on an actual production line. As the worker performs tasks, data is transmitted wirelessly to a laptop computer, allowing researchers to study relationships among force, exertion, posture, and repetition. The information can be used to boost work efficiency on the deboning line and to correct inefficient movements by workers performing the cutting task.

The tool is part of Georgia Tech's broader research program aimed at helping poultry processors and ergonomists develop effective worker rotation schemes and training programs to minimize the risk of injury.

Reducing the Strain of Occupational Knife Cutting Tasks

Workers whose jobs involve frequent or prolonged knife cutting face an increased risk of repetitive motion injuries of the arms, hands, and wrists. Wayne Maynard, technical director of ergonomics and tribology at the Liberty Mutual Research Institute for Safety, says the best way to reduce these injuries is a three-pronged approach involving ergonomic job analysis to identify and prioritize risk factors; proper knife selection and maintenance; and a proactive rest or recovery time program to mitigate effects of muscle fatigue. This type of comprehensive approach can help reduce the frequency and severity of repetitive motion injuries resulting from occupational knife use.

Analyze the Job

The first step a company should take to address repetitive motion injuries, stresses Maynard, is to identify potential problem jobs (those contributing to higher injury and severity trends) and then perform an ergonomic analysis of those jobs. “It is important to observe the worker, and break the job down into tasks to gain an understanding of the physical requirements. Look at what the worker does during the course of an 8-, 10-, or 12-hour workday. What are the positions of the shoulder, elbow, wrist, and hand? What other tasks may be further stressing the same body parts? All of these factors need to be assessed,” he explains.

Based on the analysis, the next step is to identify potentially risky task elements and prioritize what can be done to improve the overall ergonomics of the job. “We know that people are strongest and fatigue less quickly when they employ neutral wrist and upper-body postures, and keep arms and elbows close to the body. So anytime we can identify non-neutral positions and redesign the task to allow workers to maintain more optimal positions, that will help reduce fatigue and increase productivity,” notes Maynard.

For example, if a task requires the worker to perform frequent overhead or above-shoulder reaching tasks, the job should be redesigned so that the work height

and angle allow for more neutral body postures. “These types of seemingly small improvements become very significant over time,” explains Maynard, noting that even if just one awkward task is eliminated, it can make a huge difference for people who perform this task day after day over weeks, months, and years.

Get the Right Knife and Keep it Sharp

One of the most important aspects of occupational knife safety is providing the right knife for the job. “Selecting a handle design that encourages straight or neutral wrist postures, and a blade that is specifically designed for the task helps ensure that workers will be able to perform the required tasks in the most efficient and safe way possible,” explains Maynard. However, he cautions that there may be more to proper knife selection than meets the eye. “There are ergonomic knives out there with handles designed to keep the wrist straight. However, their benefit depends on the orientation of and the precision required by the work,” he notes. For example, bent-angle knives are beneficial to shoulder and wrist posture for cuts performed at or just below elbow height. But these knives may not be helpful for cuts performed over-head or cuts below waist height.

Once knife selection is completed, keeping that knife sharp should be a top priority. “Our research has revealed 20 to 30 percent reductions in grip force, cutting moment, and cutting time with sharper versus duller blades,” notes Maynard. “Since prolonged exposure to high forces contributes to repetitive motion injuries, the more we can lower those forces, the better.”

Maynard recommends that companies develop a formal protocol for keeping knives sharp. Such a protocol should include:

- Periodic scheduled sharpening;
- Training workers how to properly sharpen a blade;
- Appropriate knife-sharpening equipment; and /or
- Sharp replacement knives available for workers to exchange with duller knives.

Incorporate Rest Breaks

Employers can also help reduce repetitive-motion injuries by implementing sufficient rest breaks throughout the course of the work day. Rest breaks – which can include regular scheduled breaks (morning, afternoon, lunch), micro-breaks (pauses in work), and scheduled light work activity – help the muscles to recover between job tasks. Job rotation is commonly employed to provide a period of light work activity in-between physically demanding tasks. However, Maynard advises a cautious approach to implementing rotation programs. “Always complete an ergonomic assessment of jobs with potential for rotation to ensure that physical risk factors are such that recovery time is optimized,” says Maynard. “Otherwise, you would only be guessing that job rotation provides a satisfactory level of recovery time.”

“We’ve just begun to scratch the surface in understanding what constitutes an optimal work-to-rest ratio for repetitive upper-extremity tasks,” says Maynard. “What we *do* know is that incorporating frequent ‘microbreaks’ along with formal scheduled breaks, and proactively building in light work activity, helps reduce worker discomfort by giving muscles and joints more recovery time between tasks.”

Although there is no way to fully eliminate the high forces and repetition associated with occupational knife cutting tasks, there are ways to mitigate the associated injury risks. Employers that use a combination of ergonomic task analysis and redesign, proper tool selection and maintenance, and adequate rest breaks help their workers remain as comfortable and injury-free as possible while maintaining productivity.

“This multi-faceted approach helps companies provide safety solutions based on the whole picture, rather than on just one or two aspects of a job,” says Maynard, who believes companies that commit to all three elements in this comprehensive approach will have the most success in reducing unwanted exposures that can lead to upper-extremity repetitive motion injuries.

The Most Disabling Workplace Injuries Cost Industry $48.6 Billion

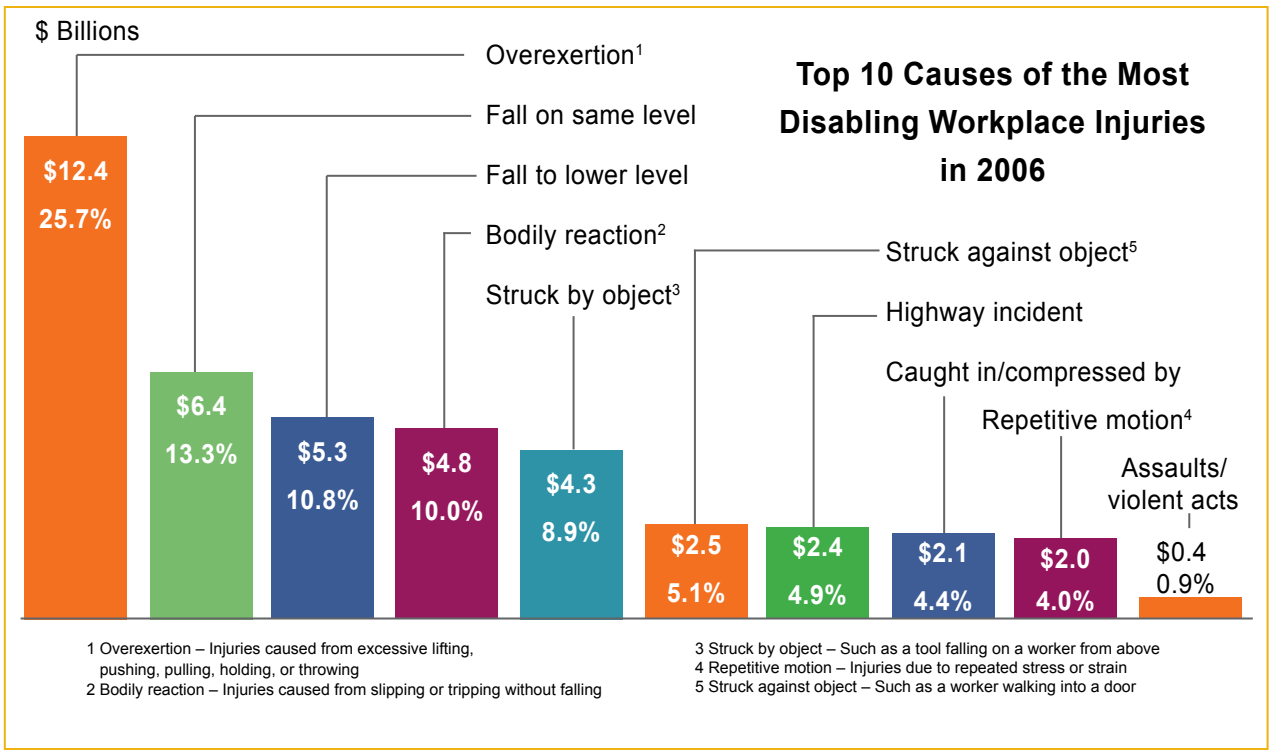
The estimated direct U.S. workers compensation costs for the most disabling workplace injuries and illnesses in 2006 were $48.6 billion. This finding and many others are presented in the 2008 Liberty Mutual Workplace Safety Index (WSI).

Produced annually, the WSI combines information from Liberty Mutual, the U.S. Bureau of Labor Statistics (BLS), and the National Academy of Social Insurance to identify the top causes of serious workplace injuries. Using more than 50 injury causes defined by the BLS, researchers ranked those that cause an employee to miss six or more days from work by workers compensation costs.

Overall, the top 10 categories produced 87.9 percent of the entire cost burden of disabling workplace injuries in 2006. As detailed in the chart below, *overexertion* maintained its first place ranking, accounting for more than one-quarter of the overall national burden at 25.7 percent and $12.4 billion, followed by *fall on same level*, *fall to lower level*, *bodily reaction*, and *struck by object*.

The remaining five injury event categories *(struck against object*, *highway incidents*, *caught in /compressed by*, *repetitive motion*, and *assaults and violent acts*) together accounted for less than 20 percent of the direct cost of disabling injuries in 2006. Among these, the *repetitive motion* category had the most significant drops of any category over the nine years of Index reporting. This category captured 4 percent of the total injury burden and cost industry $2 billion in 2006 (as compared to 1998 when *repetitive motion* was ranked fifth and comprised 6.3 percent of the total U.S. injury burden).

For more information on this year's WSI, including an overview of real growth trends for all 10 categories from 1998 through 2006, visit the Institute's website at www.libertymutual.com/researchinstitute.



Courtney Assumes Center for Injury Epidemiology Director Role

We are pleased to announce that Theodore Courtney, M.S., CSP, has assumed the position of Director of the Center for Injury Epidemiology (CIE) at the Research Institute for Safety. In his new role, he will oversee the CIE's mandate to conduct original epidemiological research into risk factors for occupational injury and to study the burden of workplace injury. He will also retain responsibilities for the Institute's extramural programs.

Courtney has advanced through several roles since joining the Institute as a research scientist in 1993. Prior to his current appointment, he served most recently as Director of Research Operations. Before that, Courtney directed the Institute's Quantitative Analysis Unit from 2003 to 2006, and served as the Associate Director for Operations from 1997 to 2002. He has been an appointed instructor in injury, ergonomics, and occupational safety at the Harvard University School of Public Health, Boston, since 1995.

Courtney holds a B.S. in applied psychology (human factors) from the Georgia Institute of Technology, Atlanta, and an M.S. in industrial and operations engineering from the University of Michigan, Ann Arbor. He is a board-certified safety professional (CSP), and serves on the Editorial Board of the *Journal of Occupational and Environmental Hygiene*. He received the Ergonomics Society's 2003 William F. Floyd Award and the CDC/2006 NORA Partnering Award for Worker Health and Safety for his work with colleagues in advancing slips and falls research and research methods.

"I am very pleased to welcome Ted as Director of the CIE," says Ian Noy, Ph.D., director of the Liberty Mutual Research Institute for Safety. "His extensive knowledge of the field of occupational injury and prior leadership experience at the Institute will position the center to play a vital role in our future research. I would also like to extend my appreciation to Dr. David Lombardi who has very capably served as interim director of the CIE during the search process."

Established in 2001 as the Quantitative Analysis Unit, the CIE conducts epidemiological studies to increase understanding of the causes and distribution of workplace injuries. In addition to conducting field and data studies, CIE research scientists identify and develop promising design and analytical methods. The CIE also produces the Liberty Mutual Workplace Safety Index (see p. 10).

Visiting Scholar Collaboration Examines Injury Data Classification

Purdue University Professor Mark R. Lehto, Ph.D., served as the Research Institute's 2008 Visiting Scholar. During his three-month tenure, Lehto collaborated with research scientists to improve epidemiological research methods for analyzing injury narratives. The goal was to develop innovative processes that use computer algorithms to classify narrative text and help determine new injury prevention scenarios. Towards this goal, he worked with researchers to develop a semi-automated approach for classifying workers compensation claim narratives into the Bureau of Labor Statistics event classifications. The resulting computer algorithms classified many of the narratives with high accuracy and ultimately may reduce the difficulty of reviewing and classifying large administrative datasets.

Lehto also worked with the Institute researchers to explore new uses of the Bayesian methodology, a statistical theory that starts with a known belief and uses conditional probabilities to derive a new outcome. The resulting submitted paper, "Electronic Application of Bayesian Methods is a Useful Tool for Classifying Injury Narratives into Cause Groups," compares and contrasts the application of two different Bayesian methods for classifying injury narratives in large administrative databases into event cause groups. Lehto continues to collaborate with the Research Institute and is working on additional papers resulting from his tenure.

"The Visiting Scholar Program provides an opportunity to work with fellow scientists on just research," says

Lehto. “The experience not only provided me with extra insight for interacting with students, but also helped me to see what problems are out there, and what is important to the practitioners in the field. It has been helpful to germinate some new ideas and perspectives. I’m grateful for the opportunity.”

At Purdue, Lehto is an associate professor of Industrial Engineering. He also serves as the co-chair of the Interdisciplinary Graduate Program in Human Factors, and technical advisor in Industrial Engineering for the Purdue Technical Assistance Program. His research focuses on human decision-making, hazard communication, safety, and ergonomics.

Lehto has interacted extensively with industry and many other groups during his career at Purdue. Currently, he is the president of Consumer Research, Inc. (West Lafayette, IN). He is an author of five books and 19 book chapters, and his volumes on the subject of warnings have become standard field references. He has published extensively in peer-reviewed journals and presented widely to international audiences.

Lehto received a Ph.D. in Industrial and Operations Engineering from the University of Michigan, an M.S.I.E. in Industrial Engineering from Purdue University, and a B.S.I.E. in Industrial and General Engineering from Oregon State University. He has served as a Director, for the Institute of Industrial Engineers, and the Human Factors and Ergonomics Society Forensics Group, and is involved with a number of additional professional organizations.

The Visiting Scholar Program began in 1994. Each year, the Institute selects a senior researcher to collaborate on a new or ongoing research initiative. The program requires a minimum of one joint, peer-review publication and encourages a longer relationship between the Institute and the Scholar’s home institution.

Australian-Based Research Team Wins 2008 Liberty Mutual Medal

An Australian-based research team recently received the 2008 Liberty Mutual Medal in Occupational Safety and Ergonomics for their work on a large scale study of occupational health and safety in the Australian mining industry. The winning paper provided detailed information about the effectiveness of occupational health and safety management with respect to work hours and fatigue management; production bonus and safety incentive schemes; and occupational health and safety management systems, including consultation. The award was presented at the Annual Conference of the Human Factors and Ergonomics Society of Australia, in Adelaide, Australia, November 17-19, 2008.

The research project, commissioned by the New South Wales Mine Safety Advisory Council, was a comprehensive investigation of occupational health and safety management within the NSW mining industry. Researchers collected in-depth, quantitative data from more than 60 percent of the industry’s workplaces and qualitative data from more than 50 sites. Participative workshops for the whole industry helped to validate data and to develop improvement strategies. The report on their project, *Digging Deeper,* can be downloaded from the New South Wales Department of Primary Industries’ website (www.dpi.nsw.gov.au/minerals/safety/consultation/digging-deeper).

“Our investigation focused on people, their relationships, and the systems that drive organizations towards being healthy and safe,” says project leader Andrea Shaw, of Shaw Idea Pty., Ltd. “Not only does the research contribute to occupational health and safety in the New South Wales mining industry, but it also has the potential to have wider impact in this and other industries around the world. It’s an honor that our work has earned this recognition from Liberty Mutual and the IEA.”

The annual award, presented by the Liberty Mutual Research Institute for Safety and the International Ergonomics Association (IEA), recognizes outstanding original research leading to the reduction of work-related injuries and/or to the advancement of theory, understanding, and development of occupational safety research. The Medal is awarded to the authors of an original scientific paper that meets criteria for innovation and impact. An international review committee, established by the IEA, selects the winning contribution from among the applicants worldwide. For more information on the Liberty Mutual Medal, visit the IEA’s web site at http://www.iea.cc/.

Joint Fellowship Program Encourages Safety Research

Lauren A. Murphy of Portland State University, Portland, OR, and David G. Kidd of George Mason University, Fairfax, VA, received Safety Research Fellowships through the joint program between American Society of Safety Engineers Foundation (ASSEF) and the Liberty Mutual Research Institute for Safety. The students completed the fellowship during the summer, working on research projects in collaboration with Research Institute scientists.

Lauren Murphy worked with researchers to conduct a literature review examining the potential effects of social modeling on safety behavior. Researchers examined existing safety-oriented social modeling investigations and reviewed parallel research areas, such as training, transportation, and aviation, to provide a systematic integrated review. Based on their findings, the researchers developed a preliminary conceptual model that will aid future social modeling research as it pertains to safety. The model aims to identify particular antecedents to safety behavior that can be enhanced through various strategies, such as training. It may also point to ways that supervisors and organizations can change the work environment to encourage continuous safety behavior from employees.

"I had an excellent experience," says Murphy. "I learned so much beyond the scope of my project. I met a number of exceptional researchers who gave me valuable advice for my future. It's an honor to have had this experience and to have taken part in some of the outstanding work at the Research Institute."

Currently, Murphy is working on a Ph.D. in Industrial/Organizational Psychology at Portland State University. At the University, she also serves as a research assistant and is a research consultant at the Portland Water Bureau. She has a B.S. in Psychology from the University of Massachusetts, Amherst.

David Kidd collaborated on an investigation of people's perceptions of their distracted driving performance, how that subjective perception differs from their actual driving performance, and their ability to adapt to distractions over time. In the study, 12 young drivers drove an instrumented van around a closed-loop test track. The drivers performed several driving tasks with and without a secondary task, over four experimental sessions. Researchers measured driver performance during various driving tasks and secondary tasks, and asked drivers to estimate their perceived level of performance on each task. Preliminary findings suggest that, in general, performance decrements did not decrease for most driving performance measures.

"The fellowship was a rewarding and unique experience," says Kidd. "It was a privilege to conduct driving research using a real vehicle in a test track environment. I was able to learn new methodologies and gain practical knowledge that strengthened and diversified my research skills. I am extremely thankful to all of the individuals at the Liberty Mutual and ASSE who made my experience so successful and rewarding."

Kidd is pursuing a Ph.D. in Psychology/Human Factors and Applied Cognition at George Mason University, where he received his M.A. in Psychology. He earned a B.S. in Psychology from Virginia Polytechnic and State University in Blacksburg, VA.

Applications for 2009 ASSEF/Liberty Mutual Research Fellowship Program are due February 1, 2009. The program encourages research activity in the field of occupational safety. Among its goals are to familiarize graduate students, faculty members, and other researchers with current research projects, models, and applications; to expand their understanding of safety research; and to provide a forum for linking safety professionals, industry needs, and quality research programs. For more information, visit the ASSEF at www.asse.org/foundation.

Conferences

National Occupational Injury Research Symposium (NOIRS) 2008: Oct. 21 – 23, Pittsburgh, PA

- Assessing Floor Slipperiness: The Effects of Friction and Perception on Gait – C.C. Chang, Ph.D., C.P.E.
- The Stochastic Distribution of Available Friction Coefficient for Human Locomotion – W.R. Chang, Ph.D.
- Fractures in Construction: Activities, Events, Sources, and Disability Duration • Worker Slips and Falls in Limited Service Restaurants – T. K. Courtney, M.S., C.S.P.
- Self-Reported Postures and Task Parameters within the Construction Industry that Lead to Instability Upon Standing – A.T. DiDomenico, Ph.D., C.P.E.
- Patterns of Severe Work-Related Traumatic Hand Injury in the People's Republic of China – K. Jin, Ph.D.
- Etiology of Work-Related Electrical Injuries: A Novel Taxonomy and Narrative Analysis of Workers Compensation Claims – D.A. Lombardi, Ph.D.
- Design and Evaluation of Multi-Modal Methods to Follow-Up Multilingual Fast-Food Workers in a Prospective Cohort Injury Study – S.K. Verma, M.B.B.S., M.P.H.

3rd International Scientific Conference on Occupational and Environmental Health: Oct. 21 – 23, Hanoi, Vietnam

- Occupational Safety Surveillance in the 21st Century: Xuan Tien Commune, Vietnam – H. Marucci-Wellman, Sc.D.
- Shaping Research to Address National Occupational Injury Research Needs – Y.I. Noy, Ph.D.

Fall 2008 Meeting of the Workers Compensation Research Group: Nov. 14 – 15, Hopkinton, MA

- Early Use of MRI for Work-Related Acute Low Back Pain – B.S. Webster, B.S.P.T., P.A.-C.
- Urban-Rural Differences in Work Disability Following Occupational Injury: Are They Related to Differences in Healthcare Utilization? – A.E. Young, Ph.D.

61st Annual Scientific Meeting of the Gerontological Society of America: Nov. 21 – 25, National Harbor, MD

- Factors Associated with Retirement-Related Job Lock in Older Workers with Recent Occupational Injury – G.S. Pransky, M.D., M.Occ.H.

Publications

Ciriello, V.M., "Does Wearing a Non-Expanding Weight Lifting Belt Change Psychophysically Determined Maximum Acceptable Weights and Forces," *International Journal of Industrial Ergonomics*, Vol. 38, pp. 1045-1050, 2008

DiDomenico, A.T. and Nussbaum, M.A., "Interactive Effects of Physical and Mental Workload on Subjective Workload Assessment," *International Journal of Industrial Ergonomics*, Vol. 38, pp. 977-983, 2008

Helmhout, P.H., Staal, J.B., Maher, C.G., Peterson, T., Rainville, J., and Shaw, W.S., "Exercise Therapy and Low Back Pain: Insights and Proposals to Improve the Design, Conduct, and Reporting of Clinical Trials," *Spine*, Vol. 15, No. 33, pp. 1782-1788, 2008

Huang, Y.H., Rau, P.L., Zhang, B., and Roetting, M., "Chinese Truck Drivers' Attitudes Toward Feedback by Technology: A Quantitative Approach," *Accident Analysis and Prevention*, Vol. 40, No. 4, pp. 1553-1562, 2008

Lesch, M.F., "A Comparison of Two Training Methods for Improving Warning Symbol Comprehension," *Applied Ergonomics*, Vol. 39, No. 2, pp. 135-143, 2008

Lesch, M.F., "Warning Symbols as Reminders of Hazards: Impact of Training," *Accident Analysis and Prevention*, Vol. 40, No. 3, pp. 1005-1012, 2008

Li, Z., Chang, C.C., Dempsey, P.G., and Ziuwen, C., "Refraction Effect Analysis of Using a Hand-Held Laser Scanner with Glass Support for 3D Anthropometric Measurement of the Hand: Strategy Comparison and Application," *Measurement*, Vol 41, pp. 851-861, 2008

Maikala, R.V., and Bhambhani, Y.N., "Functional Changes in Cerebral and Paraspinal Muscle Physiology of Healthy Women During Exposure to Whole-Body Vibration," *Accident Analysis and Prevention*, Vol. 40, No. 3, pp. 943-953, 2008

McGorry, R.W., Chang, C.C., DiDomenico, A.T, "Rearward Movement of the Heel at Heel Strike," *Applied Ergonomics*, Vol. 36, No. 6, pp. 678-684., 2008

Robertson, M.M., Huang, Y.H., O'Neill, M.J., and Schliefier, L.M., "Flexible Workspace Design and Ergonomics Training: Impacts on the Psychosocial Work Environment, Musculoskeletal Health, and Work Effectiveness Among Knowledge Workers," *Applied Ergonomics*, Vol. 39, No. 4, pp. 482-494, 2008

Wasiak, R., Young, A.E., Roessler, R.T., McPherson, K.M., van Poppel, M.N.M., and Anema, J.R., "Measuring Return to Work," *Journal of Occupational Rehabilitation*, Vol. 17, No. 4, pp. 766-81, 2008

A Message from the Director...

Y. Ian Noy, Ph.D.
Vice President and Director

Dear Readers,

As people all across America sharpen their knives to carve the traditional holiday turkey, we go to press with our sixth issue of *From Research to Reality*, which focuses on occupational knife safety. The Institute's research in this area has yielded new technologies, force data, and ergonomic knowledge to help reduce the exposures associated with on-the-job knife use.

From laboratory studies of simulated knife cutting tasks, to field studies in meat packing plants, our research uses a unique direct measurement approach to understanding and combating the associated risk of repetitive motion injuries. Our findings have significance across many industry sectors including food processing, restaurants and hospitality, manufacturing and construction – and may even provide everyday knife users with some useful safety insights.

This issue also highlights several positive Institute developments including the recent appointment of Ted Courtney, M.S., C.P.E. as Director for the Center for Injury Epidemiology, and the presentation of the 2008 Liberty Mutual Medal in Occupational Safety and Ergonomics. We thank the International Ergonomics Association for their cooperation in making this award possible and for their selection of a most worthy contribution from a record number of high quality submissions.

As always, we hope you find our newsletter informative, and we welcome your comments or suggestions.

from Research to Reality

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From Research to Reality® is a publication of the Liberty Mutual Research Institute for Safety, an internationally recognized occupational safety and health research facility. Through its broad-based investigations, the Institute seeks to advance scientific, business-relevant knowledge in workplace and highway safety and work disability. The Institute's findings are published in the open, peer-reviewed literature and often serve as the basis for recommendations, guidelines, and interventions used by industry to help reduce workplace injury and related disability.

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