

**North Carolina Occupational Safety and Health Education and Research Center (#8673)
University of North Carolina at Chapel Hill
Principal Investigator: Bonnie Rogers**

**Annual Report
July 1, 2015 – June 30, 2016**

SECTION I: ERC Summary and Relevance, and Current Contact Information

ERC Summary

The North Carolina Occupational Safety and Health Education and Research Center (NC OSHERC) is located at the University of North Carolina, Gillings School of Global Public Health with collaborating units at NC State University (NCSU) and Duke University. Academic training is provided in the core disciplines of Occupational Health Nursing, Safety and Ergonomics (NCSU), and Occupational Medicine (Duke University). In addition, specialized training in Occupational Epidemiology is available. An allied program in Occupational Exposure Science is at UNC. Both master's and doctoral degrees are offered. There are more than 50 faculty within the NC OSHERC with more than 100 enrolled students each year in these programs. We also offer an extensive Continuing Education (CE) program.

The mission of the NC OSHERC at UNC-Chapel Hill is to provide high quality education and research training in the occupational health and safety sciences for the protection and promotion of worker health and to prevent occupational illness and injury. This is accomplished through interdisciplinary training, research, and service in occupational health and safety.

Education: Train occupational health and safety professionals to acquire an expanded knowledge base, provide occupational health and safety services, and develop research skills.

Research: Define and develop the discipline of the occupational health and safety sciences to reduce work-related health hazards and improve worker health and working conditions. The purpose of the program is to:

1. Train practitioners and researchers in the academic disciplines of occupational medicine, occupational health nursing, safety/ergonomics, occupational epidemiology, and occupational exposure science within the field of occupational health and safety.
2. Provide interdisciplinary learning experiences through coursework, field projects, and seminars.
3. Provide a continuing education training program to meet the needs of practitioners and those interested in occupational safety and health.

Programs are offered at the master's and doctoral levels in the different academic disciplines, or post-doctoral level in medicine. Training activities include coursework, practica, seminars, field projects, and research activities, many which are interdisciplinary in nature. Distance education is an option for the OHN Program.

A variety of individual CE interdisciplinary courses are offered on-site, on contract basis, or through our week-long Summer and Winter Institutes. In addition to the continuing education, seminars with topics relevant to education, research, and practice in all disciplines are offered quarterly through the NORA (National Occupational Research Agenda) Interdisciplinary Seminar Series. Interdisciplinary collaboration is a key component of the NC OSHERC among

faculty, students, and community partners engaging in joint projects to improve worker health and safety. Outreach to the local occupational safety and health community is an integral part of the NC OSHERC.

Relevance

This education and research program is designed to prepare practitioners and researchers in occupational health and safety. These professionals work to protect and promote the health and safety of our nation's workforce. Education and research in occupational health and safety is essential to eliminate these hazards and make the workplace safer and healthier for all workers.

Key Personnel

Name	Role in ERC	Contact Information
Bonnie Rogers, DrPH	Principal Investigator, NC OSHERC; Program Director, Occupational Health Nursing	UNC-Chapel Hill 919-966-1765 rogersb@email.unc.edu
Susan Randolph, MSN	Deputy Director, NC OSHERC; Faculty, Occupational Health Nursing	UNC-Chapel Hill 919-966-0979 susan.randolph@unc.edu
Dennis Darcey, MD	Program Director, Occupational Medicine	Duke University 919-684-3591 dennis.darcey@duke.edu
David Kaber, PhD	Program Director, Occupational Safety & Ergonomics	North Carolina State University 919-515-0312 dbkaber@ncsu.edu
Leena Nylander- French, PhD	Program Director, Occupational Exposure Science	UNC-Chapel Hill 919-966-3826 leena_french@unc.edu
David Richardson, PhD	Program Director, Occupational Epidemiology	UNC-Chapel Hill 919-966-2675 david.richardson@unc.edu
Kathleen Buckheit, MPH	Director, CE Program	UNC-Chapel Hill 919-962-2101 buckheit@email.unc.edu

ERC Web Link

<http://osherc.sph.unc.edu/>

SECTION II: Program Highlights of High Impact Outcomes

Occupational Medicine Program Director: Dennis Darcey

Hester Lipscomb PhD was elected a Fellow of the Collegium Ramazzini at the October 2015 meeting. She serves as an advisor to the ILO group on musculoskeletal problems of children working in brick kilns in Bangladesh and Nepal. Dr. Lipscomb's pneumatic nail gun injury research has led to better understanding of the significant risks of contact trip nail gun triggering mechanisms and resultant injuries. These findings have been translated into practical industry improvements in construction through collaborations with United Brotherhood of Carpenters and Joiners, and Homebuilder trade Associations. An ANSI standard change now calls for shipping framing nailers with sequential triggers.

Resident David Caretto, NMD, MPH completed his Master's Thesis, Association between Exercise Frequency and Healthcare Costs among Employees at a Large University and Academic Medical Center, that has been accepted for publication in the *Journal of Occupational and Environmental Medicine*.

Background: Several analyses indicate that employee populations with a body mass index (BMI) > 25 are associated with higher healthcare expenditures, increased workers' compensation and disability claims, and greater levels of absenteeism compared with normal weight employees. Modifiable risk factors, such as obesity and physical inactivity, are proposed to account for the greatest proportion of these costs.

Objective: To determine if increased exercise frequency is associated with decreased healthcare costs among an employee population.

Methods: This study used an integrated database linking employee demographics, health risk appraisal (HRA) information, and health insurance claims. Negative binomial regression, with a generalized estimated equations (GEE) approach, was used to analyze the relationship between self-reported exercise frequency and cost, adjusting for important covariates such as age, sex, race/ethnicity, calendar time period and BMI category. In addition, this report is supplemented with a limited review of the literature assessing the effect of workplace wellness programs on healthcare costs.

Results: This cohort contained 16,154 individuals and 32,044 person-years of health claims experience over ten years of data. A statistically significant association was found between exercise frequency and reductions in total annual medical and pharmacy costs paid independent of BMI category ($p < 0.05$). For medical costs, the reduction in healthcare costs demonstrated a nadir in expenditures for employees who exercise 4-5 days per week and a moderate rise among employees who exercise 6-7 days per week. This effect was not observed among pharmacy costs paid, where increased exercise frequency was associated with decreased expenditures. These reductions in healthcare costs were associated with several major diagnostic category (MDC) and prescription drug class subgroups. These results are consistent with findings from the limited review of the literature, which demonstrate decreased healthcare costs among employee populations that participate in workplace wellness programs.

Conclusions: This cohort demonstrates a broad trend of decreased healthcare costs, including annual medical and pharmacy costs paid, in employee populations with increased exercise frequency. This association exhibits a statistically significant reduction in pharmacy costs and a clinically significant lowering of costs generated by MDC subgroups. In

promoting higher levels of exercise frequency, employers may lower modifiable risk factors for chronic disease and reduce healthcare costs among their employee population.

Occupational Health Nursing Program Director: Bonnie Rogers

Our 2nd year OHN trainees conduct a needs assessment in an occupational setting, develop a health promotion/protection program for a targeted group of workers, and implement and evaluate the results of the experience. Each intervention is based on assessed needs of the target group and is fully developed in collaboration with the site OHN and other appropriate personnel. One exceptional program was "Workplace Incivility" by trainee Natasha Collins. This was presented to the Butner Correctional Facility Workforce Conf. during Nurses' Week. The Regional Nurse Consultant wrote: "I was so impressed with this presentation. I shared it with the Chief Nurse of the BOP. The Chief Nurse and Medical Director agreed and recommended it be used as an annual nursing training. It will be shared with the entire BOP, to include 122 institutions across the U.S. and will be done live and recorded for staff to view in future. This will have a national impact once rolled out."

We survey students, employers, and preceptors periodically about the program and use their input to make any needed changes. One current trainee commented: "After the class plant walk-throughs, I had much greater appreciation for the safety culture here. Upon returning, I actually had the inclination to kiss the ground. My management were most pleased when I shared the reasons for that. I was also spurred on by those walk-throughs to seek out local opportunities for the same when researching the industrial use of Ozone. In doing so, I discovered many serious safety discrepancies at a new water bottling company. The original company had been shut down and new owners were just re-starting it. They were not aware of the problems they had inherited. I was able to connect them with the OSHA division of the Arkansas Dept. of Labor for free noise and air monitoring (a program offered to small companies (this one had only 10 employees), and with Concentra (a local occupational medical clinic) for Fit testing and audiometric and medical screening. Our Industrial Hygienist also offered a free consultation to them. In addition, in my role as Occupational Health Nurse, my awareness of the significance of physiological symptoms in the industrial milieu has increased exponentially. It also seems that a 'side effect' of my taking these 'Masters Level' courses has been an increase in my credibility with the employees who are aware." Selected employer/preceptor comments were: 1) "Having a new graduate who is able to function so independently as well as contribute to other's knowledge has helped improve our efficiency and better develop our team;" 2) "She has been able to positively influence member health by teaching health topics, writing educational articles in our health and safety fund news magazine, and providing health screening;" and 3) "She produced and presented information that is forward thinking and provided 'food for thought' about how we can help our employees and their families become healthier and have more cost-effective care."

Dr. Bonnie Rogers has done research on the use of reusable respirators in healthcare organizations. The results showed very limited use of non-filtering facepiece respirators by healthcare workers and inconsistent fit-testing procedures. Several recommendations were made and are being published along with competencies for respiratory protection. Dr. Bonnie Rogers was just appointed as NIOSH representative member to the ANSI Z 88 15 Respiratory Protection Committee.

OHN faculty revised the occupational health nursing knowledge/ competency areas in 2016. The competencies provide a guide for trainees to achieve a knowledge-based skill set in OHN practice.

Brenda Ruhrer, May 2016 MPH graduate, received the Imogene Pence Klingenfus Scholarship Award, and Hannah Byun, current MPH student, received the Margaret Blee-Ruth Warwick Hay Scholarship Award in Spring 2016. Several graduates also received promotions in their companies.

Occupational Safety & Ergonomics (OSE) Program
Program Director: David Kaber

Pilot Project Success Story for Police:

This past year, the NCOSHERC awarded Maryam Zahabi (OSE Ph.D. Candidate at NC State) a pilot project grant to support her dissertation research. Zahabi's research is focused on modeling Police officer performance demands in using mobile computing terminals (MCT) while driving. The effect of in-vehicle distraction on driver performance and safety has been studied; however, few investigations have focused on distraction in emergency vehicles with even fewer examining police officer distraction. Zahabi worked with Chief Tony Godwin and the Cary, North Carolina Police Department to: (1) identify perceived importance and frequency of the

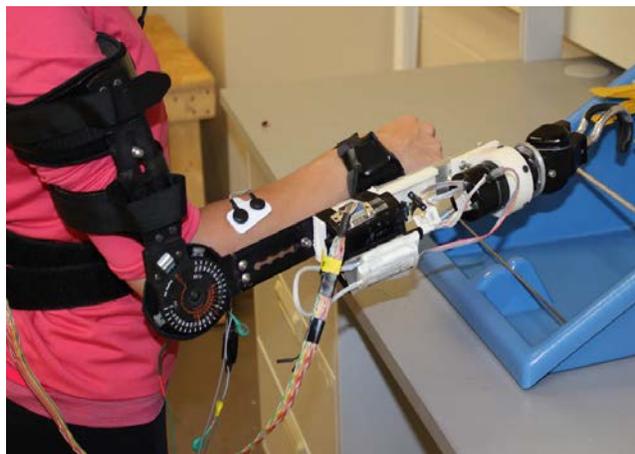


Police officer using mobile computing terminal
(Photo from: Boiseguardian.com).

range of police MCT tasks; (2) quantify visual and cognitive demands of high importance and high frequency tasks; and (3) formulate design recommendations for enhanced MCT interface design as well as develop a prototype. Zahabi is currently conducting a driving simulator experiment with a large sample of officer from the Cary Police Department to quantify officer visual behavior, performance and perceived workload with current and enhanced MCT interface designs. She plans to associate MCT usability features with officer visual behavior and vehicle control in simulated driving. Results of this research are expected to be useful for understanding perceptual, motor and cognitive demands associated with police officer MCT tasks. Any resulting MCT design improvements are expected to ultimately increase officer and civilian safety during police emergency operations. Zahabi plans to graduate from NC State in May 2017 and to take a faculty position in industrial engineering with a focus in occupational safety and ergonomics.

OSE Student Team Research with Impact for Amputees:

During the reporting period, Melissa White (NC State OSE Ph.D. student) led an interdisciplinary graduate student research team among industrial engineering and biomedical engineering in an assessment of cognitive workload and performance outcomes associated with upper-limb prosthetic design for trauma patients with residual muscle. Dr. Helen Huang (NC State BME faculty and Rehabilitation Engineering Core Director) previously developed control schemes for myoelectric prosthetics, including: (1) direct electromyography (EMG)-based control using mean signal values and thresholds for driving prosthetic movements and speed; and (2) an EMG pattern recognition (PR)-based mode capturing timing and frequency of specific amputee residual muscle activation to drive a range of prosthetic movements. Pilot research demonstrated some performance benefit of the PR mode over direct control (DC). White's team sought to determine whether intuitive contraction of residual muscles for control of multiple device degrees of freedom under the PR mode would lead to lower cognitive demands than required muscle and mode switching under the DC mode. To date, little research has been conducted on cognitive demands of prosthetic design and any measurement has been intrusive to patient task performance. White et al. (2016) designed a clothespin repositioning task and used a remote eye-tracking system to conduct participant pupilometry, including blink rate and pupil size. Results revealed the PR mode to support superior performance in simulation of an activity of daily living as well as faster and greater device learning over time. Use of the prosthetic PR control mode also reduced the number of pupil size increases during task performance, an objective indicator of lower cognitive workload. White's team concluded that intuitive use of prosthetics with EMG PR control is more accessible to traumatic amputees than conventional DC technologies and may contribute to overall quality of life through reduced complexity of task performance.



Occupational Epidemiology Program Director: David Richardson

Dr. Richardson was principal investigator of the INWORKS study and lead author of "Risk of Cancer from Exposure to Ionizing Radiation: A Retrospective Cohort Study of Workers in France, the United Kingdom, and the United States (INWORKS)" which was selected as Best Paper in Epidemiology in Occupational Health, 2016, and awarded at EPICOH, 2016. INWORKS included more than 300,000 workers, with 531 leukemia (other than chronic lymphocytic) deaths and nearly 18,000 deaths from solid cancers. The studies found a significantly elevated risk of leukemia [ERR/Gray (Gy): 2.96 (90% CI: 1.17, 5.21)] and solid cancers [ERR/Gy: 0.48 (90% CI: 0.18, 0.79)]. Since the 1970s, NIOSH has conducted research on the health effects of exposure to external and internal forms of workplace ionizing radiation. Many early studies of nuclear workers and others exposed to low doses of ionizing radiation had equivocal results. These recent findings from a large, well-conducted epidemiologic study of

workers receiving low-dose ionizing radiation exposure are supportive of the continued use of the LNT model and “as low as reasonably achievable” (ALARA) principles as a reasonable framework for protecting workers from excess risks associated with occupational exposure to ionizing radiation. In addition, the studies may be highly informative regarding assigning “probability of causation” for workplace-related cancer in the Energy Employees Occupational Illness and Compensation Program. INWORKS has already had important impact: it has been cited by NIOSH and the National Cancer Institute, as well as others, in responding to a petition to the Nuclear Regulatory Commission to drop the “linear-no-threshold” assumption about radiation risk, which would have potentially raised occupational dose limits for workers exposed to ionizing radiation. The INWORKS studies received immediate interest from the scientific community, as well, sparking editorials and letters to the editor. The Altmetrics score for the BMJ article puts it in the 99th percentile of articles of the same age, and in the 95th percentile of all articles, indicating wide interest in the work. It has been downloaded nearly 30,000 times since October.

Former trainee Jessica Rinsky, PhD is a Lieutenant in the Commissioned Corps of the U.S. Public Health Service, Epidemic Intelligence Service (EIS) Officer, Centers for Disease Control and Prevention, and has taken an assignment with the North Carolina Division of Public Health. She recently helped with an investigation of an outbreak at the US Whitewater Training Center near Asheville, North Carolina and consideration of hazards faced by workers tasked with cleaning that center.

Current trainee Nathan Debono MPH (advisor, David Richardson) is preparing his dissertation on an occupational cohort mortality study of UAW auto workers; this project was developed in collaboration with NIOSH staff after Nathan spent a summer at NIOSH-Cincinnati as part of a summer graduate fellowship.

**Occupational Exposure Science
Program Director: Leena Nylander-French**

The OES faculty includes 8 core and 9 adjunct faculty members. Two new core members have joined the OES. Dr. Roger Sit, a radiation safety officer at Department of Environment, Health and Safety at UNC and an adjunct assistant professor at ESE joined in 2015. Dr. Sit teaches a new course ENVR 425 (Introduction to Health Physics), which was offered first time in the spring of 2015 and received outstanding reviews by our students. Dr. Woods is a newly appointed Clinical Assistant Professor in ESE after serving four years as a lecturer in ESE. She joined the OES core faculty in 2016. Her training is in engineering, toxicology, and environmental health and her research is focused on understanding the human health impacts of industrial and environmental agents. Her strong interest in community impacts of industrial contaminants will provide a unique contribution to OES Program. Dr. Woods teaches ENVR 600-01W (Environmental Health), an on-line course that covers the ASPH Core Competencies in Environmental Health, and ENVR 610 (Global Perspectives on Environmental Health Inequalities). Her research program is ideally suited to provide our students with practical ES/IH experiences in both national and global settings and she will be a valuable mentor for both Master’s and doctoral students.

The NIOSH-ERC OES program supported 4 Master’s and 2 doctoral students during the academic year 2015 – 2016. OES core faculty published 39 scientific articles and 8 book chapters of which 11 were authored by current or former OES trainees and partially supported

by the NIOSH-ERC OES program. In addition, OES faculty and student delivered 38 oral or poster presentations in both national and international meetings. OES trainee Zoe Frolking (MSPH 2016, Dr. Nylander-French, adviser), a NC OSHERC pilot grant recipient, spent two months in Rwanda, Africa, working on our cookstove intervention research project funded by National Institute of Environmental Health Sciences. Results from her work were presented as a poster at the Society of Toxicology Annual Meeting 2016 in New Orleans, LA. OES trainee Kathie Sun (MSPH 2016, Dr. Nylander-French, adviser), was awarded American Industrial Hygiene Foundation (AIHF) 2015–2016 Carolina Local Section Scholarship. OES trainee Mary Kathryn Fletcher (MSPH 2015; Advisor Leena A. Nylander-French), who completed a 9-week practicum as an industrial hygiene intern at the United Steelworkers' Health, Safety, and Environment Department, worked as a Safety and Health Fellow at the American Federation of Labor-Congress of Industrial Organizations (AFL-CIO) last year. Currently, Ms. Fletcher is employed as a program assistant at Center for Protection of Worker's Rights (CPWR), Silver Springs, MD.

Continuing Education **Director: Kathleen Buckheit**

During the fiscal year of July 1, 2015 through June 30, 2016, NC OSHERC Continuing Education (CE) Program trained 5,404 participants in 144 educational from all disciplines of occupational and environmental safety and health areas. The CE Program objectives have been met, reaching all states in the Southeast region with a national and international following. Several collaborations with the other ERCs in the Southeast region have continued to be fulfilling and successful. It is reported by students that because of this Program, they have been able to work more safely and maintain OSHA and EPA compliance for their businesses. Many have received promotions because of the education received and the Technician Certificate Programs completed. A significantly higher than national passing rates for all the Certification Review Courses has been consistently achieved. The newest Applied Radiation course implemented prepares students as Radiation Safety Officers (RSO).

Kathleen Buckheit initiated a relationship with the NC Cherokee tribe and taught two respiratory protection courses with additional outreach planned for the future on developing their respiratory protection programs and train-the trainer courses for respirator fit-testing.

Students continue to enroll and complete Technician Certificate Programs, such as Fundamentals of Occupational Safety and Fundamentals of Industrial Hygiene. Upon completion, many students report that they have received promotions, passed board certification examinations, and enrolled in academic programs.