Institute Insider

Volume 13, Number 2 Spring/Summer 2010

The Newsletter of the Institute for Ergonomics at The Ohio State University
At the forefront of Human Factors since 1950

In this Issue...

Special Issue: Student Accomplishments, Awards, Research, and Job Opportunities

The core of any successful human factors/ergonomics program is a high level of student involvement, dedication, and innovative thinking.

Ohio State's graduate programs in physical ergonomics and cognitive engineering continue to nurture students who develop diverse interests, achieve high levels of expertise, and become active in local HF/E groups and professional organizations.

This issue of the *Insider* highlights several of these areas of accomplishment, including:

- **Academics**. Students who have recently graduated with a Masters or PhD are featured on page 6;
- **Research Conducted by Former Students**. One such project, from a past graduate student, is described on page 7; and
- **Publications**. Abstracts of student research begin on page 9.

These achievements often qualify for HF/E **student awards**. Details on one honor is located on page 7.

Finally, businesses and organizations continue to seek recent graduates for HF/E **part-time internships and full-time positions**. Information on recent opportunities is listed on page 8.

Institute Researchers Share in $1 Million Ohio Third Frontier Grant to Improve Low-Back Injury Treatment

On June 23rd, the Ohio Third Frontier Commission awarded a $1 million biomedical grant to finalize the design and commercialization of equipment to measure clinical kinematics of the lumbar spine in patients with back injuries.

The grant allows **William S. Marras** and **Sue A. Ferguson** to develop technology that can lead to more effective treatments among those who suffer from back injuries.

Dr. Marras and Dr. Ferguson will be part of a Columbus OH-based group who will collaborate with:

- **Lanx, Inc**—A biotech firm that provides surgeons with innovative spinal products aimed to improve quality of care;
- **OrthoNeuro**—Specialists who diagnose, treat, rehabilitate, and prevent musculoskeletal disorders in patients;
- **The Cleveland Clinic**—Ranked as one of the best hospitals in the US; and
- **Ohio Spine Network**—Makers of surgical and medical instruments.

The companies American Medical Management, KB Medical, and RBK Spine also will be involved.

More about the Ohio Third Frontier program can be found at www.development.ohio.gov/ohiothirdfrontier.

AT Ohio Offers Loan Program for Dvorak Keyboards

The most popular keyboard layout design in use today is the QWERTY. Developed in 1874, this layout is named after the first six characters on the left of the keyboard's top row of letters. Its design arose from problems with key jams on manual typewriters.

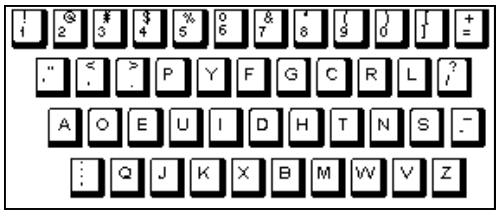
In contrast, a Dvorak layout keyboard, designed and patented in 1936, is intended to increase typing speed and efficiency by locating the keys used most often in the home row.

Interested in trying a Dvorak keyboard? Assistive Technology of Ohio has these keyboard types available to use. If you have hand use limitations, AT Ohio also has keyboards to support left-handed or right-handed operation.

Interested persons can borrow an available Dvorak layout keyboard. A request form can be downloaded at www.atohio.org/devices. Items can be borrowed at no cost for up to 30 days.

The mission of AT Ohio is to help Ohioans with disabilities learn about or acquire assistive technology (i.e., devices, equipment, or services that assist individuals with disabilities to function independently at work, home, or school). This organization offers several programs and services to achieve this goal. In addition, it stays apprised of current legislative activities that affect persons with disabilities and educates legislators about the needs and concerns of these individuals.

QUERTY keyboard layout



Dvorak keyboard layout

More information about AT Ohio's various programs and services can be found on their web site, www.atohio.org.

AT Ohio Asks for Computer Equipment Donations

AT Ohio is requesting computer equipment donations for its Computer Refurbish and Redistribution Program.

This organization has been refurbishing computers for individuals with disabilities since 2004. More than 2,500 computers have since been distributed statewide.

Hard drives from donated computers are completely erased. Damaged drives are replaced, machines are cleaned, and modems are added for consumers, who are charged a small fee to help defer shipping and storage costs.

As a Microsoft Authorized Refurbishing Organization, AT Ohio can also install a Microsoft operating system onto the computers.

Minimum requirements for recycled (desktop and laptop) computers and equipment are: 1GHz or faster processor; at least 512MB of RAM; a 10GB or more hard drive; a CD-ROM or DVD-ROM drive; keyboard; mouse; monitor (in full working condition); speakers; and cords.

AT Ohio currently accepts donations only at its Kinnear Road location in Columbus but is seeking businesses or non-profits that can serve as area drop-off locations. Special arrangements can be made for those making donations of ten or more computers.

For more information about donating computers, contact Eric Rathburn (614-688-3222, toll free at 866-801-7306, or rathburn.17@osu.edu.

IN THE NEWS

In February 2010, recent research published by **William Marras** on the injury risks from pushing and pulling during patient handling was highlighted in *Safe Lifting News*, a website aimed to support safe lifting and caregiver injury prevention programs. A summary of this research can be read at (www.safeliftingportal.com/newsletter/10-02).

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Gary Allread presented the yearly "Ergo 101" pre-conference workshop at the 13th Annual Applied Ergonomics Conference in San Antonio TX (March 22nd, 2010).

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In April 2010, an editorial written by **David Woods** and P. Carlo Cacciabue was published in a special issue of *Cognition, Technology & Work*, This issue honored Dr. Erik Hollnagel, an internationally known expert in resilience engineering, system safety, human reliability analysis, cognitive systems engineering, and intelligent man-machine systems.

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Gary Allread gave a one-day advanced ergonomics workshop titled, "Developing and Justifying Ergonomics Improvements," at the annual Ohio Safety Conference in Columbus OH, which is sponsored by the Ohio Bureau of Workers' Compensation (April 1st, 2010).

OSC 10 Ohio Safety Congress & Expo

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Thomas R. Waters, of the National Institute for Occupational Safety and Health, has joined the Institute for Ergonomics' Advisory Board.

Dr. Waters is Chief of the Human Factors & Ergonomics Research Section at NIOSH in Cincinnati OH. Welcome, Tom!

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Registration Open for Autumn 2010 Ergonomics Short Course

Mark your calendars! The Autumn offering of the Institute for Ergonomics' Short Course, *Putting Ergonomics Into Practice*, has been scheduled.

This Course will be held **October 19th** through **October 22nd, 2010**, at the new Ohio Union in Columbus.

Several Institute members take part in this Course, which teaches a systematic method to reduce injuries and improve work processes in companies and organizations.

Course topics will include:

- How to address body size differences among employees;
- Principles of workplace biomechanics;
- Applying these principles to low-back, shoulder, neck, and hand/wrist work activities;
- Using ergonomics assessment tools;
- Cognitive workplace issues; and
- Successful ergonomics processes.

More information, including a registration form, can be downloaded from the Institute's web site, www.ergonomics.osu.edu, or by emailing a request to ergonomics@osu.edu.

For questions about this Short Course, contact Gary Allread (614-292-4565 or allread.1@osu.edu).

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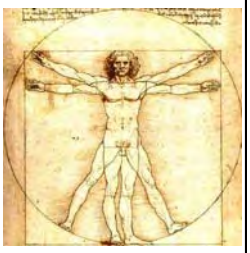
The most thorough ergonomics class I've been to!

— Brandy Hanson

Environmental & Safety Coordinator

Swagelok Company

The latest *Professional Society News*



Dr. Philip Smith has taught in Ohio State's Industrial & Systems Engineering Program for the past 30 years.

Information about Dr. Smith's distinguished career can be obtained from his web site, http://ise.osu/edu/biosketch_PSmith.cfm.

Smith Honored

Philip J. Smith, Executive Director of the Institute for Ergonomics, has been recognized for his significant contributions to air traffic management by the Air Traffic Control Association.

The ATCA has awarded Dr. Smith with the prestigious David J. Hurley Memorial Award for Aviation Traffic Management, in recognition of his innovative accomplishments and valuable contributions to the National Air Transportation System.

Specifically, Dr. Smith was recognized for his superb contributions, through development of innovative solutions for reducing traffic congestion and weather delays. His research has been vital to the understanding of near-term challenges in airspace flow management and collaborative decision-making. It also has been repeatedly shown to produce significant cost savings for the FAA and industry by developing solutions to improve the resilience and predictability of NAS operations.

Dr. Smith has been a significant contributor to the collaborative decision making program in the Air Traffic Organization–System Operations service unit for over a decade. His research contributes to the Next Generation Air Transportation System by developing and validating innovations in collaborative aviation traffic management.

Kudos, Phil, on being awarded this great honor!

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Upcoming Conferences & Meetings

AHFE International Conference 2010
Miami FL
July 17th - 20th, 2010
(www.ahfe2010.org)

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ICCM 2010 — 10th International Conference on Cognitive Modeling
Philadelphia PA
August 5th - 8th, 2010
(http://iccm2010.cs.drexel.edu)

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OAAAA Annual Conference on Aging
Columbus OH
September 13th - 14th, 2010
(www.ohioaging.org)

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2010 Human Factors and Ergonomics Society — Annual Meeting
San Francisco CA
September 27th - October 2st, 2010
(www.hfes.org/web/HFESMeetings/2010annualmeeting.html)

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IEEE Conference on Cognitive Methods in Situation Awareness and Decision Support
Miami FL, February 22nd - 24th, 2011
(http://cogsima2011.org)

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14th Annual Applied Ergonomics Conference
Orlando FL, March 21st-24th, 2011
(www.iienet.org/Ergo/Conference)

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14th International Conference on Human-Computer Interaction
Orlando FL
July 9th - 14th, 2011
(http://hcii2011.org)

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Research Corner

Quantitative Dynamic Measures of Physical Exposure Predict Low Back Functional Impairment

WS Marras, **SA Lavender**, **SA Ferguson**, **RE Splittstoesser**, and **G Yang**

Spine, 35(8):914–923

Abstract

Study Design. Prospective field study of work exposure and changes in back function.

Objective. Quantify dynamic physical exposures in the workplace and their association with decreases in kinematic back function (indicative of low back pain [LBP]).

Summary of Background Data. Previous epidemiologic studies of work have measured gross categories of exposure and found moderate relationships with LBP.

More precise quantitative measures of exposure and spine function were hypothesized to increase the chances of identifying any significant associations.

Methods. Three hundred and ninety real-time physical exposure measures were collected from distribution center workers performing repetitive manual materials handling tasks. Low back health effect measures were quantitatively measured prospectively for workers performing each of the jobs using a kinematic measure of function.

Results. Significant decreases in spine function were observed in workers associated with 40% of the jobs sampled.

Numerous significant univariate odds ratios were identified that indicated an association between physical exposure and decreased function. A multivariate model including right lateral trunk velocity, timing of the maximum dynamic asymmetric load moment exposure, and the magnitude of the dynamic sagittal bending moment, predicted reduced spine function well. The model resulted in excellent sensitivity (85%) and specificity (87.5%) as well as excellent positive predictive value (89.5%) and negative predictive value (82.4%).

Conclusion. This study suggests that, with proper quantification of job exposure and spine function, it is possible to identify which dynamic physical exposures are associated with reduced spine function and increases in low back pain.

PUBLISH or PERISH

Investigating Reduced Bag Weight as an Effective Risk Mediator for Mason Tenders

KG Davis, SE Kotowski, J Albers, and **WS Marras**
Applied Ergonomics, available online (www.sciencedirect.com).

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Quantitative Biomechanical Workplace Exposure Measures: Distribution Centers

WS Marras, **SA Lavender**, **SA Ferguson**, **RE Splittstoesser**, and **G Yang**
Journal of Electromyography and Kinesiology, available online (www.jelectromyographykinesiology.com/inpress).

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Quantitative Dynamic Measures of Physical Exposure Predict Low Back Functional Impairment

WS Marras, **SA Lavender**, **SA Ferguson**, **RE Splittstoesser**, and **G Yang**
2010, *Spine*, 35(8):914–923

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These are the latest publications authored by Institute members (indicated in **boldface** font)

Graduate Student News

Graduate Student Degree Completions and Recent Activities

Rajiv Gumpina completed his Masters degree requirements and graduated in December 2009.

Under the guidance of Dr. Carolyn Sommerich, Rajiv conducted an, "Assessment of Human Response to DC Torque Tools for Experienced Subjects using a Dynamic Biomechanical Model." An abstract of this work is provided on page 10.

Rajiv is now working as a Certified SAS Professional in East Brunswick NJ. He is also seeking a full-time position that uses his biomechanics skills and can be contacted via email at g.rajivkumar@gmail.com.

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Best wishes to **Laura Czuba**, who graduated with her Masters degree during Winter Quarter 2010. She had been a recipient of a NIOSH Training Grant.

With her advisor, Dr. Carolyn Sommerich, Laura completed her safety practicum project, titled, "Ergonomic and Safety Risk Factors in Home Health Aides: Assessment and Intervention." (See the research abstract on page 11.)

Laura is now employed with TSO Management, a national home healthcare company. She is working primarily on the implementation of a workload distribution system across all company offices. This system will assess risk factors and determine the potential for changes that reduce physical workloads on home health aides. (She had initially developed this system while working on her safety practicum.) Laura's email address is lauraczuba@yahoo.com.

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Kudos to **Gang Yang**, who successfully defended his doctoral dissertation in May 2010 and graduated in Spring Quarter 2010.

Working with advisor William Marras, Gang studied, "The Biochemical Response to Biomechanical Loading on the Low Back during Physical Work Exposure." (His research abstract can be found on page 9.)

Dr. Yang is currently searching for a faculty position that will allow him to continue his research. He can be reached via email, at yang_gang72@yahoo.com.

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Riley Splitstoesser spoke on, "Spinal Loading and Biochemical Responses to Personality and Mental Load during Repetitive Lifting," at the Annual IIE Conference and Expo in Cancún, Mexico (June 6th, 2010).

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Students: Consider joining the Human Factors and Ergonomics Society Student Chapter at The Ohio State University.

Membership Information and chapter events can be found on its web site, http://hfes.org.ohio-state.edu.

Graduate Student News

What Are They Up To Now?

A 1996 graduate of Ohio State's cognitive engineering program, **Jennifer Watts-Perotti** has been applying her expertise to studying the use of technology in the mobile workplace.

This is a rapidly growing field of interest, as reports estimate that, by the end of 2011, 75% of the US workforce and 80% of Japan's workforce will be mobile workers. These individuals will wish to use the latest technology so they can essentially work from almost anywhere.

Jennifer is an ethnographer with Xerox; she is interested in studying what technology will help workers be more efficient and productive.

In a recent study, "The Future of Work," Jennifer and her colleague Mary Ann Sprague studied a group of non-traditional, virtual workers. They observed how these workers used technology, collaborated with co-workers, and integrated work and personal life.

Key results from this study found that mobile workers:

- Still find there is no easy way to incorporate information from the paper they use (e.g., notes, business cards) with their digital devices;
- Are not able to access information from wherever they are. That is, they wish to see the same material from their laptop, PDA, or Smartphone; and
- Are using their phones in parallel with their laptops; further, a Smartphone is often replacing the computer as the "go-to" device for obtaining information.

A summary of this research can be read online, at www.xerox.com/innovation/news-stories/futureofwork/enus.html. Jennifer is reachable at jennyperotti@yahoo.com.

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Jennifer Watts-Perotti (left), pictured studying a mobile phone user.

Ethnography is the study groups and/or cultures over time, with the goal of better understanding the workings of that group/ culture.

Student Award Opportunity

Call for HFES Student Award Applications

The HFES Student Affairs Committee will recognize the accomplishments and service to the Society of students and student chapters through two awards.

The Student Member With Honors Award honors those who have made outstanding contributions to the discipline and HFES while a graduate or undergraduate student. Eligible students must meet several membership, GPA, service, research publication/ presentation, and project requirements.

The Outstanding Student Chapter Award will be judged on the number and quality of Chapter activities, which include: recruitment; guest speakers; field trips; collaboration; outreach/volunteerism; service to HFES; social; exploration; info dissemination; mentorship; student membership in HFES; continuous improvement; and creativity. Recognition levels are: Gold (activity in at least nine categories); Silver (at least six categories); and Bronze (at least three categories).

The deadline for receiving award applications is **July 1st, 2010**. Additional application details can be obtained on the HFES web site (www.hfes.org/web/Students/students.html). Materials should be compiled and sent as an email attachment to Student Affairs Chair Sandra Garrett (garrett@clemson.edu).

Award recipients will be recognized at the 54th HFES Annual Meeting in San Francisco.

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Graduate Student News

Internship Opportunity with BWC

The Ohio Bureau of Workers' Compensation has **College Intern** opportunities for undergraduate or graduate students in industrial & systems engineering.

Flexible, part-time positions are available in the Pickerington, Ohio office, for a minimum of 15 hours per week.

Job Duties:

- Develop experimental designs to analyze workers' comp data for evaluating occupational safety & health hazards and intervention methods. Use sampling methods to determine health & safety parameters (e.g., gather data, determine type/size of a sample group, develop reporting forms). Use databases for research projects, analyze data using descriptive statistics, basic inferential tests, and advanced statistical procedures.
- Review and synthesize state-of-the-art information found in literature reviews, to evaluate and develop occupational safety & health intervention methods.
- Conduct benchmarking research relative to general safety research and in applying intervention technology for private and public employers and agencies.
- Interface and work with technical experts at BWC and other agencies (i.e. NIOSH) in safety research projects.

Major Intern Characteristics include: a knowledge of basic statistics; additional coursework in occupational health & safety; experience using large databases; data collection; writing; and cooperating with co-workers on group projects.

Minimum Qualifications for Employment:

- Undergraduate or graduate student in biostatistics, statistics, mathematics, public health, computer science, engineering or comparable field, with at least one term of statistics.
- Competent in Microsoft Word, Excel, and Access necessary to organize and produce reports and documents and analyze data.

For More Information, contact Don Bentley, Director of Technical Support (614-752-8647 or Donald.B.12@bwc.state.oh.us).

Employment in Motion Analysis

The Motion Analysis Laboratory in the Department of Orthopedic Surgery at Rush University Medical Center (near downtown Chicago) is seeking a **Research Engineer**.

This lab, directed by Markus Wimmer and Kharma Foucher, features 12 Oqus cameras (Qualisys), two high-speed video cameras (Point Grey), five Bertec force plates, a 16-channel Noraxon wireless EMG system, and other biomechanical testing equipment.

Research Areas. Biomechanics of hip and knee osteoarthritis; biomechanical function of patients after total hip & knee arthroplasty.

Duties and Responsibilities:

- Maintain IRB-related documents and subject testing database; generate motion study reports.
- Support research activities within the core MAL group (e.g., subject testing, literature searches, manuscript and presentation visuals).
- Help collaborators from within and beyond Orthopedics, by initiating and conducting short– and long-term research studies.

Qualifications. Masters in biomedical engineering, bioengineering, kinesiology, biomechanics or related fields required. Position also can be adapted somewhat to suit the needs of an early-stage PhD, within the constraints of the noted responsibilities. Prior motion analysis experience is not strictly required, but some biomechanics research experience, especially with human subject testing, is preferred. Strong oral and written communications skills are required, as is basic statistics knowledge, and MATLAB programming experience. Fluency with Microsoft Word, Excel, PowerPoint and Access is desired.

For more information, submit a CV or resume and cover letter to Dr. Kharma Foucher (kharma_c_foucher@rush.edu).

Students: Have you registered with Ohio State's Engineering Career Services? This service will alert you to companies coming to interview on campus, send you job postings, assist with resume writing, and much more.

Register online, at (https://career.eng.ohio-state.edu).

Engineering Career Services
Connecting engineering students with employers

Graduate Student News

Recent Student Research

The Biochemical Response to Biomechanical Loading on the Low Back during Physical Work Exposure

Gang Yang

Doctoral Dissertation

Abstract

Work-related musculoskeletal disorders impose a substantial economic burden on society. Low back pain represents one of the most common and costly health issues in the workplace.

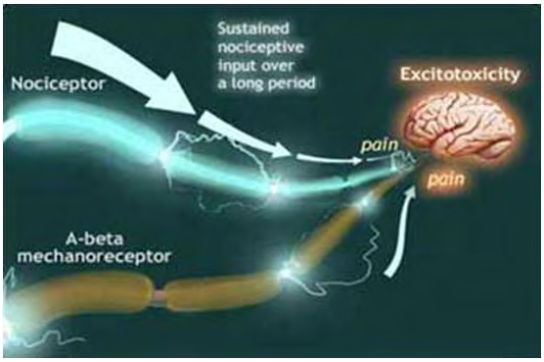
Previous research suggests that cytokines play a key role in the development of back pain. However, how biomechanical loading acting on various tissues in the low back initiates cytokine response is not clear.

The purposes of this study were to assess whether there are acute biochemical responses to physical work that stresses the low back and to identify specific tissue loading that might lead to the biochemical responses using advanced biomechanical modeling techniques.

Twelve healthy male subjects completed three sessions of experimental tasks (control, lifting and lowering 5 lbs and 25 lbs for two hours at a frequency of 12 exertions per minute). Blood was sampled before, immediately after, two hours, and 24 hours after the physical work. Plasma was analyzed for IL-1β, IL-10, TNF-α, IL-6, IL-8, and PGE2. Blood was also analyzed for white blood cell (WBC) counts with differential and creatine kinase (CK) level.

Biomechanical data were collected during the tasks and used as inputs into an EMG-assisted lumbar spine model to calculate three-dimensional end plate loading at each lumbar disc level and trunk muscle forces.

The plasma concentrations of IL-1β and TNF-α



increased significantly two hours after the 25-lb task compared to their baselines ($p<0.05$). The plasma IL-6 level elevated from the baseline immediately after the 5-lb lifting task ($p<0.05$), while it also significantly increased immediately after and two hours after the 25-lb lifting task ($p<0.0001$). The magnitude of changes in IL-6 levels was greater for the 25-lb task when compared with the 5-lb task and the control condition. The WBC and granulocyte counts all significantly increased immediately after and two hours after both the 5- and 25-lb tasks ($p<0.001$), with the latter condition showing the greatest changes. The plasma CK levels continued to increase immediately after the task until 24 hours later for both weight lifting conditions ($p<0.05$).

Correlation analysis demonstrated that the changes of most biochemical variables were moderately correlated with the maximum spinal loads and muscle forces (Pearson's $r=0.3\sim0.7$). Multiple regression analysis found that the combinations of biomechanical and individual variables were able to predict 40-50% of the variability in biochemical responses.

In conclusion, the current study indicates that there are acute inflammatory responses which involve various cytokines, especially IL-6, after physical work at the occupational level. It may be possible to use inflammatory cytokines as biomarkers to monitor the physiological responses of the human body to biomechanical loading. Identifying the possible sources of cytokine up-regulation using an advanced biomechanical model may help develop more effective interventions to reduce the risk of low back pain in the workplace.

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This special issue of the *Insider* summarizes recently conducted research by Ohio State graduate students.

"Identifying the possible sources of cytokine up-regulation using an advanced biomechanical model may help develop more effective interventions to reduce the risk of low back pain in the workplace. "

Graduate Student News

Recent Student Research

Assessment of Human Response to DC Torque Tools for Experienced Subjects using a Dynamic Biomechanical Model

Rajiv Kumar Gumpina

Masters Thesis

Abstract (edited)

Manufacturing research often focuses on reducing production time and increasing efficiency. This includes study of powered torque tools, which increase task precision but are a major cause of injuries to the upper extremity, from overexertion, repetitive use, and vibration.

The goal of this study was to reestablish or compare relationships found in the literature between torque tool mechanical parameter estimates and independent variables, such as work orientation, handle displacement, joint hardness, and control algorithm, for users experienced with these tools.

The focus of this research was on torque tool "kickback;" that is, the inertia pulling on an operator's arm following a bolt-tightening operation. This kickback causes muscle overexertion and can lead to injuries, as can direction of the kickback.

Previous studies have focused on changing torque tool parameters and quantifying the outcome. Handle displacement and reaction forces have been found to correlate with subjective responses; tools having more displacement and requiring higher grip force were positively correlated with increased discomfort. Relating subjective rating to more tangible parameters can yield opportunities for improving torque tools.

Targeted torque for a task seems to directly affect subjective discomfort but is often unchangeable due to job requirements. However, the time taken to reach targeted torque may be manipulated. Shorter build-up times (associated with stiffer joints) may correlate with lower discomfort.

Torque tool control algorithms also appear to significantly impact muscle EMG activity and perceived exertion, but these findings were reported for inexperienced subjects.

Human subject testing has been used to validate many torque tool use hypotheses, but a major constraint is not injuring subjects; this makes studying injury mechanisms difficult. To overcome this, the human arm was modeled to study its response across various conditions. Static models appear to overestimate hand forces, compared to direct measurement. Thus, a more refined modeling was required.

A dynamic model was developed that represented the human arm as a second-order, single degree-of-freedom, spring-mass-damper system. The stiffness component represents the amount of active force an operator exerts when using a torque tool. The damping component represents the muscle tension produced to dampen the external perturbation (i.e., the 'kick-back'). The mass component represents the muscle mass involved or recruited in the muscle contraction.

This model along, with the method used to assess torque tool stiffness, mass, and damping parameters, has been more accurate in estimating human response, with correlations as high as 0.9. The model showed change in the values of the spring, mass, and damping elements as the user's posture changed.

Use of this dynamic model provided handle force estimates caused by powered tool torque use. It was found to be affected by work posture, tool properties, and joint hardness. It was also found that jobs requiring high handle force were associated with more injuries than those with less handle force.

It is evident that a need exists for biomechanical modeling to reproduce human responses that are more flexible and less risky. Along with a mechanical testing rig, this knowledge will be helpful for making decisions about reducing injuries caused by powered torque tools for assembly operations.

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The US Bureau of Labor Statistics reports that 27% of all hand tool related injuries are due to powered hand tools.

Graduate Student News

Recent Student Research

Ergonomic and Safety Risk Factors in Home Health Aides: Assessment and Intervention

Laura Czuba

Safety Practicum Project

Abstract

The home healthcare industry is one of the fastest growing segments of businesses in the US. There is a growth of demand for home healthcare services, which is expected to continue, due to: the increasing population of the elderly; the preference for being cared for within one's own home; and hospitals releasing patients sooner than ever before.

The home healthcare industry, compared to other healthcare sectors, presents a unique challenge of risk to workers because of the "uncontrollable" environment (patient's home). Among the various healthcare workers (in hospitals, nursing homes, and in home healthcare), home healthcare workers experience a greater number of lost workdays due to injuries, a higher cost of injuries, and higher turnover.

The goals of this project were to (1) improve our understanding of the risk factors to home health aides that may lead to injury and increased turnover and (2) test intervention ideas that evolved from the first part of the study, for potential effects, feasibility, and acceptance by home health aides.

Analysis of historical injury data (workers' compensation), worker surveys, direct observations of patient care and other tasks, and participatory workshops were conducted to systematically assess the home health aides' work. A pilot test of solution elements and interventions was conducted to evaluate the impact on the home health aides' workload and fatigue.

A workload distribution system based on three types of patient characteristics was created, which allowed for the redistribution of the physically demanding patients. A pilot test of the workload distribution system consisted of a convenience sample, which included 21 home health aides from a single office.

During Week 1 of the pilot test, the sampled home health aides who worked less than 50% of their time with patients categorized as a 4 or 5, with 95% confidence, perceived less fatigue (M=4.3, SD=2.4), compared to aides who worked greater than 50% of their time with patients categorized as a 4 and 5 (M=7.0, SD=1.7). In addition, with 95% confidence, the sample of home health aides that participated in the pilot who experienced a reduction in workload perceived significantly less fatigue (before: M=6.9, SD=1.2; after: M=4.8, SD=1.7) at the end of their workday when the workload distribution system was tested. Also, of the sampled home health aides who worked 100% of their hours with patients categorized as a 4 or 5 were 5.25 times more likely to perceive aches or pains at the end of their workday than those who worked 50% of their hours with patient categorized as a 4 or 5.

The home healthcare industry would likely benefit from the use of a workload distribution system. The sampled home health aides who experienced a workload reduction not only perceived significantly less fatigue at the end of their workday, but also expressed a desire for the workload distribution system to continue. The potential business outcomes or benefits of reducing fatigue and aches or pains in home health aides could reduce injuries, decrease turnover, lower workers' compensation, and increase employee satisfaction.

Home healthcare has been and will continue to be a critical industry; its workforce cares for our parents, our neighbors, and our friends who are elderly, disabled, or ill. Therefore, it is essential that companies and policymakers work to preserve the well-being of the home healthcare workforce.

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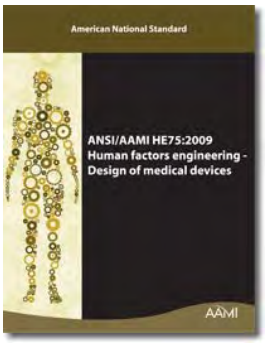
"The home healthcare industry would likely benefit from the use of a workload distribution system."

Allread Contributes to New Human Factors Standard for Medical Devices



Human Factors Engineering—Design of Medical Devices can be ordered from AAMI online, at www.aami.org.

The Institute's Program Director, **Gary Allread**, has contributed his expertise on anthropometry and biomechanics to a new medical device standard recently released by the Human Factors Engineering Committee of the Association for the Advancement of Medical Instrumentation (AAMI).

The 460-page document, AAMI HE-75:2009, *Human Factors Engineering—Design of Medical Devices*, will enable medical device manufacturers to incorporate broad user-interface design guidance into critical medical devices by taking advantage of the human factors/ergonomics literature.

HE-75 complements the existing HF/E process standard, AAMI HE-74:2001 (*Human Factors Design Process for Medical Devices)* by focusing primarily on design guidance across 25 sections, including displays, alarms, documentation, hand tools, and mobility. This new standard has extensive reference lists and a bibliography for users seeking additional detail.

The nearly decade-long effort was headed by Dr. Matthew Weinger (Vanderbilt) and Dr. Edward Israelski (Abbott Laboratories). Dr. Allread was part of the 25+ member committee composed of international experts from the medical device manufacturing industry, healthcare providers, clinicians, and government agency representatives, including the US Food and Drug Administration.

HE-75 contains relevant design advice and includes prescriptive design requirements, examples, checklists, and illustrated case studies that focus on a wide variety of medical devices.

The AAMI HF/E Committee has also prepared a companion and supplemental textbook, *Handbook of Human Factors in Medical Device Design*, which was edited by Dr. Weinger, Michael Wiklund (Wiklund Research & Design), and Daryle Gardner-Bonneau (Bonneau and Associates). Its 850+ pages add more material, advice, and case studies to the HE-75 document and is scheduled to be available from CRC Press(www.crcpress.com) in August 2010.

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