NIOSH-Supported
Education and Research Center

13th Annual

2012 Pilot Research Project (PRP) Symposium

October 4—5, 2012
Room E-351, Medical Sciences Building
University of Cincinnati College of Medicine
Thursday, October 4th 1:00 pm—5:00 pm
Friday, October 5th 8:00 am—11:45 am

Keynote Speakers

Linda A. McCauley, PhD, RN, FAAN, FAAOHN
Dean, Nell Hodgson Woodruff School of Nursing,
Emory University
and
Carol Rice, PhD, CIH
Emerita Professor of Environmental Health,
University of Cincinnati

Podium and Poster Presentations by PRP Awardees

Supported by NIOSH grant #T42-OH008432

UNIVERSITY OF Cincinnati

Pilot Research Training Program and Symposium

Welcome to the University of Cincinnati Education and Research Center's (ERC) **13th Annual Pilot Research Project (PRP) Symposium** on October 4-5, 2012**,** held in Room E-351 of the Medical Sciences Building (MSB), College of Medicine. 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 – Medical 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 2011-12 awardees will be presenting the results of their research and the 2012-13 awardees will make poster presentations of their proposed work. The keynote speaker on **Thursday, October 4, 2012** is **Linda A. McCauley, PhD, RN, FAAN, FAAOHN,** Dean and Professor at the Nell Hodgson Woodruff School of Nursing and Professor at the Department of Environmental Health, Rollins School of Public Health at Emory University, who will deliver the keynote address on **"Female Agricultural Workers: Ergonomic Hazards, Heat Stress, and Pesticide Exposures." Dr. Carol Rice, PhD,** Professor Emerita of Environmental Health at the University of Cincinnati, will deliver the keynote address on **"Retrospective Exposure Assessment: Making the Best Exposure Estimate Possible with Sparse Data"** on **Friday, October 5, 2012.** There will also be opportunities to speak with all of the presenters individually.

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 approximately $998 thousand dollars to support pilot research projects. These projects have served as a catalyst in bringing over $26.5 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 also brought 27 new investigators from other fields of expertise to the area of occupational safety and health research.

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Symposium attendees are eligible for:

- ◊ **Eligible for ABIH (IH) CM Points; Apply online.**
- ◊ **Meets BCSP criteria for continuation of certification credit**
- ◊ **Approved contact hours: 7.6 Continuing education contact hours for nurses are approved by the Ohio Board of Nursing through the OBN Approver Unit at the University of Cincinnati College of Nursing, Continuing Education Program, (OBN-011-93). Contact hours are valid in most states. Program #121004-2**

The 13th Annual PRP Symposium is free and open to the public.
For more information about the PRP program, please contact
Dr. Amit Bhattacharya, PRP Program Director, at (513) 558-0503
or email Amit.Bhattacharya@uc.edu

Keynote Speaker, Thursday, October 4, 2012

Linda A. McCauley,
PhD, RN, FAAN, FAAOHN

Dean and Professor, Nell Hodgson Woodruff School of Nursing, Professor, Department of Environmental Health, Rollins School of Public Health Emory University

Dr. Linda McCauley is a nationally recognized leader in nursing education and research. As dean at Emory University's Nell Hodgson Woodruff School of Nursing, she continues to do her research, serve on mentoring teams, and teach in the undergrad and graduate programs. Under her leadership, the School of Nursing is executing a comprehensive strategic plan to expand the school's research enterprise, forge new clinical partnerships, and increase diversity among the faculty and student population. Enrollments have increased and new programs have been launched, including the creation of three Dedicated Education Units for one-on-one clinical instruction at Emory Healthcare facilities; and research and research funding have significantly increased. The school secured a ranking among the top twenty-five in Best Graduate Schools in the *U.S. News and World Report* and received recognition as one of the nation's top doctoral programs by the National Research Council.

Dr. McCauley serves on numerous research committees and is a national leader in the area of environmental exposures research. She provides ongoing consultations, leadership on advisory panels, and testimony to governmental oversight bodies at the local and national levels. She is a fellow of the American Academy of Nurses, the American Academy of Occupational Health Nurses, and a member of the Institute of Medicine. She currently serves on the executive committee as one of the founding leaders for the Future of Nursing: *Campaign for Action* initiative in Georgia.

Dr. McCauley received her bachelor's degree in nursing from the University of North Carolina at Chapel Hill, her master's degree in nursing from Emory University, and her Ph.D. in environmental health from the University of Cincinnati.

Keynote Speaker, Friday, October 5, 2012

Carol Rice,
PhD, CIH

Professor Emerita of Environmental Health,
University of Cincinnati

Dr. Rice is a professor emerita at the University of Cincinnati, Department of Environmental Health. She is an occupational hygienist with more than 35 years experience in professional practice and 25 years in academic research and teaching and worker health and safety education. She specializes in the assessment of current industrial exposures and the evaluation of working lifetime exposures and has a special interest in the use of historical exposure data to reconstruct past human exposures for occupational epidemiology studies.

Dr. Rice directed the NIOSH-sponsored Education and Research Center (ERC) at the University of Cincinnati from 2008 until June of 2012 and served as Deputy Director for the previous 9 years. She continues as the Deputy Director of Occupational Hygiene for the University of Cincinnati ERC and is active in research.

Dr. Rice organized the multi-state, multi-institution Midwest Consortium (MWC) for Hazardous Waste Worker Training in 1987 The MWC participants include site workers, emergency responders and workers in a range of industrial settings; the Consortium also serves the needs of minorities and low-income residents impacted by hazardous materials in their neighborhoods For the past several years, Dr. Rice worked with students to establish a partnership with the Cincinnati Interfaith Workers Center, serving low-wage and immigrant workers.

Dr. Rice has received a number of scientific awards, including the Alice Hamilton Award in 2008 from the American Industrial Hygiene Association and the Alice Hamilton Award for Excellence in Science (Human Studies) in 2011 from the National Institute for Occupational Safety and Health.

PODIUM PRESENTATION SCHEDULE

	Thursday, October 4, 2012		
	Moderator: Alexander V. Sergeev, MD, PhD, MPH		
Time	**Title**	**Speaker**	**Affiliation**
1—1:15 pm	Welcome and Opening Remarks	Tiina Reponen, PhD, CIAQP, ERC Director Amit Bhattacharya, PhD, CPE, PRP Program Director	Environmental Health University of Cincinnati Environmental Health University of Cincinnati
1:15—1:20 pm	Introduction of Keynote Lecturer: Linda McCauley, RN, PhD, FAAN, FAAOHN, Dean and Professor, Nell Hodgson Woodruff School of Nursing, Emory University, Atlanta	Amit Bhattacharya, PhD, CPE, PRP Program Director	Environmental Health University of Cincinnati
1:20—2:05 pm	Keynote Address: "Female Agricultural Workers: Ergonomic Hazards, Heat Stress, and Pesticide Exposures "	Linda McCauley, RN, PhD, Professor, Dean	Nell Hodgson Woodruff School of Nursing, Emory University, Atlanta
2:05—2:15 pm	Keynote Q & A		
2:15—2:35 pm	Effects of Coping Strategies on Chronic and Traumatic Stress Experience at Work	Michael Sliter, PhD	Psychology Bowling Green State University
2:35—2:55 pm	Vibration-Frequency Induced Changes in the Bone Tissue Morphology	Brian Kim for Srikara Peelukhana	School of Dynamic Systems University of Cincinnati
2:55—3:55 pm	Poster Session I and Break		
3:55—4:15 pm	Merits of Employing Carbon Foam Fabrics in Firefighter's Helmet Shell	Ahmed Elgafy, PhD	School of Dynamic Systems University of Cincinnati
4:15—4:35 pm	Documenting Amount of Manual Lifting Performed by Nurses in a Hospital Setting	Tiffany Poole Wilson	Environmental Health University of Cincinnati
4:35—4:55 pm	Endocrine Disruptor Exposure in Firefighters	Max Stevenson for Yuet-Kin Leung, PhD	Environmental Health University of Cincinnati
5:00—7:00 pm	PRP Networking Picnic		CARE Crawley Building Kaplan Area and Patio

PODIUM PRESENTATION SCHEDULE

	Friday, October 5, 2012		
	Moderator: Diana J. Schwerha, PhD		
Time	**Title**	**Speaker**	**Affiliation**
8:00—8:10 am	**Opening Remarks**	**Amit Bhattacharya, PhD, CPE PRP Program Director**	**Environmental Health University of Cincinnati**
8:10—8:15 am	**Introduction of Keynote Lecturer: Carol Rice, PhD, CIH, Emerita Professor of Environmental Health, Department of Environmental Health, University of Cincinnati**	**Tiina Reponen, PhD, CIAQP, ERC Director**	**Environmental Health University of Cincinnati**
8:15—9:00 am	**Keynote Address: "Retrospective Exposure Assessment: Making the Best Exposure Estimate Possible with Sparse Data"**	**Carol Rice, PhD, CIH, Emerita Professor**	**Environmental Health University of Cincinnati**
9:00—9:10 am	**Keynote Q & A**		
9:10—9:30 am	**Developing a Method to Assess Organizational Climate for Healthy Weight**	**Katherine Sliter, PhD**	**Psychology Bowling Green State University**
9:30—10:30 am	**Poster Session II and Break**		
10:30—10:50 am	**Development of a Method to Classify Fall-prone Individuals in the Population of Parkinson Disease Patients Using Measures of Dynamic Stability**	**Ashutosh Mani**	**Environmental Health University of Cincinnati**
10:50—11:10 am	**Design of Novel In Vivo Neutron Activation Analysis System for Noninvasive Quantification of Mn in Bone with Monte Carlo Simulations**	**Yingzi Liu for Linda H. Nie, PhD**	**Health Sciences Purdue University**
11:10—11:30 am	**Comparative Effectiveness of Cardiovascular Procedures in Pneumoconiosis Patients**	**Alexander Sergeev, MD, PhD, MPH**	**Social and Public Health Ohio University**
11:30—11:40 am	**Closing Remarks and Program Evaluation**		

PRP POSTER PRESENTATION LIST

No.	Title	Author	University
1	Profiling of Effector Cell Types in Nanoparticle- and Asbestos-exposed Lung	Evan Frank	Environmental Health University of Cincinnati
2	Encouraging Prevention and Detection Safety Behaviors: Effects of Goal Framing	Ashlie Britton	Psychology Bowling Green State University
3	Rapid Neutralization of Organophosphate Nerve Gas Agents	Daqing Gao, PhD	Natural Sciences Central State University
4	Mobile System for Fatigue Assessment in Firefighters	Fred Beyette, Jr, PhD	School of Electronics & Computing Systems University of Cincinnati
5	Assessment of Faceseal Leakage in a Half-mask Respirator Used by Firefighters	Xinjian (Kevin) He	Environmental Health University of Cincinnati
6	Light Emitting Diode (LED) Ultra-violet (UV) Disinfection of Water	Leeann Racz, PhD	Systems & Engineering Management Air Force Institute of Technology
7	Use of Pyrosequencing to Assess Bacterial Diversity in Moisture-damaged Buildings	Eric Kettleson, PhD	Environmental Health University of Cincinnati
8	Aerosol Contamination at Fire Scenes	Barbara Alexander, PhD	Environmental Health University of Cincinnati
9	An Examination of the Work-Family Interface among Farming Dyads	Justin Sprung	Psychology Bowling Green State University
10	A Pilot Study: Mechanical Damping and Spine	Liming Zhao, MD	Biomedical Engineering Indiana University – Purdue University Indianapolis
11	In-Vitro Mechanistic Approach to Under-stand LPS Toxicity in and out of Workplace	Umesh Singh, PhD	Internal Medicine University of Cincinnati

NON-PRP INVITED POSTERS

12	Evaluating the Effect of Heat Stress on Firefighters	Georganne L. Kincer, RN, BSN, COHN-S	College of Nursing University of Cincinnati
13	Carbon Nanotube Reinforced Textiles: Advanced Personal Protection Technology for Firefighters	James Joseph Sullivan	School of Dynamic Systems University of Cincinnati
14	Identifying Health Disparities in Ohio Using Self Organizing Maps	Anitha Kisanga	Environmental Engineering Central State University

KEYNOTE SPEAKER ABSTRACT
PRP Symposium October 5, 2012

Retrospective Exposure Assessment: Making the Best Exposure Estimate Possible with Sparse Data

Carol Rice, PHD, CIH,
Emerita Professor of Environmental Health
University of Cincinnati

Retrospective exposure assessment is an occupational hygiene specialty that bridges exposure assessment and epidemiology to evaluate the human health impact of the workplace over long periods of time. Detective and anthropology skills are useful in determining first the duration over which exposures can be assessed and second how to best guard against the likely challenge to any exposure response relation identified.

The presentation includes rationale for undertaking these investigations as part of determining occupational exposure guidelines. Illustrations are presented showing how both quantitative and qualitative information are identified, assessed and utilized to fill gaps in measurement data.

The primary project used to show the process of retrospective exposure assessment is a 25-year surveillance of refractory ceramic fiber workers in several work locations across the US. Paper records from various sources were identified and the information used to document in which plant locations manufacturing processes and equipment could be traced. A current exposure assessment effort was launched at all facilities in the late 1980s. Several approaches were used to estimate airborne exposure where measurement data were especially sparse: the same equipment in a different industry; the same equipment in a different space; industry-wide exposure control implementation. Several different exposure metrics were constructed—each with a strength. Consistency in findings across several metrics strengthens overall assessment of exposure-response.

While retrospective exposure assessment may be challenged as more art than science, it is noteworthy that creative approaches to using available data based on understanding of exposure assessment and the industrial process(es) under study reveal exposure-response relations that can be used by workers, the industry and decision makers to improve the workplace environment.

2011-12 PRP Awardees
PODIUM PRESENTATION ABSTRACTS

Effects of Coping Strategies on Chronic and Traumatic Stress Experience at Work

Michael Sliter (PI), Steve M. Jex
Department of Psychology
Bowling Green State University

Purpose: The current study had three purposes: 1) to replicate previous research findings on the main effects that chronic stressors and traumatic stressors have on employee outcomes, 2) to investigate whether chronic stressors exacerbate the negative relationship between traumatic stressors and employee outcomes, and 3) to investigate the efficacy of coping mechanisms that might buffer the relationship between chronic and traumatic stressors and employee outcomes.

Design: A two-time point survey methodology was used. Firefighters, as they have frequent exposure to traumatic events, were used as the target sample for the current study.

Methods: A total of 179 firefighters were recruited from a major Midwestern city for participation in two waves of surveys. Firefighters were sent hard copies of surveys, which contained validated measures of chronic stressors, traumatic stressors, coping mechanisms, and employee outcomes (e.g., burnout, physical symptoms, PTSD). A second set of surveys were sent 3 months following the first wave of data collection.

Results: All chronic and traumatic stressors related in the expected direction with employee outcomes. There was little support, however, for an interaction of stressor type in predicting outcomes. Most adaptive coping mechanisms did reduce the negative impact of traumatic events, particularly humor.

Conclusions: Both chronic and traumatic stressors do appear to have a negative impact on employee well-being outcomes, though this effect tends to be direct rather than compounded by the experience of multiple stressor types. Adaptive coping mechanisms were shown to be generally effective in lessening the negative impact of traumatic stressors, particularly in reducing burnout. Future research could investigate methods for training coping mechanisms to firefighters, or for creating interventions aimed at coping with trauma.

Impact: Currently, research on workplace stressors tends to focus almost exclusively on chronic stressors. This is a clear shortcoming, as traumatic stressors might cause significant and long-term negative effects. As such, traumatic stressors should be studied in organization health research in "at risk" jobs. Understanding the relative cost of the interaction between chronic and traumatic stressors might motivate organizations to eliminate chronic stressors in order to preserve the physical and mental health of "at-risk" employees.

Literature on coping with traumatic work events is limited to a retrospective examination of employees' coping strategies/mechanisms following disasters (e.g., natural disasters; military- related). However, these events are few and far between, and are different from those traumatic events experienced by "at-risk" employees. Additionally, these studies are typically cross-sectional and have employees recall traumatic events from far in the past. The current study improved upon previous research by 1) employing a longitudinal, less-retrospective design, 2) using a scale of traumatic events that is occupation-specific rather than general, and 3) by examining not only frequency of coping methods, but also *efficacy* of coping mechanisms.

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Vibration-frequency Induced Changes in Bone Tissue Morphology

Shilpi Goenka[1], Brian Kim[2], Srikara V. Peelukhana[2] (PI), Keith F. Stringer[3], Jay Kim[2], Rupak K. Banerjee[2]

[1]Materials Engineering Program, [2]Mechanical Engineering Program, University of Cincinnati

[3]Department of Pathology, Cincinnati Children's Hospital Medical Center

Purpose: Hand-Arm Vibration Syndrome (HAVS) is caused by hand-transmitted vibration in industrial workers. Delineation of the response of bone tissue under different frequencies of vibration will have a significant *positive impact* by allowing formulation of more accurate guidelines for bone disorders linked to HAVS and eventually for its therapeutic outcome.

Design: A rat-tail model is used to investigate the effects of higher frequencies >100 Hz and duration of vibration (1D, 5D and 20D; D=days) on bone tissue. Male Sprague Dawley rats (250 ±15 gm) were used. Rat-tails were vibrated at 125 Hz and 250 Hz (49 m/s^2) for 1D, 5D and 20D (4hr/day). Control rats were sham vibrated for 1D, 5D and 20D.

Methods: Structural damage of bone was quantified by i) osteocyte and empty lacunae count in cortical bone, and ii) trabecular bone histomorphometry, using H&E staining. The biochemical changes were assessed by nitrotyrosine (NT) staining. The results were analyzed using one-way repeated measures mixed model ANOVA at $p< 0.05$ level of significance.

Results: Structural damage in cortical bone was significant at 250 Hz while the structural damage in the trabecular bone showed a moderate significance at 125 Hz and 250 Hz. The biochemical damage was significant at both the 125 Hz and 250 Hz vibration frequencies. Also, the structural damage was significant at 1D and 20D for the trabecular bone, while it was significant at 5D for cortical bone. Also, the biochemical damage was significant at all the time points of vibration (1D, 5D and 20D).

Conclusions: Our results demonstrate that bone alterations in the form of structural and biochemical disruption in bone tissue are significant at 125 Hz and 250 Hz. The duration of vibration also has a significant effect. Hence the current ISO guidelines might underestimate vascular damage at frequencies > 100 Hz.

Impact: Assessing vibration induced damage is one of the NORA priority areas. This project is designed to help in better assessment of the vibration-induced bone damage. This will, in turn, help in better diagnosis of the HAVS as a whole and aid in devising accurate guidelines.

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Merits of Employing Carbon Foam Fabrics in Firefighter's Helmet Shell

Ahmed Elgafy (PI), Sarthak Mishra

School of Dynamic Systems, College of Engineering and Applied Science

University of Cincinnati

Purpose: In the present work; numerical and experimental studies have been performed to investigate and predict the merits of using carbon foam fabric as an alternative material for firefighter's helmet shell.

Design: A three dimensional simulation was used for modeling the carbon foam helmet shell, carbon foam impact liner, a hemispherical striker and a headform. The helmet shell and the impact liner were designed as hemi-ellipsoids whereas the striker was designed as a solid hemisphere. The helmet shell was designed with

length of 0.253m, width of 0.232m, depth of 0.116m. The thickness was varied as 0.0015m and 0.0014m. The impact liner had length of 0.25m, width of 0.229m and depth of 0.1145m, with thickness of 0.015m. An aluminum ISEA size 7 headform was modeled according to the NFPA standards. While in the experimental test, the carbon foam sample was impacted by a disc-shaped steel striker (diameter of 0.09m, thickness of 0.006m and weight of 0.211kg).

Methods: Numerical simulations were conducted to test both the thermal and mechanical characteristics of introduced carbon foam. Simulations of impact tests were conducted using ABAQUS CAE dynamic explicit solver in which a hemispherical striker was made to fall freely on the helmet firmly seated on a headform. Similarly for the thermal analysis, simulation was conducted using ANSYS Fluent CFD software. On the other hand; a low-velocity impact test was conducted in the Structural System Testing Laboratory of University of Cincinnati.

Results: With helmet shell made of carbon foam with porosity of 0.10; the numerical impact test showed that the maximum force transmitted to the skull of the headform through the helmet was recorded to be 3534 N which is below the standard of 3780N. This shows that the firefighter would be safely protected from the impact. For the same porosity, thermal conductivity of 0.55 W/m-k and specific heat of 1260 J/kg-K and density 1400 kg/m^3, the numerical flame test showed that the temperature dropped from 1001K at the outer edge of the helmet to 300K at the inner edge of the helmet. This shows that the firefighter would be safely protected from the thermal stresses caused by the sudden fire flame. On the other hand, carbon foam helmet shell with previous specifications weighs 0.174 kg, which is fairly light weight, while the impact liner with a porosity of 0.95 weighs 0.0962 kg. The impact experimental test results showed that the carbon foam fabric is an excellent fabric to be used in firefighter helmet.

Conclusions: Carbon foam would be very effective in fabrication of firefighter's helmet. The proposed parametric study provides good combinations of carbon foam properties in order to achieve more impact and thermal resistances along with a firefighter's helmet of. less weight.

Impact: By using the new carbon foam fabric, the firefighter's helmet will be more protective and lighter which would enable the firefighter to accomplish his/her mission more efficiently.

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Documenting the Amount of Manual Handling Performed by Nurses in a Hospital Setting

Tiffany Poole-Wilson[1] (PI), Kermit Davis[1], Nancy Daraiseh[2]
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[2] Cincinnati Children's Hospital Medical Center, University of Cincinnati

Background: Musculoskeletal disorders (MSDs) are the most costly injuries for nurses in medical care facilities. MSDs in the low back and shoulder are the most prevalent and have been linked to patient handling activities. However, to date, patient handling activities have been observed through subjective responses by the nurses. The objective of the current study was to take direct observations of the handling of patients and other medical equipment performed by nurses during a 12-hour work shift.

Methods: 11 out of 20 recruited nurses working 12-hour shifts at a regional teaching hospital in the Midwest were observed. The nurses were recruited from 3 units: Medical Intensive Care (MICU), Surgical Intensive Care (SICU) and Neuroscience Intensive Care (NSICU). The type of lifting performed and utilization of lifting assist devices were documented. The nurses completed a Symptom Survey – assessed current pain levels and Lifting Questionnaire – assessed nurses' perception of lifting performed, at the conclusion of the shift. The observed lifting was compared to the perceived lifting with simple inference statistics.

Expected Results: Nurses have a high prevalence of manual lifting of both patients and medical devices but limited utilization of lifting assist devices. Nurses underestimate the amount of manual lifting actually performed during the shift and suffer high levels of pain at the end of the shift with greatest prevalence in lower back and shoulders.

Current Status of Study: Observations are in the process of being conducted in the identified hospital units.

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Endocrine Disruptor Exposure in Firefighters

Max Stevenson, Barbara Alexander, Stuart Baxter, Yuet-Kin Leung (PI)
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University of Cincinnati

Purpose: Firefighters indirectly expose themselves to a wide variety of agents. These agents are generally smoked-derived. Among these smoke-derived agents (SDAs) are phthalate diesters that are incorporated into polyvinyl chloride, a common component of household plastics. Indirect contact with these agents may perturb hormone homeostasis.

Design: We tested the estrogenic activity of the SDAs found on the hoods and gloves of new and used firefighter gears.

Methods: SDAs were extracted from different layers of firefighter gloves and hoods. Gloves and hoods have been determined to be areas of high exposure. Samples from new and unused gear were collected along with gear that was heavily used for 8 weeks or longer. A 3-inch square was cut out of the palm of the gloves and a 2-inch square was cut out of the hood. In order to extract the smoke derived agents methylene chloride was used. Methylene chloride is able to extract the organic compounds in or on the gloves and hoods.

The estrogenic activity was determined through a yeast estrogen screen assay. The yeast was genetically modified, constructed from two plasmids, an estrogen receptor expression plasmid and an estrogen response element reporter plasmid. With both of these plasmids, the yeast can produce luminescence signal whenever estrogens or estrogen-like compound was incubated with the yeast. These estrogenic compounds bind to the ER and induce the production of β -galactosidase as a reporter. The amount of β -galactosidase is measured by chemiluminescence-based assay. Any SDAs with estrogenic or antiestrogenic activities extracted from the firefighter gears were evaluated using this method.

Results: In this study, we found that the known phthalate diesters, were not estrogenic per se but acted as potent antiestrogens through inhibition of the function of the estrogen receptor in the presence of a known estrogen, 17β -Estradiol (E2). Most of the SDAs found on used firefighter gear we examined displayed a strong inhibitory effect on estrogen receptor activity in the presence of E2. Surprisingly, we found that new firefighter equipment had a significant amount of estrogen activity. Furthermore, the new outer layers of the new equipment have more estrogenic activity than the material on the new inside layers. It also appears that the SDAs are passing through multiple layers to reach the inside layer of the glove and ultimately the bare hand of the firefighter, indicating a possible route for direct exposure to these chemicals.

Conclusion: Overall, our data suggested that firefighters are indirectly exposed to endocrine disruptors that may lead to perturbation of hormone homeostasis.

Impact: The results that were found contribute to providing solutions to Occupational Safety and Health problems in that it is a step in the right direction to understand more about hazardous occupations. This research allows us to understand and help protect people that have chosen one of these professions.

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Developing a Method to Assess Organizational Climate for Healthy Weight

Katherine A. Sliter (PI), Steve M. Jex, Michael J. Zickar
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Bowling Green State University

Purpose: A large percentage of American employees are now obese. As a result, an increasing amount of research is being conducted to better understand the antecedents and consequences of excess employee weight. One construct often of interest to organizational researchers wishing to understand and influence employee health is organizational climate. Unfortunately, a viable measure of climate as related to employee weight does not currently exist. The purpose of the present study was to remedy this by developing and validating a concise, psychometrically sound measure of climate for healthy weight.

Design: The present study combined traditional and modern methodology to develop and validate a new scale.

Methods and Results: A large pool of items was developed based on surveys of full-time employees, and a sorting task was used to eliminate ambiguous items. Next, items were pilot tested by a sample of 338 full-time employees. An initial 3-factor structure was established through exploratory factor analysis, and the set of items was further reduced using reliability analysis and item response theory. Finally, the 14 retained items were completed by a sample of 360 full-time employees, representing 26 different organizations from across the United States.

Conclusions: Multilevel modeling indicated that sufficient variance was explained by group membership to conclude that the measure tapping a group-level construct, and confirmatory factor analysis supported the hypothesized model of three subscale factors and an overall climate factor. Validation analyses provided evidence of construct validity. Implications and directions for future research are discussed.

Impact: The results of this study will benefit both researchers and practitioners seeking to better understand the antecedents and consequences of obesity in the workplace. The newly developed scale will be particularly useful in developing and evaluating weight-related interventions.

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Development of a Method to Identify Fall-prone Individuals in the Population of Parkinson Disease Patients Using Measures of Dynamic Stability

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Purpose: Falls are the most common cause of injury-induced death and injury-related hospitalization in the elderly (65 years and older) population. Falls are the second most common cause of hospitalization in Parkinson Disease patients. Falls can cause fractures, abrasions, cuts and soft tissue damage, reduced fitness, social isolation and psychological trauma, increasing the risk of mortality and morbidity. Falls not only affect the patient but also are a huge burden on health care costs. The purpose of this study is to use kinematics data from Activities of Daily Living (ADLs) to develop a method to differentiate between fall-prone individuals and non-fall-prone individuals in the population of Parkinson Disease (PD) patients. Such a method will help in identifying fall-prone individuals not only in the PD population but also other populations like older workers, Parkinsonism patients, and other workers who have postural instability resulting from workplace exposures. Once these individuals are identified, appropriate interventions (e.g. symptom specific exercise intervention) can be

put in place to improve their balance and reduce their probability of falling.

Design: This was a cross-sectional study.

Methods: Static and dynamic balance of PD patients and controls were tested using a force platform, wireless sensors (accelerometers and gyroscopes), gait measurements (using GAITRite system) and Timed Up and Go Test (TUG). Along with these objective measures, subjective perception data was also collected (e.g. perception of sway and slip). The center of mass motion was measured for each subject (using the accelerometers and gyroscopes) while they simulated Activities of Daily Living (ADLs). Subjects were categorized as fallers and non-fallers based on a history of falls questionnaire. Additionally, PD patients completed the freezing of gait questionnaire.

Results: We are still in the process of collecting data. In the data collected so far (four subjects: 3 PD and 1 control), TUG was found to be higher for fallers (2 PD patients; avg: 14.82 seconds) as compared to non-faller (1 PD patient; avg: 6.61 seconds). TUG value for the control subject was 8.53 seconds. Sway length and area were also higher in the fallers. However, the fallers had a higher average age (68.5) as compared to the non-faller (51). More data is being collected to investigate the effect of age on these outcome parameters.

Conclusions: We plan to finish the process of data collection by December 2012. After all the data is collected, we will also use non-linear time series analysis methods (measure of chaos: Maximum Lyapunov Exponent) to differentiate between fallers and non-fallers. The goal of the study is to develop a categorization matrix (using static and dynamic balance outcome measures) which help us identify fall-prone individuals in the population of Parkinson Disease.

Impact: Our method can also be used to identify fall-prone individuals in populations other than PD, e.g. roofers, construction workers and people who have been exposed to neuro-toxins that impair balance and hence increase their risk of falling. This will enable us to develop pro-active interventions that can reduce the risk of falling, increase their quality of life and also reduce the amount of money spent on injuries related to falls.

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Design of Novel In Vivo Neutron Activation Analysis System for Noninvasive Quantification of Mn in Bone with Monte Carlo Simulations

Yingzi Liu[1], David Koltick[2], Patrick Byrne[1, 3], Wei Zheng[1], Linda H. Nie[1] (PI)
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Purpose: This study was conducted to investigate the methodology and feasibility of developing a transportable Neutron Activation Analysis (NAA) system to quantify Manganese (Mn) in bone using a portable Deuterium-Deuterium (DD) neutron generator as the neuron source.

Methods: Since a DD neutron generator is not available in our laboratory, a Deuterium-Tritium (DT) neutron generator coupled with a uranium moderator and a paraffin reflector was used to obtain experimental data and validate the results from Monte Carlo (MC) simulation. The count rates calculated from MC simulation were in agreement with those obtained from the experiment. MC simulations using a DD generator as the neutron source were then conducted. Different types of moderators and reflectors were simulated and paraffin was selected as the best material for both the moderator and reflector. The optimal thicknesses for the reflector and moderator were determined.

Results: Assuming normal concentration of Mn in bone is about 1 μg/g wet bone, the count rate from a hand

phantom was estimated to be 0.6 counts/sec if we use a DD generator with an emission rate of $5x10^8$ neutrons/sec and 4π NaI detectors with close to 100% absolute efficiency. The dose to the hand for 10 minutes irradiation time is about 54.63 mSv from MC simulation. This same exposure corresponds to about 60.8 μSv total body equivalent dose.

Conclusion: In conclusion, it is feasible to develop a transportable NAA system to quantify Mn in bone *in vivo* with an acceptable radiation dose exposure to the subject.

Impact: Occupational and environmental exposure to Mn has been associated with kidney and liver disease, cardiovascular disorders, and most significantly, neurological disorders. In its final stages, Mn toxicity manifests along with a psychological disorder termed manganism, with the signs and symptoms closely resembling Parkinson's disease. The transportable NAA system is promising to be used for on-site human field studies and it provides a noninvasive way for reliable assessment of body Mn burden.

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Comparative Effectiveness of Cardiovascular Procedures in Pneumoconiosis Patients

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Purpose: Pneumoconiosis (PNC) is a major occupational disease that develops as a result of occupational exposure to dust via inhalation. In addition to its harmful effects on the respiratory system, PNC can increase vulnerability to coronary heart disease (CHD) – the leading cause of death in the U.S. and in the world. Currently, two types of cardiovascular intervention procedures for CHD treatment are percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG). The objective of this study was to investigate comparative effectiveness of the two major cardiovascular intervention procedures–PCI and CABG–in PNC patients with CHD.

Research Design and Methods: Patient data from 535,330 hospitalizations of adults 21 years and older who underwent either a PCI or CABG procedure were obtained from the State Inpatient Databases developed under the auspices of the federal Agency for Healthcare Research and Quality. There were 1,094 hospitalizations of patients with PNC and CHD (CHD-PNC patients) and 534,236 hospitalizations of CHD patients without PNC (CHD-nonPNC). Adjusted odds ratios for in-hospital death in relation to PNC status and the type of procedure, adjusted for patient socio-demographic and clinical characteristics and hospital characteristics, were calculated using multivariable logistic regression (SAS software). The associations between length of stay (LOS) and cost of hospitalization and PNC status and type of procedure, adjusted for known confounders, were investigated using general linear models (GLM).

Results: Men constituted 97.8% of CHD-PNC patients and 68.6% of CHD-nonPNC patients. Male CHD-PNC patients had higher modified Elixhauser-Walraven comorbidity scores than male CHD-nonPNC patients (2.07 ± 4.64 vs. 1.47 ± 4.32, $p<0.001$), with higher scores indicating the presence of more severe co-existing conditions. Within the CHD-PNC group, crude (unadjusted) hospital mortality after CABG and PCI did not differ significantly (1.35% vs. 2.00%, $p=0.425$) and remained insignificant in the multivariable analysis, adjusted for patient and hospital characteristics (adjusted OR = 0.714, 95% CI 0.220-2.323, $p=0.576$). But in the CHD-nonPNC group, hospital mortality was significantly higher after CABG than after PCI both in crude (2.83% vs. 1.28%, $p<0.001$) and adjusted (adjusted OR = 1.637, 95% CI 1.541-1.738, $p<0.001$) analyses. In male CHD-PNC patients who underwent CABG, LOS was significantly higher than among their counterparts who underwent PCI (10.0 ± 8.62 vs. 2.82 ± 3.92 days, $p<0.001$); the difference remained statistically significant when adjusted for patient and hospital characteristics. Hospitalization costs for CHD-PNC patients who underwent

CABG were also significantly higher as compared to those CHD-PNC patients who underwent PCI (166.6±132.6 vs. 71.0±57.2 thousand dollars, $p<0.001$), and the costs difference remained statistically significant after adjusting for known confounders. In all multivariable adjusted analyses, patient socio-demographic and clinical characteristics were significant predictors of the outcome.

Conclusions: In terms of hospital mortality, PCI is as safe as CABG in male CHD-PNC patients. LOS and hospitalization costs are lower in male CHD-PNC patients undergoing PCI as compared to CABG. Patient socio-demographic and clinical characteristics, including comorbidities, should be adjusted for in comparative effectiveness studies of cardiovascular intervention procedures in PNC patients.

Impact: This study developed the body of scientific evidence on comparative effectiveness of cardiovascular interventions in male patients with PNC. It established that in male CHD-PNC patients, PCI is as safe as CABG, but LOS and hospitalization costs are lower for PCI than for CABG.

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2012-13 PRP Awardees
POSTER PRESENTATION ABSTRACTS

Profiling of Effector Cell Types in Nanoparticle- and Asbestos-exposed Lung

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Emerging nanotechnology has yielded novel nanomaterials with unknown health implications; in particular multi-walled carbon nanotubes (MWCNT) have come into focus owing to their versatile potential and utility. Currently toxicological evaluation of these materials is in its infancy, however production volumes are increasing rapidly, indicating that this material will become ubiquitous as most projections predict. Although there is evidence of physiological sequelae following heavy exposure to various MWCNT preparations, the cellular actions deterministic of these responses are unknown. In addition, it has been acknowledged that MWCNT toxicity may have parallels with the toxicity/carcinogenic potential of asbestos. Despite its notoriety, mechanistic knowledge on the pathogenic effectors of asbestos-related disease (mesothelioma) is similarly absent. The focus of this study is to better elucidate the effectors of chronic MWCNT exposure/risk in the lung and compare the toxicological profile of this material to asbestos. We will test our hypothesis that lung toxicity/pathology in carbon nanotube exposures is governed by specific cell types and their effectors and that these component players overlap with those critical in asbestos pathologies. To accomplish this we propose to challenge a mouse model with repeated low-doses of MWCNT and asbestos and obtain cell type-specific populations from digested lung via FACS sorting. Once sorted cell populations have been achieved, detailed profiles of specific cell types in advanced stages of response will be investigated in terms of gene expression and secreted mediators. In this way, a better understanding of the effectors driving pathology in these cases can be reached. This platform will continue to be used to orient future research and provide likely targets for investigation into pathogenic potential and toxicity mechanisms of nanoparticles in the lung.

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Encouraging Prevention and Detection Safety Behaviors: Effects of Goal Framing

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This study will examine goal framing effects in the promotion of occupational safety behaviors. Specifically, it will investigate the effectiveness of gain- and loss-framed messages for the encouragement of prevention and detection safety behaviors. Based on findings regarding the promotion of health behaviors, it is expected that gain-framed messages will be more effective at encouraging prevention safety behaviors and loss-framed messages will be more effective at encouraging detection safety behaviors. In order to test this, participants from the manufacturing, construction, and mining sectors will be presented with safety promotional messages with a gain- or loss-frame and encouraging either two prevention or two detection safety behaviors. Participants will then indicate their behavioral intent, attitudes toward the behaviors, and perceived efficacy regarding the behaviors. In addition, data will be collected at a second time point in order to examine if the promotional messages had lasting effects on participants. If the hypotheses are supported, this study will increase

our understanding of what types of messages are most persuasive in encouraging two distinct types of safety behaviors, allowing for more effective interventions aimed at increasing workplace safety behaviors.

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Rapid Neutralization of Organophosphate Nerve Gas Agents

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Synthetic organophosphates are widely used as pesticides, herbicides and active components in chemical warfare agents (CWA). One of the most dangerous of the CWA is the compound designated VX. The abiotic hydrolysis of VX produces, depending on the pH of hydrolysis, results in a mixture of products including ethylmethylphosphonic acid (EMPA), diisopropylethylmercaptoamine (DESH or DIEM), EA-2192 and ethanol. Though less toxic than VX, these products are still both toxic and persistent. The enzymatic catalysis of VX, on the other hand, promises a better strategy over chemical hydrolysis, because degradation can be accomplished largely *in situ* and produces a set of products, both lower in toxicity and subject to further bioremediation. Because of the inherent dangers in handling VX, the chemical stimulant malathion is being used in initial screens and VX byproducts being used in subsequent analysis. However using either parent compound, under ideal conditions, will result in complete remediation, the final fate of the compound being utilized in normal metabolic processes.

Several enzymes are known to act on the C-P and P-S bonds in the malathion backbone, thereby, producing less toxic byproducts; the P-S-C (phosphonate) bond being the more difficult to catalyze. These enzymes, however, are not constitutively expressed and are regulated by conditions of phosphorus and sulfur starvation. Our labs propose to screen for degrading organisms, not using the traditional method of substituting malathion as the sole carbon source, but instead by identifying degraders based upon the ability to use malathion as sole sources of phosphorus and sulfur. In altering the screen, we hypothesize to also identify those organisms with the best activity towards phosphonate bonds, making these same degraders better candidates against VX and its byproducts. We have isolated over 100 clones from a screening of our microbiology culture collection, greenhouse soil sampling and activated wastewater sludge and are in the process of further characterizing them.

The specific aims of the project are to:

Isolate and identify microorganisms able to bioremediate malathion as a sole source of carbon, sulfur and phosphorus.

Study the kinetics of malathion bioremediation by comparative analysis of substrate disappearance and novel product appearance over time by GC-MS.

Screen the organisms (1) for the ability to metabolize the abiotic byproducts of VX degradation, e.g. EMPA, DESH/DIAM and EA-2192.

Study the kinetics of EMPA, DESH/DIAM and EA-2192 bioremediation by comparative analysis of substrate disappearance and novel product appearance over time by GC-MS.

Study the genetics of positive organisms (3) to identify and isolate specific genes and proteins involved in byproduct bioremediation.

Clone and express degrading enzymes for protein purification and further study.

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Mobile System for Fatigue Assessment in Firefighters

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Many professions such as firefighters work under severe stress and/or harsh environmental conditions. Under these challenging work environments fatigue, which impacts both physical and mental performance, can have a severe impact on their ability to perform their job. In the most critical examples, diminished work performance associated with fatigue could significantly increase the risk of serious injury to both the worker and his/her colleagues. Thus, the ability to detect the onset of fatigue is critical for maintaining a safe workplace for all workers who work in these professions. While recent research done with kinesthetic studies and fMRI imagining have demonstrated the ability to detect fatigue through changes in eye motions and physical changes (i.e. posture and balance) in firefighters, these systems are not amenable to the creation of a technology that can be used for continuous monitoring of firefighter fatigue. We proposed the development of an EEG based fatigue assessment system that captures brainwave signals that could be associated with fatigue. Building on the recent successful use active dry electrode EEG systems to monitor gross-motor activity, we hypothesize that such a system could eventually be compact and lightweight enough to include in the firefighter personal protective equipment.

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Assessment of Faceseal Leakage in a Half-mask Respirator Used by Firefighters

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Firefighters are often exposed to ultrafine combustion particles during the fire overhaul. The ultrafine aerosol exposures at workplaces have been associated with impairments of cardiovascular function and other adverse health outcomes. To control the exposure, the firefighters and first responders conventionally wear half-mask elastomeric respirators. Currently, it is unknown how the faceseal leakage occurring when wearing such a respirator affects its performance. To address this issue, we propose to conduct a respirator performance evaluation study using the size-selective measurements of the aerosol concentrations inside and outside the respirator.

First, each subject of the standard NIOSH 25-subject panel wearing a half-mask respirator will undergo a series of exercises while exposed to the NaCl surrogate of combustion aerosols, and the total inward leakage (TIL) will be determined particle-size-selectively. Second, the subject- and exercise-specific breathing patterns will be recorded and replicated on a breathing manikin with the tested respirator sealed on it. Again, the aerosol concentrations inside and outside the respirator will be measured to determine the filter penetration (in absence of the faceseal leakage). This approach will allow differentiating the relative contribution of the two penetration pathways: the filter media and the faceseal leakage. The effects of facial/body movements, particle size, and breathing patterns on the protection efficiency of the half-mask respirator will be quantified.

The results will help establish a better understanding of the respirator performance against combustion aerosols and develop strategies for its improvement. The proposed study will not only benefit firefighters but also other workers since the half-mask respirators are widely used throughout occupational environments.

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Light Emitting Diode (LED) Ultra-violet (UV) Disinfection of Water

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This project intends to evaluate the effectiveness of pulsed gallium nitride (GaN) light emitting diode (LED) ultraviolet (UV) lamps to disinfect drinking water. This project will employ a novel probe configuration of an array of LED lamps encased in acrylic which can be immersed in water. Another innovative feature of this project will apply pulsed current to the LEDs rather than continuous current which is expected to reduce the power requirements of such a water disinfection device as well as extend the life of the LED lamps. Specifically, we aim to answer the following research questions:

a) How well does a pulsed LED UV light disinfect water with Bacillus subtilis spores compared to LED UV light with continuous current.
b) How much less power does the pulsed current configuration require compared to continuous current configuration.
c) How long does the pulsed LED UV lamp remain effective compared to the continuous current configuration.
d) What is the relationship between pulse width and peak power on the effectiveness of LED UV light for disinfecting water containing Bacillus subtilis spores.

This project aims to develop a novel water disinfection device that has wide-reaching applications for workers and other personnel in austere environments, such as military personnel deployed to Forward Operating Bases (FOBs) and those struck with disaster who have disrupted access to safe drinking water.

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Use of Pyrosequencing to Assess Bacterial Diversity in Moisture-damaged Buildings

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Bacteria coexist in moisture-damaged building materials with fungi and could contribute to the adverse health outcomes associated with exposure. However, much less information is available on the bacterial communities in moisture damage buildings compared to that of mold. The aim of the proposed work is to investigate how the bacterial diversity differs between moisture-damaged buildings and undamaged reference buildings. Pyrosequencing will be used to determine the bacterial diversity in dust samples collected from moisture-damaged buildings and undamaged reference buildings in the Cincinnati area. The use of the culture-independent pyrosequencing method is expected to indentify individual major strains of bacteria specifically associated with moisture-damaged buildings that might normally be missed by culture-based methods. Pyrosequencing is a time- and cost-efficient sequencing technique that employs coupled enzymatic reactions to detect inorganic pyrophosphate (PPi) released as a result of nucleotide incorporation during DNA synthesis. The results are expected lead to improved early prediction and cost-effective testing of microbial contamination in buildings. The proposed study is also expected to lead to a better understanding of the association between building moisture damage and respiratory symptoms, namely which specific bacterial species could contribute to these respiratory symptoms.

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Aerosol Contamination at Fire Scenes

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High levels of several semivolatile contaminants, phthalates and polycyclic aromatic hydrocarbons (PAHs), have been measured on firefighter personal protective gear. Due to the high boiling points of the contaminants, it is anticipated that the contaminants originate from the fire scene as aerosols: in the form of fine droplets or adsorbed on fine ash particles. Contaminants may accumulate on firefighter gear during fire knockdown or during overhaul. If contaminants are in the air during overhaul, there is the potential for higher exposures, because firefighters rarely wear respiratory protection during the overhaul phase.

It is proposed to sample aerosols in firefighters' breathing zones at fire scenes during the overhaul phase and to characterize the chemistry of the particulate. These findings will be compared to the contamination found previously on personal protective gear. The hypothesis is that semivolatile chemical contamination measured on particulate in firefighters' breathing zones will be significantly higher than the limit of detection during overhaul, an operation during which water is not being sprayed and smoldering areas are being disturbed.

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An Examination of the Work-Family Interface among Farming Dyads

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Work and family are two of the most important aspects of many peoples' lives regardless of occupation or work schedule. Though work-family conflict and work-family facilitation have become increasingly important topics of study within organizational pschology, previous research has focused primarily on managerial and white-collar occupations. Thus, the primary goal of this project is to examine the work-family interface among farming dyads. This represents a novel sample, as well as a unique work situation, that has received very little attention in psychological research in general, let alone in the work-family literature.

This study seeks to extend work-family research by examining whether previous findings regarding crossover (attitudes/strain flowing from one person to another) and spillover (attitudes/strain flowing from one domain to another) effects generalize to farming dyads. Due to the close proximity of work and family among farmers, it is likely that these effects will be stronger within this population. Additionally, the multiple directions (work-to-family, family-to-work) and nature (conflict, facilitation) of work-family processes will be inspected to determine whether their prevalence among farmers is similar to previous research findings.

Finally, perceptions of control, spousal support, and job involvement will be examined to determine if these factors may buffer the relation between work-family conflict, spillover, crossover, and strain. These three factors are likely to play a role in the perceived stress both within and between farmers and their partners. In order to obtain the goals of this study, a cross-sectional design will be used to examine farming dyads within a major Midwestern farming state. Using a survey format, validated measures will be completed by consenting participants. The data will be examined to determine if the proposed relationships exist.

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A Pilot Project: Mechanical Damping and the Spine

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The long-term objective of this pilot project (Mechanical Damping and Spine) is to develop a strategy for reducing back pain through investigation of the mechanism of mechanical damping in spine and gene expression induced by loads. Back pain is a common symptom encountered by many workers engaged in a variety of occupations. A group of researchers at the University of Cincinnati, led by Dr. Bhattacharya, made an intriguing observation about superior mechanical damping in spine in healthy individuals, which allowed us to raise a set of questions: Is an intervertebral disk, a vertebral body, or a surrounding tissue a major contributor to mechanical damping in the spine? Does cyclic loading to the spine enhance mechanical damping? If yes, what genes are activated in the disk, body, and surrounding muscles and ligaments? A specific goal of this project is to answer those questions using mouse spine as a model system. Our working hypothesis is: cyclic loading activates genes that alter viscoelastic characteristics in the disk and body, and enhances mechanical damping in the disk and connective tissues as well as mechanical stiffness in the body. To test the hypothesis, we are conducting the following specific aims:

Aim 1: Damping analysis of the disk and body as well as surrounding tissues in response to impulsive loads

Aim 2: Gene expression analysis of the disk, body, and surrounding tissues in response to cyclic loads

Loads are applied with an electro-force loading device, and a finite element analysis is conducted for evaluating experimental data for damping and stiffness. Gene expression is analyzed using quantitative real-time PCR. We expect that impulsive loads will be damped mostly through the intervertebral disk but the contribution of the vertebral body is not negligible. We also expect that moderate loads through cyclic loading not only elevate bone mineral density in the vertebral body but also increase mechanical damping in the intervertebral disk and surrounding tissues. The proposed study should contribute to our basic understanding of the mechanism of mechanical damping in the spine and the role of loading for regulating back pain.

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In-Vitro Mechanistic Approach to Understand LPS Toxicity in and out of Workplace

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Rationale

Pattern recognition receptors such as membrane bound Toll-Like Receptors (TLRs) and cytoplasmic Nod-like receptors (NLRs) of surface epithelial cells and antigen presenting cells detect airborne pathogens and activate innate immune response providing the first line of defense against these inflammatory agents. Pathogen-associated molecular patterns, such as lipopolysaccharide (LPS) in bacterial cell walls and bacterial flagella, acts as ligands to trigger for downstream pathways that release inflammatory mediators such as TNF-α and interleukins (IL1β, IL2, IL6 and IL18). TLR dimerization by PAMPs is critical for subsequent downstream signaling mediated by inducible nitric oxide synthase (iNOS) to

cause oxidative or nitrative stresses that lead to tissue inflammation. Effect of size-specific airborne LPS on these inflammatory pathways, however, has been under-researched.

Methods

Human bronchoepithelial cells (BEAS2B) will be maintained in BEBM at 37°C, 5% CO2 and ambient O2 (21%). Cells plated in 6-well plates will be treated 24 hours later with LPS extracts from PM1 and T1 (>1.8 μM) fraction of Bioaerosol sampler (NIOSH). Untreated cells will used as controls. In separate experiment either CM-H2DCFDA (oxidative stress indicator) or DAF-FM (nitrative stress indicator) will be loaded into cells (×30 minutes) and subsequently will be observed for fluorescence intensity under confocal microscopy. Intensity being proportional to stress mediators will be indicator of the extent of cellular stresses upon exposure to particular size-specific LPS. IL-1β, IL-6, TNF-α and iNOS mRNA and protein expressions will be measured in the in cultured media of naïve and size-specific-LPS treated BEAS2B.

Expected results

TLRs on APCs dimerize in order to convey intracellular signals that produce inflammatory mediators. Larger LPS particles from T1 fraction would be more effective at causing such dimerization than smaller PM1 LPS. Thus cells exposed to T1 LPS is expected to produce more fluorescence than that exposed to PM1 indicating that later cause less airway inflammation. Compared to cells exposed to T1-LPS, the IL-1β, IL-6, TNF-α, iNOS mRNA and protein expression will be significantly higher in than cells exposed to PM1-LPS.

Conclusion

These in-vitro experiments would help in understanding LPS-toxicity from airborne size-specific LPS particles that are of specific relevance to health care, farm and animal care workers.

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INVITED NON-PRP POSTER PRESENTATION ABSTRACTS

Evaluating the Effect of Heat Stress on Firefighters

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Purpose: The purpose of this research study is to investigate the effects of heat stress on cardiovascular, neuromuscular and cognitive systems of firefighters. Sudden cardiac death has been determined to be the primary cause of on-duty firefighter deaths. The focus of this research is to assess and reduce firefighters on-duty risks by utilizing emerging technologies to control firefighters adverse reactions when exposed to heat stress and physical exertion. The ultimate goal is to develop an exposure measurement system that will allow incident commanders to pull firefighters out of situations prior to incidents that result in on-duty injury or fatality.

Design: The data collection process has been designed around the firefighters live burn trainings. The live burn trainings involve three scenarios with rest periods in between. The scenarios include three evolutions that last approximately ten minutes each and which involve search and rescue, hose advancement, and backup procedures.

Methods: During the October 2011 data collection full-time firefighters were recruited from the Sycamore Township fire department. The data was collected during their regularly scheduled live burn trainings. Measurements were taken at baseline, pre-scenario, and post-scenario times. These measurements included blood pressure, pulse, oxygen saturation (SPO_2), skin temperature, reaction time, Borg rating of perceived exertion (RPE), respiratory distress, and thermal comfort. The subjects were given FDA approved radio pills during the time that consent forms were obtained and baseline data was gathered. Prior to the start of live burn training the core body temperature (CBT) devices were synchronized, polar heart rate (HR) belts were applied, and pre-scenario data was gathered. The use of CBT and polar HR devices allow for continuous live monitoring throughout the training.

Results: There appears to be an association between exposure to elevated temperatures and the firefighters increased perception of physical exertion, respiratory distress, and thermal discomfort. The mean HR, skin temperature, CBT, and polar HR increased at pre-scenario stage and remained elevated, while there was a decrease in SPO_2 levels that occurred after an initial increase at the pre-scenario stage.

Conclusion: A limitation with this data collection is having only six subjects from one fire department. Recruiting subjects from different fire departments is another consideration that needs to be addressed to strengthen this study.

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Carbon Nanotube Reinforced Textiles: Advanced Personal Protection Technology for Firefighters

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Heat stress and exhaustion lead to an increased risk of injury and decreased performance for firefighters and first responders. This poster presents results of an initial evaluation of carbon nanotube (CNT) enhanced composite textiles as an advanced personal protection technology to reduce heat stress and fatigue in firefighters and first responders. The research method taken was to create a highly simplified Finite Element Analysis (FEA) model of a traditional textile fabric embedded with CNT and study its response to different ambient conditions. Nanotubes have several advantages related to improving protective gear for workers: they are very strong, light weight, and highly thermally and electrically conductive. To add to these amazing properties, from Molecular Dynamic (MD) simulations of the tubes, the tubes are thought to have anisotropic thermal conductivity. This property of CNT can allow the flow of thermal energy to be directed, in this case away from the firefighters and first responders.

Carbon nanotubes are grown as a vertically aligned forest on a silicon substrate. A CNT ribbon can be made by drawing a line of CNTs from the forest. The CNT ribbon is a mode in which the nano-scale CNTs can be constructed into a macro-scale product. Layering the ribbon forms a CNT sheet. Twisting the ribbon forms a CNT thread. Multiple threads can be plied together and twisted to form a yarn. The CNT structures mentioned are the potential building blocks to the new CNT enhanced composite textiles that will be tested for possible use as personal protective garments for firefighters and first responders.

An FEA model was constructed and it was subjected to arbitrarily selected ambient temperatures to determine how the embedded CNTs would affect the heat flux through the material into the body of the person "wearing" the garment. The model considered two different thermal conductivities of the thread. The first being the thermal conductivity of CNT reported in current literature. The second being the highest thermal conductivity reported in current literature of a CNT structure, to make a guess at the thermal properties we can expect of CNT thread upon further refinements.

Conclusions from this study indicate that CNT composite textiles may provide increased thermal protection for firefighters. The material may also have multi residual benefits, in that the CNT composite textiles would be strong and light. This would add to the abrasion resistance of the garment and further increasing the protection from heat-stress. The material may also have multifunctionality in that it could be dual purposed to also serve as an antenna, or sensor, or both. All of this combined points the notion that CNT enhanced composite textiles have great potential to improve the safety for firefighters and first responders.

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Identifying Health Disparities in Ohio Using Self Organizing Maps

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Health disparity may exist in various aspects including gender, age, race and region. The initial step to eliminate the disparity is identifying its forms and its social, behavioral and environmental origins. This study presents a Self Organizing Map (SOM) based methodology to identify the health disparity. A case study in all 88 Ohio counties among three age based demographic groups is presented. Counties were grouped into four regional settings: Appalachian, metropolitan, rural and suburban. Age groups were children (<18), adults (18-64) and seniors (>64). County level Ohio Family Health Survey (OFHS) data for 2008 was used. The pre-treated survey questions were grouped into the following socio-behavioral groups: Habits, health conditions, male income, female income and healthcare affordability. SOM clusters were obtained for any appropriate socio-behavioral group for each age group. These SOM clusters for each age group were used in developing the health disparity scores for the four regions. Results were visualized in the GIS .There was a definite regional disparity with Appalachian region significantly lacked from the suburban region. This may be due to the reason that many individuals who live in Appalachian region work in coal mines and related industries, and they are at high risk to get exposed to adverse work environment which might contribute to the poor health conditions. Metropolitans performed next to suburban areas. The standing of a rural region varied depending on the individual county. Among the adults, income disparity was detected among the male and female. The severity in disparity among the age groups varied depending on the region they live, but still with the suburban area outperformed the others. Future studies will be done within the Appalachian region to see the how one individual's occupation is connected to the health conditions.

Acknowledgment: *Center for Allaying Health Disparities through Research & Education (CADRE), Central State University*

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NOTES:

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