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Guest Editorial

Ergonomic Products

According to the International Ergonomics Association, "ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance." Or in fewer words, "the science of fitting the work to the worker". Ergonomist develop solutions to better fit the work to the worker by drawing on principles from engineering, physics, biomechanics, physiology, psychology and numerous others disciplines.

A potential framework for developing and evaluating ergonomic solutions may be described as follows: 1) conduct an analysis to identify each step involved in completing a task, 2) quantify the biomechanical, cognitive and psychosocial loads associated with each step of the task, 3) develop and implement changes to reduce those loads, 4) quantify changes in loads associated with the task, and 5) assess health and performance outcomes.

In the process of creating ergonomic solutions, the assessment of loads (i.e. the second and fourth step in this framework) is often overlooked; many interventions are implemented with few quantitative measures supporting their purported benefits. This was the motivation behind the current special issue of the journal which aims to draw attention to the role of quantifying biomechanical, cognitive and/or psychosocial loads in ergonomics.

By quantifying loads before developing an ergonomic solution, ergonomist can identify aspects of a task that may be particularly challenging or pose a high risk of injury. Quantifying loads after implementing a solution allows ergonomist to evaluate the solution more rigorously. With quantitative numbers, different solutions can be compared for their potential effectiveness in reducing loads.

This special issue presents seven original research studies and a review article in which a number of quantitative tools and methodologies are employed including, electromyography, electrogoniometers, force gauges, accelerometers, and self-report questionnaires. The studies cover a variety of sectors, among them, office work, consumer products, manufacturing, transportation and laboratory work.

In the office environment, keyboards are a potential source of injury to computer users. Asundi and Odell review the existing literature on the effects keyboard keyswitch design parameters have on user preference and biomechanical outcomes. They summarize major findings and suggest new avenues of research to improve comfort and reduce the risk of injury associated with keyboard use.

Computer workstations also play a significant role in office workers health. Computer work typically involves maintaining static postures for extended periods of time and therefore proper workstation configuration is critical. Asundi, Johnson and Dennerlein compared wrist kinematics and typing forces during computer work across two workstation configurations. Their measurements demonstrated a workstation configuration in which the keyboard is elevated and positively tilted would not negatively affect wrist kinematics or typing forces and therefore may serve as an alternative to the generally recommended configuration in which the keyboard is set flat at elbow height.

In the transportation sector, cargo transported on flat bed trailers is typically protected by covering them with large tarps. The placement and removal of these large tarps raises concerns of high musculoskeletal loads and dangerous falls from the flatbed. Marshall and Wells compared three tarping methods using a number of methods including force gauges, electromyography, heart rate monitors and self-report questionnaires. They concluded two methods provided a range of benefits including reduced physical demands and reduced risk of falling.

Manufacturing can expose workers to a wide range of risk factors depending on the specific job requirements.

Dale, Rohn, Burwell, Shannon, Standeven, Patton and Evanoff evaluated sheet metal assembly workers who work with hand tools that expose them to high frequency vibrations. They presented a method to quantify the change in vibration transmitted to the hand through the use of anti-vibration interventions under realistic work conditions. By evaluating workers under such conditions, they capture potential aspects of the task that may be missed under more controlled conditions.

In the laboratory, two studies evaluated workers who use micro-pipettes, a task that can involve highly repetitive motions, high thumb loads and sustained non-neutral postures. Rempel, Janowitz, Alexandre, Lee and Rempel used both surface electromyography recordings and self-reported usability evaluations to compare upper extremity supports during pipetting. Their measurements demonstrated potential ergonomic benefits of using supports and identified differences between the two supports. In another study evaluating the pipettes themselves, Lichty, Janowitz, Lee and Rempel used self-reported usability evaluations to assess manual and electronic pipettes. In their analysis they identified specific features which correlated with greater comfort. These findings can help pipette manufacturers when designing the next generation of hand held micro-pipettes.

Among researchers and clinicians, isokinetic dynamometry is often used to assess muscle strength. The dynamometers are generally designed for adult patients; however they are often used to evaluate children. Tsiros, Grimshaw, Shield and Buckley assessed the safety, usability and reliability of such a tool, the Biodex System 4 isokinetic dynamometer, when used to assess knee strength of children. They identify a number of advantages and limitations of the system and provide suggestions to improve safety and reliability when evaluating children.

In the area of consumer products, few tools are available to evaluate product usability among users with disabilities. Lenker, Nasarwanji, Paquet and Feathers describe how they developed and evaluated a 12-item user-report tool based on the seven principles of universal design. The tool is meant to aid designers in identifying usability concerns for a diverse group of users including the elderly and those with visual or physical disabilities.

The studies included in this special issue develop or employ quantitative methods to evaluate potential ergonomic solutions. It is important to keep in mind however that a quantitative analysis of biomechanical, cognitive and psychosocial loads is one of several important steps. Follow-up studies which assess productivity and health outcomes are necessary to fully evaluate any ergonomic solution.

As guest editor, I would like to thank those who contributed to the issue. I would like to extend a special thank you to Karen Jacobs for providing me this opportunity and to Victoria Hall for all her work in bringing this special issue together.

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