2019 Pilot Research Project (PRP) Symposium
University of Cincinnati NIOSH Education and Research Center
October 10-11, 2019
Kettering Laboratory Complex

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University of Cincinnati Education and Research Center (ERC) Supported by the National Institute for Occupational Safety and Health (NIOSH) Grant # T42-OH008432

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About the ERC and PRP

Welcome to the University of Cincinnati Education and Research Center's (ERC) **20th Annual Pilot Research Project (PRP) Symposium** on October 10-11, 2019, held in the Kettering Lab Auditorium. 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 and Dr. Gordon Gillespie, research proposals are solicited and peer-reviewed annually by 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 2018-19 awardees will be presenting the results of their research and the 2019-20 awardees will make poster presentations of their proposed work. The keynote speaker on Thursday, October 10, 2019 is **Dr. Laura Punnett, Professor of Biomedical Engineering, University of Massachusetts Lowell; Co-Director, Center for the Promotion of Health in the New England Workplace, a NIOSH Center of Excellence in Total Worker Health®; Senior Associate, UML Center for Women and Work presenting on "Total Worker Health®: Integrating Workplace Health Protection with Workforce Well-Being."**

The University of Cincinnati's Education and Research Center is one of 18 national centers funded by the National Institute for Occupational Safety and Health (NIOSH). 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 in 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 $1.5 million to support 248 pilot research projects. These projects have served as a catalyst in bringing over $41 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 59 new investigators from other fields of expertise to the area of occupational safety and health research.

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Thursday, October 10, 2019

12:00pm	**ABIH Ethics Training**	Glenn Talaska, PhD, CIH
12:30pm	**Registration**	
1:00pm	**Welcoming Remarks and Introductions**	Amit Bhattacharya, PhD, CPE, PRP Program Director *University of Cincinnati, Environmental Health*
1:05pm	**Introduction of Education and Research Center**	Tiina Reponen, PhD, CIAQP, ERC Director *University of Cincinnati, Environmental Health*
1:10pm	**Introduction of Keynote Lecturer**	Amit Bhattacharya, PhD, CPE, PRP Program Director *University of Cincinnati, Environmental Health*
1:15pm	**Total Worker Health®: Integrating Workplace Health Protection with Workforce Well-Being**	Laura Punnett, Sc.D. *Professor of Biomedical Engineering* *Co-Director, Center for the Promotion of Health in the New England Workplace, a NIOSH Center of Excellence in Total Worker Health®, and Senior Associate, UML Center for Women and Work* *University of Massachusetts Lowell*
2:00pm	**Gender Differences in Nursing Job Demands and Resources** Moderator: Joe Abulhassan	Katherine Barlow *Bowling Green State University, Industrial-Organizational Psychology*
2:20pm	**Fragility Analysis of Steel Buildings in Fire** Moderator: Joe Abulhassan	Rachel Chicchi, PhD *University of Cincinnati, Civil and Architectural Engineering and Construction Management*
2:40pm	**Poster Session I & Break**	Devika Chauhan, Aditya Milind Deshpande, Yanbo Fang, Yao Fu (Mengze Ma), Ola Wasel *See page 3 for poster titles*
3:20pm	**Poster Session I Q&A** Moderator: Gordon Gillespie, PhD, DNP, RN	Devika Chauhan, Aditya Milind Deshpande, Yanbo Fang, Yao Fu (Mengze Ma), Ola Wasel *See page 3 for poster titles*
3:50pm	**Effect of Heat Stress on Immune Function in Firefighters** Moderator: Joe Abulhassan	Brijesh Yadav, PhD *University of Cincinnati, Environmental Health*
4:10pm	**Predicting Changes in Driving Safety Performance on an Individualized Level Under Naturalistic Driving Conditions** Moderator: Joe Abulhassan	Robert Leonard, PhD *Miami University, Information Systems and Analytics*
4:30pm	**Development of a Sensor Frame Based Gait Assessment Device For Occupational Health In Nursing** Moderator: Joe Abulhassan	Tamara Lorenz, PhD *University of Cincinnati, Psychology, Mechanical Engineering, Electrical Engineering*
4:50pm	**Neuromotor Effects of Manganese Exposure in Adolescents Entering Workforce** Moderator: Joe Abulhassan	Danielle McBride *University of Cincinnati, Environmental Health*
5:30pm	**Dinner**	

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Friday, October 11, 2019

7:30am	**Registration and Breakfast**	
8:00am	**Welcoming Remarks and Introductions**	Gordon Gillespie, PhD, DNP, RN, PRP Deputy Director *University of Cincinnati, Nursing*
8:10am	**Unmanned Aerial Vehicles (UAVs) for Information Gathering during Urban Disaster Situations** Moderator: Kermit Davis	Zach Wells (Presenting for Mohammadreza Radmanesh) *University of Cincinnati, Mechanical and Materials Engineering*
8:30am	**Educational Intervention to Mitigate the Effects of Bullying in the Student Nurse Population** Moderator: Kermit Davis	Dawna Rutherford *University of Cincinnati, College of Nursing*
8:50am	**Exposure to Traffic-Related Air Pollution, Home Dust, and the Respiratory Mycobiome** Moderator: Kermit Davis	Christine Uebel-Niemeier *University of Cincinnati, Environmental Health*
9:10am	**Poster Session II & Break**	Mahnoosh Khosravifar, Kimberly Tumlin, Ashley Turner, Yao Addor, Brijesh Yadav *See page 3 for poster titles*
9:50am	**Poster Session II Q&A** Moderator: Gordon Gillespie, PhD, DNP, RN	Mahnoosh Khosravifar, Kimberly Tumlin, Ashley Turner, Yao Addor, Brijesh Yadav *See page 3 for poster titles*
10:20am	**Vote for Favorite Poster and Presenter**	
10:40am	**Panel Discussion of the Podium Presentation Topics** Moderator: Gordon Gillespie, PhD, DNP, RN	Cynthia Betcher, Amit Bhattacharya, Clint Pinion, Ellen Wells University of Cincinnati College of Nursing, University of Cincinnati Environmental Health, Eastern Kentucky University, Purdue University
11:30am	**BEST Award Presentations**	Diana Schwerha, PhD *Ohio University, Industrial and Systems Engineering*
11:50	**Closing Remarks and Program Evaluation**	

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2019-20 PRP Awardee Posters & Invited Posters

Poster Session 1

Title	Presenter	Program
A Lead-Free Carbon-Based Shielding Material to Protect Healthcare Workers	Devika Chauhan	*University of Cincinnati Mechanical and Materials Engineering*
IoT based AI Application for Posture Recognition to Reduce Workplace Injuries	Aditya Milind Deshpande	*University of Cincinnati Mechanical and Materials Engineering*
Dual-Functionality Heatable Carbon Nanotube Air Filters for Healthcare Providers	Yanbo Fang	*University of Cincinnati Mechanical and Materials Engineering*
Designing Next-Generation Solid Electrolyte via a Multiscale Computational Scheme to Avoid Workplace Battery Hazard	Yao Fu (Mengze Ma)	*University of Cincinnati Aerospace Engineering and Engineering Mechanics*
Neurotoxicity of Polyfluoroalkyl Substance (PFAS) Mixtures in Firefighting Materials	Ola Wasel	*Purdue University School of Health Sciences*

Poster Session 2

Title	Presenter	Program
Heavy Metal Sensor for Construction Workers Based on 3D Graphene	Mahnoosh Khosravifar	*University of Cincinnati Mechanical and Materials Engineering*
Assessing Volunteer Workers' Exposure to Dust, Metals and Bioaerosol During Equine Assisted Activities/Therapies: An Exploratory Study	Kimberly Tumlin	*University of Kentucky Preventative Medicine and Environmental Health*
Characterizing Fine and Ultrafine Particle Exposure Among Home Healthcare Workers	Ashley Turner	*University of Cincinnati Environmental Health*
Home Health Care Workers' Occupational Exposure to Bioaerosols and Potential Association with Respiratory Health Issues	Yao Addor (Targeted Research Training Poster)	*University of Cincinnati Environmental Health*
Role of Firefighting-Associated Chronic Stress Factors in Immune Dysfunction in Mouse Model	Brijesh Yadav	*University of Cincinnati Environmental Health*

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Important Links

Whova app instructions

- App includes for speaker bios, agenda, abstracts, and all other event information
- If you registered ahead of time, use the email you registered with to access the event in the Whova app
- If you did not register in advance you can either download the app in your app store and use the code **"apral"** to access the event OR
- Visit the registration desk to be manually added to the event & use the email address given at the desk to access the event in Whova

***Voting for favorite poster and presenter:** https://www.surveymonkey.com/r/SDNGBTR
***Program Evaluation:** https://www.surveymonkey.com/r/W6H9RNM
Speaker webpage: https://whova.com/embedded/speakers/aprps_201910/?utc_source=ems
PRP Agenda webpage: https://whova.com/embedded/event/aprps_201910/?utc_source=ems
ERC upcoming events: http://med.uc.edu/eh/centers/erc/upcoming-events

**if you don't have access to a device to vote and do the program evaluation, please visit the registration desk*

Continuing Education

Attendees are eligible for the continuing education options below, certificates will be emailed after the event if you registered and checked that you needed a certificate. If you did not register in advance, make sure to check in at the registration desk and indicate you need a certificate.

- ABIH (IH) CM hours, www.abih.org
- Meets BCSP criteria for professional development conference CSP recertification points, www.bcsp.org
- ABIH ethics training points claimable for participating in 1 hour ethics session on 10/10/19 at 12pm

Social Media

Twitter

- Follow us on Twitter @uc_erc
- Use **#20PRP** in all of your PRP related comments and questions so they will be displayed in the event feed

Facebook

- Follow and like us on Facebook at University of Cincinnati NIOSH Education and Research Center

CERKL

- Subscribe to our CERKL pages at CERKL.com to get email newsletters about ERC program events, alumni news, job opportunities and more
- Subscribe to one or all of the ERC CERKL pages to receive updates via email: UC Education and Research Center, UC Environmental & Industrial Hygiene, UC Occupational Health Nursing, UC Occupational Medical Residency, UC Occupational Safety and Health Engineering

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2018-19 PRP Awardee Abstracts

Gender Differences in Nursing Job Demands and Resources

Katherine Barlow
Bowling Green State University, Industrial-Organizational Psychology

Purpose: While the challenges nurses face in their work have been widely studied, previous research has been unable to determine how the demands of nursing work might differ for men and women in this majority-female career field. The present study sought to explore the way that male and female nurses experience differing job demands, resources, and outcomes in order to better tailor interventions and improve worker health, safety, and retention.

Design: Demerouti and Bakker's job demands and resources model was used as a framework to understand the ways in which job-related challenges lead to negative health and work outcomes while job resources mitigate those demands. Methods: 240 nurse participants were reached by email and snowball sampling through social media and nurse support groups. Registered nurses and licensed practical nurses (50% male) completed a 30-40-minute one-time survey with questions about their experiences at work as nurses as well as physical and psychological outcomes.

Results: Multiple job demands, resources, and outcomes showed differences along gender lines. Female nurses report more frequent attention switching, but male nurses experience more distress and errors due to attention switching requirements. Women report more work issues due to understaffing. Male nurses not only complete more high-risk physical behaviors as part of their work, but they also are asked to do these high-risk behaviors on behalf of another nurse more frequently than female colleagues. Men also experienced greater incivility from coworkers and greater disrespect from patients, families and supervisors. In terms of job resources, women experienced greater social support from coworkers while men felt greater support from their supervisors. There were no gender differences in experienced autonomy. Men experienced more frequent injuries, including back injuries, bruises, and human bites. Women reported more instances of pain across body regions.
No differences were found in job turnover intention, but male nurses reported greater likelihood of leaving the field of nursing and greater perceived stress. However, men also reported greater affective commitment to their organizations. No gender differences were found for burnout or its components of energy and exhaustion.

Conclusion: Male and female nurses clearly experience their work differently; men not only seem to do more high-risk physical behaviors than female colleagues, but they also face social challenges in the forms of coworker incivility and disrespect from patients, possibly due to their token male status in a predominantly female field. Negative outcomes of these differences include stress, injuries, and desire to leave the field of nursing altogether.

Impact Statement: While health, safety, and inclusion are concerns for all nurses, further research should examine the possibility that male nurses might require tailored interventions to prevent their higher incidence of injury, stress, and intent to leave nursing. Additionally, new awareness of the differing experiences of male and female nurses points to a need for greater consideration of demographic differences when studying occupational health. Treating all subjects in a highly gendered career field as one homogenous group may result in an incomplete picture of the challenges, advantages, and outcomes experienced in fields like nursing.

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Fragility Analysis of Steel Buildings in Fire

Rachel Chicchi (PI), Seng (Tong) Ngann
University of Cincinnati, Civil and Architectural Engineering and Construction Management

Purpose: The purpose of this study is to implement a performance-based fire analysis procedure on steel buildings that allows for evaluation of building performance subjected to a variety of fire hazard scenarios. Fragility curves will be used to recommend feasible intensity measures and damage parameters that are effective in the analyses.

Design & Methods: A procedure for developing fragility functions for steel gravity columns is articulated through four prototype buildings of 3, 9, 10, and 20 stories. Selected columns from each building are used to demonstrate the procedure and compare results. A standard Eurocode fire time-temperature curve was used to simulate a compartment fire and was scaled by different intensity measures. Uncertainties in fire demand (fireproofing thickness) and column capacity (mechanical properties of steel) were incorporated into the analyses. Failure was defined as buckling of the column and capacity was determined using the design equation in AISC 360. The maximum steel temperature was calculated using a simplified lumped mass equation in lieu of more complex heat transfer analyses. The maximum temperature of the steel was compared with the critical temperature that causes failure in order to calculate the probability of failure and generate fragility curves. The following intensity measures were evaluated: fuel load density, opening factor, thermal properties of enclosure, peak fire temperature, and utilization ratio.

Results & Conclusions: The proposed approach explores methods of scaling fires that can be used effectively to capture a range of potential fire demands. None of these intensity measures are perfect, and they all contain some drawbacks, as outlined in the report. However, the fuel load, peak fire temperature, and load ratio all provided reasonable intensity measures for developing fragility curves. These curves can also be used concurrently with one another to capture a wider range of unknowns (i.e. – scaling peak fire temperature while also considering different $q_{t,d}$ values). The proposed work empowers owners and structural engineers to have a better understanding of the implications of the design and the safety inherent in each design. Minor improvements such as increasing fireproofing or column size can significantly decrease the probability of failure.

Impact Statement: This work contributes to the fundamental goal of preventing building collapse due to fire hazards. This is achieved through better understanding of building behavior in the event of a fire. By implementing the proposed methodology, the likelihood of structural failures due to fire can be decreased, thereby improving building safety.

Effect of Heat Stress on Immune Function in Firefighters

Brijesh Yadav (PI), Jagjit Yadav
University of Cincinnati, Environmental Health

Purpose: To examine the effect of heat stress on immune functions in firefighters.

Design: In this study, we had planned to recruit 20 firefighter subjects. Ten firefighters in lower exposure group (≤5 years of total firefighting service including part-time and full-time employment) and ten firefighters with higher exposure group (≥5 years of total firefighting service including part time and fulltime employment); up until this report, 13 subjects were recruited. Peripheral blood samples were collected to analyze immune cell profiles and the corresponding cytokines and heat stress markers (HSP70 and Orexin-A). Metadata were collected using a study questionnaire to correlate with the lab findings.

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Methods: We have collected blood sample from a total of 13 subjects. Two with Lower exposure group (mean length of experience= 3 years) and 11 of Higher exposure group (mean experience=14.81 years). Complete blood count (CBC) in the samples was analyzed at the CCHMC Core facility. We compared gene expression levels Heat shock protein-70 (*HSP*-70), and TNF-α using quantitative RT-PCR and plasma protein levels of circulating IL-10, Orexin-A and HSP-70 using ELISA. Meta-data from the study questionnaire and experimental findings were compared with Graph pad software by using parametric *t* test.

Results: The results showed upregulation of the pro-inflammatory cytokine (TNF-α) and downregulation of the anti-inflammatory cytokine (IL-10) in the Higher exposure group compared to Lower exposure group. The targeted markers of stress (HSP70 and orexin-A) however showed decreasing trend in this group. The CBC data showed an increasing trend for lymphocyte, monocyte and Eosinophils cell count and decreasing trend for basophils, neutrophil and platelets count.

Conclusion: In this study we have found immune dysregulation in higher exposure group of firefighters based on perturbation of immune cellular and molecular signatures in the blood.

Impact Statement: In this study, we are first time demonstrating the effect of occupational heat stress on immune function in firefighters. As the Firefighters experience heat stress and are prone to developing many immunological diseases, it was considered worthwhile to study the immune status in this occupational group. An understanding of immune function will help in devising a strategy to mitigate the deleterious effects of occupational heat exposure and sleep deprivation in firefighters and use these findings as prototype for investigating other similar cohorts like industrial workers and residents living under high temperature conditions as well as truck drivers, and nurses, who usually experience sleep deprivation in their occupational setting.

Predicting Changes in Driving Safety Performance on an Individualized Level Under Naturalistic Driving Conditions

Robert Leonard (PI)[1], Nicholas Jerdack[1], Ying-Ju Chen[2], Lora Cavuoto[3], Fadel Megahed[1]
[1]Miami University, Information Systems and Analytics; [2]University of Dayton; [3]University at Buffalo

The aim of this project was to use predictive analytics to integrate disparate data sets to understand the factors influencing the likelihood and severity of trucking crashes. Our approach initially included a consideration of environmental factors such as weather, time of day, and roadway construction in addition to public policy considerations like speed limits, distracted driving laws, and company policies. Human factors such as driver rest were also to be considered. We found this approach to be novel since these factors have not been considered in aggregate before. However, early in the project our team unfortunately discovered that the data acquired from drivers using wearable technology did not overlap well enough with the national transportation data on large truck and bus accidents. Therefore, the culmination of this project to create a real-time risk assessment model that calculates a "relative risk score" for a trucking trip was not possible. The model was envisioned to predict the risk (probability and severity) of various trip scenarios, and suggest ways to reduce the risk through mitigation strategies. For example, a trip along a treacherous roadway in bad weather conditions would generate a higher score than the same trip being performed the next morning, after the weather has cleared. Another example might involve alternate routes; some of which include construction, historically high accident rates for that time of day, and expected congestion based on real-time GPS tracking data from cloud based platforms. The predictive model could then assess a risk score and suggest alternate routing involving fewer hazards.

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Development of a Sensor Frame Based Gait Assessment Device for Occupational Health In Nursing

Tamara Lorenz (PI)[1], Manish Kumar[2], Amanda Miller[2]
[1]University of Cincinnati, Psychology; [2]University of Cincinnati, Mechanical Engineering

Purpose: Every year, people in physically strenuous fields such as nursing are at risk of work-related injury due to unhealthy, unsafe, and repetitive movements, such as lifting and moving heaving objects.

Design: To reduce this risk, we present a novel approach to collecting movement data with a lower-limb IMU-based sensor frame. IMUs are inertial measurement units which allow the determination of joint acceleration. On the proposed frame seven IMUs are located above and below the ankle, knee, and hip joints, allowing the online-estimation of joint angles by applying an Unscented Kalman Filter to the data. The IMU sensors are incorporated into a custom-made pair of leggings that has channels to route the wiring between sensors. The leggings allows for the sensors to be easily accessed via pockets, but at the same time ensures that the sensors are firmly connected to the user.

Methods: The data from the IMU's is collected through an Arduino and is then transmitted to a Raspberry Pi, which filters the incoming data. Once the recording is complete, the data is printed to csv files. Joint centers and limb locations along the user's body are calculated using the Denavit-Hartenberg method. The overall system is analyzed with respect to its data accuracy and online capacity by comparing the user-based tracking system (leggings) to measurements from an external motion tracking system.

Results and Conclusion: Although the IMU-leggings are a promising concept, the data collection and filter methods still need improvement before even pilot applications can be considered. Higher sampling rates are necessary to capture rapid human movements, which requires an update in computing power of the current system without reducing its flexibility or adding to weight. Nevertheless, the system will enable future research in online and used-based tracking of lower-body movement for posture analysis.

Impact Statement: The current project laid the groundwork for occupational health studies related to the field of nursing and resulted in a prototype for a tool to be used in real-time by nurses to help reduce workplace injury.

Neuromotor Effects of Manganese Exposure in Adolescents Entering Workforce

Danielle McBride[1], Heidi Sucharew[2], Erin Haynes[3]
[1]University of Cincinnati, Environmental Health; [2]Cincinnati Children's Hospital Medical Center, Biostatistics and Epidemiology; [3]University of Kentucky, Epidemiology, Preventive Medicine and Environmental Health

Purpose: Manganese (Mn) toxicity is most often a result of industrial point sources, as Mn compounds are emitted from metal processing factories. Concerns of industrial point sources include both high concentrations of occupational exposure as well as low concentrations of environmental exposure found in the surrounding communities. Environmental Mn exposure has been linked to deficits in neuromotor function. Marietta, Ohio is home to the longest operating ferromanganese refinery, the top source of ambient Mn in North America. In this community-based longitudinal cohort study, we investigate the relationship between childhood exposure to Mn and neuromotor function in adolescence.

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Design: In this community-based longitudinal cohort study, we leverage our well-established and maintained Communities Actively Researching Exposures Study (CARES) cohort to examine the extent of childhood Mn exposure on neuromotor function now that the cohort has aged into adolescence.

Methods: Biomarkers collected in childhood (ages 7-9) include blood and hair Mn, blood Pb, and serum cotinine. Study participants returned in adolescence (ages 13-17) for evaluation of static and dynamic neuromotor function. Postural balance and gait testing were conducted. Multivariable linear regression models were used to evaluate the relationship between childhood Mn biomarkers and adolescent postural balance and gait adjusting for blood Pb, serum cotinine, age, sex, height to weight ratio, total foot area, weight ratio, parent IQ, and parent education.

Results: We enrolled 124 adolescents from the CARES cohort in this neuromotor sub-study. The cohort comprised of 53% female, 98% Caucasian, and mean age of 16 years. Median hair and blood Mn were 380 ng/g (range 63 to 7379) and 9.8 µg/L (range 5.3 to 18.8), respectively. Median blood Pb was 0.76 µg/dL (range 0.36 to 2.71). Median serum cotinine was 0.03 ng/mL (range 0 to 6.08). On average, sway area increased by 0.24 cm^2 (95% CI -0.38 to 0.85; p-value=0.45) per ng/g log hair Mn and 1.67 cm^2 (95% CI -0.61 to 3.96; p-value=0.15) per µg/L log blood Mn, neither statistically significant. Clearance of foot in swing phase over obstacle increased by 0.20 inches (95% CI -0.04 to 0.43; p-value=0.10) per ng/g log hair Mn and decreased by 0.14 inches (95% CI -1.00 to 0.72; p-value=0.74) per µg/L log blood Mn, neither statistically significant. Secondary analyses of additional gait measurements showed similar results, with the exception of return distance of stance foot before barrier and blood Mn with an average increase of 2.7 inches (95% CI, 0.92 to 4.42; p-value=0.003) per µg/L log blood Mn .

Conclusion: Early life blood Mn was significantly associated with a variable in gait, return distance before obstacle crossing in our adolescent cohort.

Impact Statement: Evidence from recent epidemiological studies suggests childhood Mn exposure causes subclinical developmental neurotoxicity. However there is limited knowledge on the longitudinal impact of childhood Mn exposure. This is the first longitudinal study of Mn exposed children to evaluate the long-term impact of gross motor function. Findings from this epidemiological longitudinal cohort study confirm childhood Mn exposure may manifest subclinical developmental neurotoxicity during adolescence as impaired motor function. Findings suggest Mn-exposed children as at risk for occupational slips, trips, and fall as they age into the labor force. This study has implications regarding the research needs identified at the 2016 international Mn conference to revise NIOSH standards for more adequate protection of workers' health and strategies for prevention of Mn toxicity.

Unmanned Aerial Vehicles (UAVs) for Information Gathering during Urban Disaster Situations

Mohammadreza Radmanesh (PI), James Wells, Aditya Deshpande, Nate Calabrese, Manish Kumar
University of Cincinnati, Mechanical and Materials Engineering

The purpose of this project was to investigate and develop a system which will increase first responders situational awareness and in turn reduce the risks of having an environmental related accident by reducing the time it takes for first responders to get to injured individuals after an incident occurs. In order to achieve this, several cutting-edge technologies and algorithms have been researched, developed and applied. These cutting-edge technologies include searching algorithms based on camera parameters and multiple UAVs, Simultaneous Localization and Mapping (SLAM) algorithms, and finally computer vision-based object identification and victim state estimation. All key areas are being

put together to develop an interactive map for first responders showing suggested paths in order to get to victims in the most need as fast as possible.

Educational Intervention to Mitigate the Effects of Bullying in the Student Nurse Population

Dawna Rutherford (PI), Carolyn Smith
University of Cincinnati, College of Nursing

The aim of the pilot study was to analyze the feasibility of an intervention for student nurses to mitigate the effects of bullying behaviors while in a simulated clinical setting. Bullying is pervasive in healthcare and unfortunately nurses often are often the perpetrators as well as targets of this type of behavior. The American Nurses Association defines bullying as recurrent, unsolicited harmful actions that are intended to demean, and cause distress in the targeted individual. As many as 89% of student nurses in one study experienced at least one incident of bullying behavior. These actions pose a danger to the targeted individuals as well as a threat to patient safety. To analyze an intervention mitigating the effects of bullying behaviors in the clinical setting, a randomized controlled trial (RCT) posttest-only design pilot study was used. At the time of this report, data analysis is in progress, however, results and conclusions will be completed by September 2019. The educational intervention provided instruction and methods of how to manage bullying in the clinical setting. When student nurses and novice nurses can mitigate bullying behaviors, they and importantly, the patient, will be safe and free from physical and emotional harm in the healthcare setting.

Exposure to Traffic-Related Air Pollution, Home Dust, and the Respiratory Mycobiome

Christine Uebel-Niemeier (PI), Jerek Meller, Jennie Cox
University of Cincinnati, Environmental Health

Purpose: Though our understanding of the human microbiome has grown significantly in the past decade, the fungal microbiome (mycobiome), particularly the lower respiratory tract mycobiome, is still an understudied area. In this study, we aimed to characterize the fungal community profiles in the lower respiratory tract of adolescents and to characterize the mycobiome of home dust samples from these participants. We also investigated the association between exposure to traffic-relate air pollution (TRAP) and the lower respiratory tract mycobiome and compared the diversity indices and relative abundance of taxa in the two TRAP exposure groups.

Design: We recruited forty subjects from the Cincinnati Childhood Allergy & Air Pollution Study birth cohort and divided them into two TRAP exposure categories, high and low. Induced sputum, saliva, and home dust were collected from each participant. The ITS1 region of fungal rDNA was sequenced and the relative abundance and diversity indices were compared across sample type and exposure group.

Methods: Extracted DNA was amplified using ITS1F-ITS2aR primers for the amplification of the ITS1 region and sequenced using Illumina MiSeq. We quantified the total fungal load of the samples using quantitative-PCR with universal fungal primers. To account for sequencing depth, we calculated absolute abundance by multiplying the relative abundance of each assigned sequence variant (ASV) by the total fungal load as measured by qPCR. Shannon's diversity index, the total number of observed ASVs, and Faith's phylogenetic diversity index were calculated for each sample. We compared the total fungal load, diversity indices, and relative abundance of each sample type, exposure group, and asthma status.

Results: Very few sputum samples amplified well enough for sequencing, so our sample size for sputum was reduced to 10. Nearly all dust samples amplified. This finding is opposite of the bacterial results from the R21 study for which these samples were originally collected. We did not find any significant differences in alpha diversity between the exposure groups for the dust or sputum samples. However, there was a trend of higher total fungal abundance as measured by qPCR of the dust in both the high TRAP exposure group (p=0.24) and in asthmatic participants (p=0.13). The relative abundance of taxa at the phylum level were similar across all three sample types, but at the class level dust had a profile unique from sputum and saliva.

Conclusion: These results indicate that bacteria dominate the sputum microbiome and fungi dominate the home dust microbiome. The low fungal abundance in sputum provides a challenge in studying the lower respiratory tract mycobiome. The trend of higher fungal load in the dust of asthmatics and of the high exposure group suggests further research of the effect of traffic-related air pollution on the human mycobiome and the indoor environment mycobiome is needed.

Impact Statement: This pilot research furthered knowledge of Occupational Safety and Health by 1) demonstrating some of the challenges that future studies may encounter when studying the respiratory mycobiome, and 2) providing some indication for the need of future investigation of TRAP exposure on the human and indoor environment microbiomes.

2019-20 PRP Awardee Abstracts

A Lead-Free Carbon-Based Shielding Material to Protect Healthcare Workers

Devika Chauhan (PI), Henry Spitz, Mark Schulz
University of Cincinnati, Mechanical and Materials Engineering

Healthcare workers employed in the field of radiography are exposed to small doses of radiation as occupational radiation exposure. The low doses of radiation primarily are due to scattering from the patient. Over time, the radiation exposure causes the development of cataract, skin cancer, thyroid disease and left-sided brain tumor among radiation-exposed healthcare workers. Currently, the most effective radiation shielding available to the radiography healthcare worker is the lead-based personal protective equipment (PPE). Lead is toxic and an environmental hazard source. Moreover, lead-based PPE is heavy causing fatigue and injuries associated with wearing bulky PPE by healthcare workers. Recently, the development of lightweight PPE made with lead composites and lead-free materials is replacing lead PPE for radiation shielding. However, the shielding properties of the lead-free polymer based PPE is not equivalent to that of lead. This research aims to an innovative potential solution to limit occupational radiation exposure of radiography healthcare workers. Here, we explore the novel application of CNT-metal (such as tin, bismuth) hybrid fabric towards lead-free X-ray radiation shielding PPE for healthcare workers. The success of this research results in lead-free aprons, gloves, and structural barriers with X-ray shielding for healthcare workers and patients. The X-ray shielding effectiveness of the CNT-metal hybrid fabric material is compared with lead shields and lead-free polymer based shields available commercially.

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IoT based AI Application for Posture Recognition to Reduce Workplace Injuries

Aditya Milind Deshpande (PI), Kumar Manish
University of Cincinnati, Mechanical and Materials Engineering

Lifting heavy items is one of the leading causes of injury in the workplace. U.S. Bureau of Labor Statistics reported that over 36 percent of injuries involving missed workdays were the result of shoulder and back injuries in 2001. As per the U.S. Bureau of Labor Statistics 2017, the number cases of workers taking a day away from work involving overexertion in lifting or lowering rose to a total of 97,990. But most of these injuries are due to work with overexertion during manual heavy object transportations. Ignoring weightlifting pain can result in additional inflammation and trauma to the tissue in and around the joints. It can also lead to more chronic degenerative issues over time including wear and tear of the joints and cartilage, degeneration of the tendons, and early-onset arthritis. Awkward, repetitive and extreme human postures during work are some of the many causes of these injuries and health problems. In monotonous work conditions, body of a worker might deviate from the neutral position which can cause injuries. It is of high priority to protect the health and safety of these workers by preventing injuries and allow safe and comfortable working conditions. This can be accomplished by ensuring that worker safety and health is addressed systemically during the working hours in the factory floor by monitoring the body postures and suggesting appropriate corrective steps for incorrect postures during work.

In this work, we intend to address the problem of detecting and monitoring body postures in the work place where heavy object lifting is a part of the worker routine. We believe that automation of body posture monitoring can prove valuable to address the problem of determining the healthy working requirements for the task of manual transportation of heavy objects on the factory floor. The main objective of this study is to automate the process of determining the body posture of the person of interest. This automation will allow recommendation of the suitable body posture in the chosen working environment and reduction of occurrence of chronic workplace injuries. This can be achieved by identifying suitable sensor suite for monitoring body posture. For this study, we intend to use camera and develop a computer vision based Internet of things (IoT) application using deep learning.

Dual-Functionality Heatable Carbon Nanotube Air Filters for Healthcare Providers

Yanbo Fang (PI), Vesselin Shanov
University of Cincinnati, Mechanical and Materials Engineering

Face mask is an imperative gear to the safety of healthcare workers. The working environment for them entails a complex variety of infectious risks. Conventional fabric filters due to their single functional feature of simple filtration, could not completely trap all biological hazards. Lacking inactivation procedure significantly increases the risk of infection and impairs their ability to protect healthcare workers.

This project proposes the design and fabrication of carbon nanotube sheets that are ideal for air purification through heating. The integration of CNT heater into a fabric filter enables dual functionality. One is to trap pathogens and another- eliminate them by thermal treatment. Our group has previously demonstrated the lightweight, fast heating/cooling and low operating voltage of CNT sheet heaters. All this brings substantial benefits of providing the proposed mask with metal-free heating components and powering them with small portable batteries, supplying low voltage which is safe to human body.

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Designing Next-Generation Solid Electrolyte via a Multiscale Computational Scheme to Avoid Workplace Battery Hazard

Yao Fu (PI)
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The long term goal of the project is to design stable and safer solid-state electrolytes to replace flammable liquid electrolytes currently used in Lithium batteries, of which short circuits and thermal runaway leads to serious workplace hazard. The specific aim is to demonstrate the viability of a versatile computational approach to understand and increase the ion conductivity in ionic polymer – nanoparticle hybrid material -- a promising novel solid polymer electrolyte. The central hypothesis is that combined mechanical rigidity and high conductivity, which are desirable properties for solid state electrolytes, can be realized by employing rigid polymer chains, small counter-ion, and introducing nanoparticle to polymer matrix.

The research design involves: (1) Establish a full atomistic description of the potential ionic polymers for solid state electrolyte and characterize their mechanical and ionic and mechanical properties; (2) Establish a coarse-grained description of the ionic polymers to extend the spatiotemporal scale of the full atomistic model. (3) Understand the effect of nanoparticles to the structural, ion transport and mechanical properties of ionic polymers. (4) Elucidate the effect of increasing polymer chain rigidity on the ion transport mechanism.

The success of this project can potentially affect workers who respond to emergencies occur that threaten people's life and property, who engage in the mechanical and chemical transformation of materials and substances into new battery products, and those who provide transportation and storage of batteries.

Heavy Metal Sensor for Low Wage Workers Based on 3D Graphene

Mahnoosh Khosravifar (PI), Vesselin Shanov
University of Cincinnati, Mechanical and Materials Engineering

This proposal focuses on developing and providing high sensitive sensors made of 3D graphene based hybrid structures as a portable device that could be used for low wage workers, especially construction workers, who are potentially in danger of lead exposure through contaminated soil or even drinking tap water in the buildings that have lead containing pipes. Carbon-based nanomaterials and particularly graphene have received increased interest as sensors due to their outstanding properties such as low density, interconnected porous structure, fast electron transfer rate, large specific surface area, mechanical stability and flexibility. Our focus is to synthesize a novel 3D graphene based hybrid structure that we believe will provide high sensitivity. We are aiming towards achieving a pM detection limit for lead, which is going to be a major difference in sensitivity compared to previous studies. The mechanism for sensing will be based on Field Effect Transistor (FET) technique where the gate voltage changes with lead concentration in the contaminated soil or water.

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Assessing Volunteer Workers' Exposure to Dust, Metals and Bioaerosol During Equine Assisted Activities/Therapies: An Exploratory Study

Kimberly I. Tumlin (PI)[1], Erin Haynes[2], Sa Liu[3]

[1]University of Kentucky, Preventative Medicine and Environmental Health; [2]University of Kentucky, Epidemiology; [3]Purdue University, College of Human Health Sciences

Equine assisted activities/therapies (EAA/T) serve youth with special needs. Many volunteers work in this setting and donate billions of dollar of volunteer hours every year. Prior survey data regarding use of indoor arenas indicates 85% of participants reported dust as a major concern. However, there are limited data to characterize exposures in these environments. This proposed project will establish preliminary data on work practice in EAA/T facilities and complete an initial evaluation of volunteer workers' exposure to dust and dust constituents during these activities. To accomplish this pilot project, we have assembled a team with complementary expertise in qualitative research in equestrian health, exposure assessment, and aerosol science to complete the proposed research. In addition to a novel population, measures will include both traditional and innovative methodologies. Specifically, this pilot project proposes to: 1) qualify work practices that impact volunteer workers' exposure to airborne contaminants in EAA/T environments. We will survey facilities offering EAA/T to evaluate type of tasks, frequency and duration of tasks, task location at the facility, activity level of volunteers, and general volunteer demographics; 2) quantify volunteer workers' personal exposure to respirable dust and metals on the respirable dust, including iron, manganese, cadmium and lead. Biological samples (hair and toenails) will be collected and analyzed for metals as biomarker of exposure; 3) quantify volunteer workers' personal exposure to bioaerosol, measured as total airborne bacteria by a novel bioaerosol sampler (developed by Dr. Park, significant contributor). The results of this study will serve as preliminary data for a large grant proposal to investigate volunteer workers' and patients' (youth served in these activities) exposure during equine assisted activities/therapies and potential health effects related to the exposure.

Characterizing Fine and Ultrafine Particle Exposure Among Home Healthcare Workers

Ashley Turner (PI)[1], Patrick Ryan[2]

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Every day, we are faced with the challenge of an aging population. As such, the healthcare field continues to increase at an alarming pace. Among healthcare workers, the field of home healthcare (HHC) continues to be the fastest growing sector, reaching projected growth rates of 40-60% by 2024 and 2026, respectively (BLS). Though a promising outlook for future employees, occupational risks for this population have recently gained attention and the need for scientific evidence grows as well. Currently, there are limited amounts of data on HHC workers, therefore we have proposed a novel study on an exposure not yet found in HHC literature. Air pollution, specifically exposure to ultrafine particles (UFPs), has shown adverse health outcomes, suggestive of a causal relationship. Unfortunately, many researchers use stationary ambient models or whole exposure data that includes other co-pollutants (PM2.5) so that independent effects of UFPs are lost in the mix. To counteract this limitation, a 5-day simultaneous personal sampling period using two types of personal real-time air monitors will be deployed among employees within HHC during daily activities. Sampling will include several microenvironments to identify spatio-temporal exposure trends of UFPs and PM2.5. An acute health assessment designed to capture respiratory responses during the sampling period will be distributed as well to identify the exposure metric that best characterizes health outcomes. We hypothesize that HHC workers experience significantly higher exposure to PM2.5 and UFP's during transit and patient homes compared to their reference environment.

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To complete this project, we propose the following aims:
Specific Aim 1: Characterize home health care workers' personal exposures to PM2.5 and UFP at their homes, during transit, and during patient visits.

Specific Aim 2: Compare varying UFP exposure metrics, including particle number concentration, mass concentration, and lung-deposited surface area (LDSA) and determine their association with respiratory symptoms.

Neurotoxicity of Polyfluoroalkyl Substance (PFAS) Mixtures in Firefighting Materials

Ola Wasel (PI), Jennifer Freeman
Purdue University, School of Health Sciences

Perfluoroalkyl substances (PFAS) are synthetic fluorine-containing compounds that are present in many of our daily life applications due to their stick and stain resistant properties. Since the carbon-fluoride bond is very strong, PFAS are persistent in the environment and can accumulate in the human body. Based on the confirmed adverse health effects of the longer carbon chain compounds (C8), such as perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS), those compounds were phased out. New products with shorter carbon chains (<C8) and different chemical forms were produced to potentially minimize persistence in the environment and bioaccumulation in the human body. Firefighters and first responders are at high risk of being occupationally exposed to PFAS. PFAS are present in firefighting foams, turnout gear, and contaminated drinking water in firefighter training sites. In addition, firefighters can be exposed to PFAS by inhaling the combustion smoke of consumer products, such as furniture and carpets that contain PFAS. This project aims to study neurological effects of GenX and ADONA, the newly developed perfluoroalkyl compounds that replaced the longer chain compounds and targets the interests of the Public Safety Sector of NORA. The replacement PFAS are not regulated by federal agencies and limited information about their toxicity is available. Also, since the phased out PFAS are persistent (e.g., PFOA), we are interested in understanding the nature of the combined effects and interaction of long and short chain PFAS mixtures. In this study, the zebrafish will be used as an integrative vertebrate animal model to assess short and long-term neurological outcomes. This study will test the central hypothesis that exposure to GenX or ADONA will result in developmental neurotoxicity (DNT) targeting the dopaminergic (DA) system in larvae and persistent neurotoxicity in adult zebrafish with the combined effects of GenX or ADONA and PFOA being different compared to the effects of each chemical alone. Several endpoints will be assessed to define mechanisms of neurotoxicity from single and binary PFAS exposures to inform and guide future regulatory decisions.

Role of Firefighting-Associated Chronic Stress Factors in Immune Dysfunction in Mouse Model

Brijesh Yadav (PI), Jagjit Yadav
University of Cincinnati, Environmental Health

Firefighters, like many other occupational groups, perform multiple work shifts involving nightshift and thus experience sleep deprivation. Increasing evidences suggest that sleep deprivation (SD) induces stress or injury in multiple organs and thus may predispose individuals to development of different diseases. Indeed, SD has been associated with many human disease like type 2 diabetes mellitus, obesity, cancers, cardiovascular disease, infections, among others. Firefighters in particular undergo stress due to sleep deprivation and exposure to hazardous chemicals such as those in the firefighting foams (e.g perfluorooctanoic acid/PFOA). Continued stress may induce immune perturbations which may interact with other prevailing environmental stress factors thereby increasing the risk for occupational diseases. This initial study therefore focuses on investigating the influence of co-exposure to SD induced stress and PFOA on immune

function as a part of our long-term goal to study role of occupational chronic stress in inducing immune dysfunction and underlying occupational health conditions in firefighters. We propose to perform these studies using a mouse model of sleep deprivation without or with co-exposure to PFOA. Completion of the study will open up ways to provide insights into role of sleep deprivation and PFOA exposure- induced chronic stress in causing immune perturbations. These studies will eventually help understand the etiological factors and biomarkers of occupational health risks in firefighters.

Home Health Care Workers' Occupational Exposure to Bioaerosols and Potential Association with Respiratory Health Issues

Yao Addor (PI), Tiina Reponen
University of Cincinnati, Environmental Health

With the United States' population aging, people living longer, health care cost soaring, receiving health care in the comfort of one's own home has become the preferred choice. As a consequence, there is a boom in home health care industry. In 2008, 13.3 million people were employed in private-sector health care in the United States. Through 2026, it is estimated that healthcare settings job growth will be 18% and the number of home healthcare workers (HHCWs) will increase by 41% meaning more than 4 million jobs. However, unlike other health care settings such as hospitals, clinics, nursing homes and hospices, private homes in which health care is provided are not considered workplaces and thus are not subject to any occupational standards, regulations or laws. HHCWs face many challenges including their exposure to airborne microbial agents in the visited homes. Such microbial agents could be associated with adverse respiratory health issues. In fact, health care professionals have a higher prevalence of asthma attacks than non-health care workers. Unfortunately, no study has been conducted to assess HHWs exposure to bioaerosols, a potential contributing factor of respiratory health issues. Therefore, research is needed to assess the exposure of HHCWs to bioaerosols in the visited homes and to investigate the association between such exposure and the prevalence of respiratory symptoms. The purpose of this project is to fill the data and knowledge gaps of HHCWs' exposure to bioaerosols in the course of their duties by analyzing the visited homes' surfaces and air samples. We hypothesize that HHCWs working in private homes are exposed to more diverse microbial agents and therefore, elevated bioaerosol exposure in quantity, diversity and abundance will be associated with increased respiratory health symptoms, as compared to other occupational studies. We aim to: 1) assess the exposure to bioaerosols that HHCWs may be subject to during their duties in patients' private homes and 2) find out if there is an association between such exposure and respiratory health symptoms. We will use real-time polymerase chain reaction for DNA quantification, and metagenomic with next-generation sequencing for home microbiome profiling. The findings of this study will contribute in establishing occupational standards and regulations to improve the health and safety of HHCWs.

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