

## Background

- Firefighters are challenged with extremely stressful and hazardous conditions in their occupational settings [1, 2]
- Firefighters are exposed to dangerous heat stress causing fatigue, cardiac death, cancer, kidney disease and other chronic diseases[2,3]
- As firefighters encounter extreme conditions of toxic chemical exposures and heat stress, a normal immune function dysfunction in firefighters cannot be ruled out.
- Recent studies on firefighters by our Department (Dept of Environmental Health, University of Cincinnati) and others has revealed high concentrations of PAHs on the firefighter's bodies which potentially exposes them to the risk of cancer [4], Type 2 diabetes, cardiovascular diseases as well as systemic and pulmonary inflammation disease [5].
- General studies in the literature provide evidence that chronic heat stress can alter innate immune response by inducing expression of stress proteins, (such as heat shock proteins-HSP) 6,7], neuropeptides such as orexin A [8], and stress hormones such as cortisol [9]
- Furthermore, some studies suggested heat stress lead immediate increase of leukocytosis, sustained elevation of neutrophil and monocyte count, plasma cortisol level, after post-firefighting [9]. One study also reported heat-stress induce inflammatory cytokines IL-6, TNF- $\alpha$  production from organ/tissue other than blood mononuclear cells[10]. Furthermore animal studies shows, hematopoietic system respond to heat stress by decreasing, hemoglobin synthesis, erythrocyte formation and packed cell volume and tilting T cell response towards immunosuppressive axis [11]
- Few reports shows chronic heat exposure weakened innate immune system leading to increase vulnerability for many communicable and noncommunicable disease including MRSA in firefighters [2,5,12, 13]

- Hypothesis:** Collectively, these facts coupled with the reports of elevated exposure to heat stresses in high risk jobs lead us to hypothesize that heat stress during firefighting can significantly alter the physiological homeostasis in firefighters in terms of altered innate and adaptive immune parameters. This alteration in immune parameters, may at least in part, can serve as a tool for finding novel biomarkers and help understand the mechanism of different disease conditions as a result of firefighting- related exposures.

## Objectives

**Aim 1: Analyze for immune phenotyping and heat stress level in firefighters.**

Aim 1a: To Collect blood samples from exposed firefighters, before and after the firefighting event and immune cell profiles by flow cytometry and ELISA.

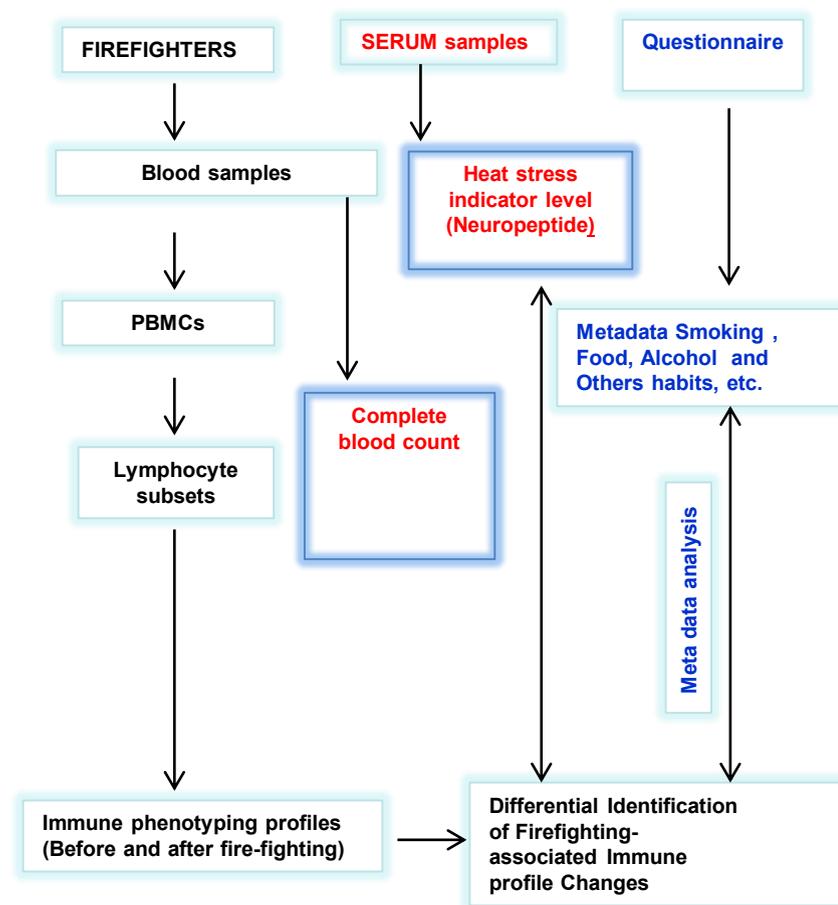
Aim 1b: To analyze heat stress associated bio-markers by ELISA in serum.

**Aim 2: Integrated analysis to understand heat stress-associated immune changes in relation to the metadata collected from the Questionnaire.**

## Study population

For accessing of the firefighters cohort and their sampling will be carried out in association with our Co-investigators team from Western Kentucky University. In the present investigation, a subset of 20 firefighters actively engaged in firefighting will be considered, for sampling right before the fire event and 24 hrs. after the fire event (N = 20 subjects x 2 samples/subject = 40 samples).

## Experimental design



**Work flow for Effect of Heat Stress on Immune Function of Firefighters**

## Limitations

We anticipate no specific problems with the human blood/serum sampling and its relevance in obtaining the desired information on immunological changes. It may be possible that other factors such as alternate profession, age, medical history may be influencing the immune status. To account for all that data, we will use our existing specially-developed questionnaire in a way that it could provide us with the information on the other significant factors.

## Expected results

- We expect to identify the alterations in immune profile in the firefighters owing to their occupational exposure to firefighting-associated heat stress.
- This will also give us insights into the interplay of the altered immune parameters with the levels of occupational exposure, health condition, stress levels and lifestyle of the Firefighters.

## Future directions

- This study will characterize the specific biomarkers and immune alterations that are critical in the induction and/or progression of occupational diseases in firefighter.
- Modulation of the altered immune status might help restore the homeostasis of the firefighters to regain the healthy natural condition.
- Preliminary data obtained through this pilot study will be used to submit a larger grant to NIOSH to pursue future expanded studies on the role of heat stress, fatigue in immune-mediated neurological health disorders and diseases in firefighters.

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**University of Cincinnati  
19th Annual  
Pilot Research Project  
Symposium  
October 11-12, 2018**



## Pilot Research Training Program (PRP) Overview

Welcome to the University of Cincinnati Education and Research Center's (ERC) 19th Annual Pilot Research Project (PRP) Symposium on October 11-12, 2018, held in the Kowalewski Hall 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 2017-18 awardees will be presenting the results of their research and the 2018-19 awardees will make poster presentations of their proposed work. The keynote speaker on Thursday, October 11, 2018 is Captain Lauralynn McKernan from the CDC/NIOSH Division of Surveillance, Hazard Evaluation and Field Studies, presenting on "Listen to the Music: How Rock 'n' Roll Provides Touchstones for the Evolution of Occupational Health."

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 \$1.4 million to support 239 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 55 new investigators from other fields of expertise to the area of occupational safety and health research.

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