I. Project Title
PREDICTING HEAT STRESS EVENT WITH PHYSIOLOGICAL AND ENVIRONMENTAL METRIC-BASED MATHEMATICAL MODEL (Previous title)

Comparative analysis of physiological measurements and environmental metrics on predicting heat stress related events (new title)

II. Project Completion Date
June 15, 2018

III. Student(s), Department(s), and Major(s)
(1) McKenzie Barlow, Biomedical Engineering, MS Biomedical Engineering

IV. Faculty Advisor and Department
Dr. Michael Whitt, MBA, Ph.D., Biomedical Engineering

V. Cooperating Industry, Agency, Non-Profit, or University Organization(s)
University of Utah, NORA Conference

VI. Executive Summary

Exposure to high heat and humidity can lead to serious health risks, including heat exhaustion and heat stroke. Wet Bulb Globe Temperature (WBGT) and heat index have historically been used to predict heat stress events, but individualized factors are not included in the measurement. It has been shown that there is a relationship between cardiovascular measurements and heat stress, which could be used to measure heat stress risk on an individual level. Research has been done to find relationships between cardiovascular metrics in a workplace environment, however the study did not include the use of a controlled environment as a baseline. This study provides measurements of transepidermal water loss (TEWL), heart rate, body core temperature, and blood pressure in a controlled environment when human subjects are exposed to high heat and humidity. Thirty subjects (n=17 females, 13 males) were asked to self-express their activity level (active vs. sedentary), gender, and age. The subjects performed a 30-minute moderate exercise routine on a stationary stepper machine in a heated environmental chamber (average WBGT of 26°C). TEWL, heart rate, tympanic temperature, and blood pressure were recorded at every 10-minute increment of the exercise protocol per subject. The data was analyzed using JMP software to find significant (P<0.05) relationships between the following factors and groups of subject characteristics: TEWL (activity level, gender, heart rate, systolic blood pressure, MAP, time, tympanic temperature); tympanic temperature (age, heart rate, time, TEWL); heart rate (age, time, tympanic temperature, TEWL). It is possible that an algorithm can be developed based on the relationships found between individualized metrics including TEWL, heart rate, blood pressure, and body core temperature to predict heat stress related events.
VII. Major Accomplishments

(1) Performed Human Subject Research Experiment with equipment partially provided by grant.

(2) Found significant relationships between physiological measurements in heat stress environment.

(3) Presented thesis to faculty to receive Master’s degree, as well as present at Women in Science Fair.

VIII. Expenditure of Funds

McKenzie was able to travel to the University of Utah to attend the NORA Conference which gave her exposure to occupational and environmental health studies. She was also able to meet with one of her thesis board members, Dr. Rod Handy, who is a professor at the University of Utah, and to meet a University of Utah Master’s student, Jacob Thomas, who has completed a similar study to McKenzie. They were able to discuss McKenzie’s progress with her own study and gave advice.

Some of the funds were also used to purchase some of the equipment and CPR/AED training needed for the study, as well as the NORA registration fee.

IX. Impact on Student Learning

McKenzie was able to learn about other Graduate student studies (at University of Utah) that relate to her own study. Because Cal Poly does not have a strong environmental health department, McKenzie was able to gain more perspective and receive advice for her own study. Traveling to University of Utah helped her to meet with Dr. Rod Handy and go over her progress with him in person. She was also able to make connections and network with the University of Utah mechanical engineering department faculty and some of their students, as well as get a tour of the Rocky Mountain Center where they perform lab tests for graduate studies.