Inclined Surfaces – Impact on Postural Stability and Spine Loading

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Project Summary
Many work environments require workers to perform manual materials handling (MMH) tasks on surfaces that are not perfectly flat – sloped, slippery, or uneven surfaces in industries such as construction, agriculture, and maritime workplaces. Although these situations are common, there is little research focus on how working on these types of surfaces may impact the lifting strategies and techniques utilized by the worker and how this in turn affect the biomechanical loading of the spine as well as ability to maintain upright posture. According to the Bureau of Labor Statistics (BLS), falls in the workplace are a major cause of injuries and fatalities and 76% of fatalities in the roofing industry are attributed to falls. The cost of these falls in workers compensation is currently put at an average of $106,000 per fall. While falls from elevated and inclined surfaces account for many fatalities, performing MMH activities on these surfaces has the potential to impact many more workers by altering the loading of the spine and potentially increasing low back injuries. Biomechanically, these inclined surfaces require the body to maintain a stable posture by keeping the center of pressure (COP) within the base of support (BOS) when lifting. Theoretically, postural stability would have a direct impact on the biomechanics of the human system where more unstable inclinations would result in great muscle coactivation and spine loads during the handling of materials. However, little is known about the impact of inclined surfaces on spine loading. Furthermore, there is limited understanding of the potential mechanism between postural stability at the base of support and the corresponding impact on the low back system, which may be loaded at elevated levels, ultimately increasing the risk for low back injuries. This study will examine three novel hypotheses: 1) surface inclines will increase muscle coactivation and corresponding spine loading, 2) surface inclines will increase postural instability as determined by the COP moving closer to the BOS boundary, and 3) a strong relationship exists between postural stability and spine loads. These hypotheses will be tested by repeated-measures within subject experimental design. The specific aims will be to: 1) determine the impact of different work surfaces (flat versus inclined at 14^{o} and 26^{o} respectively) on spine loading during routine roofing activities involving manual materials handling, 2) measure deviations of the body's COP from the BOS associated with changes in the different work surfaces, and 3) compute the relationship between postural stability indices and spine loading variables from the different work surfaces. These aims will allow for independent evaluation of the three dimensional spine loads from peak normalized electromyography (EMG) activity of the 10 major trunk muscles and 8 major postural stability muscles, three dimensional trunk kinematics and kinetics, and the path lengths (PL) and sway area or elliptical area (EA) while working on these inclined surfaces. It is expected that the study outcomes will provide beneficial information on the link between postural stability and dynamic spinal loading, which will positively impact the reduction of low back musculoskeletal disorders and potential fall related incidents resulting from inclined working surfaces. This will also potentially result in significant reduction in overall workers compensation costs across affected industries including the current healthcare costs of over $90 billion spent annually on low back injuries/disorders in the United States. This study aligns with the National Occupational Research Agenda (NORA)'s mission of stimulating innovative research and improving workplace practices including musculoskeletal disorders and construction.

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Pilot Research Training Program (PRP) Overview

Welcome to the University of Cincinnati Education and Research Center's (ERC) 16th Annual Pilot Research Project (PRP) Symposium on October 8-9, 201Welcome to the University of Cincinnati Education and Research Center's (ERC) 17th Annual Pilot Research Project (PRP) Symposium on October 13-14, 2016, held in the Auditorium of Proctor Hall, College of Nursing. The purpose of the PRP is to increase the research capacity of research trainees and young investigators in occupational health and safety and to encourage those in related disciplines to pursue occupational health and safety research.

Under the administrative direction of Dr. Amit Bhattacharya, research proposals are solicited and peer-reviewed annually from qualifying faculty and graduate students from the **University of Cincinnati and the following PRP partnering institutions – Air Force Institute of Technology, Bowling Green State University, University of Toledo – Health Science Campus, Central State University, Purdue University, University of Kentucky, Western Kentucky University, Eastern Kentucky University, Murray State University, Ohio University and Kentucky State University**.

At this symposium, the 2015-16 awardees will be presenting the results of their research and the 2016-17 awardees will make poster presentations of their proposed work. The keynote speaker on Thursday, October 13, 2016 is **Anita Schill, PhD, MPH, MA**, Senior Science Advisor to the Director and Co-Manager for the Total Worker Health® Program with the National Institute for Occupational Safety and Health (NIOSH), will deliver the keynote address on "**Advancing Well-Being Through Total Worker Health.**"

The University of Cincinnati's Education and Research Center is one of 18 such centers funded by the National Institute for Occupational Safety and Health (NIOSH) nationally. Dr. Tiina Reponen serves as the director of the ERC, which is based in the university's Department of Environmental Health within the College of Medicine. The purpose of the ERC is to train professionals in the didactic and research skills necessary to lead the occupational safety and health disciplines. Results of research are translated into action through an outreach program and shared with professionals and practitioners in the region via continuing education.

Since 1999, the PRP program has allocated over $1.3 million to support 222 pilot research projects. These projects have served as a catalyst in bringing over $34 million in additional research support to the region from sources independent of the PRP program, such as, the National Institute for Occupational Safety and Health (NIOSH), National Institutes of Health (NIH), United States

Department of Agriculture (USDA), National Science Foundation (NSF), and the Centers for Disease Control and Prevention (CDC). Additionally, the PRP has brought 47 new investigators from other fields of expertise to the area of occupational safety and health research.

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