Appendix

Geospatial Health #629 - Report-back for geo-referenced environmental data: a case study on personal monitoring of temperature in outdoor workers

And here is the average temperature exposure for workers at NCSU and MSU that participated the same week you did:

NCSU	Monday 7/18 Individual / weather station	Tuesday 7/19	Wednesday 7/20	Thursday 7/21	Friday 7/22
Average Temperature	83.0°/ 84.3°	84.3°/ 86.1°	81.8°/ 82.0°	81.7°/ 83.1°	82.9°/ 84.8°
Max Temperature	102.2°/ 91.9°	103.1°/ 91.9°	104.1°/ 89.1°	97.8°/ 90.0°	98.7°/ 91.9°
Minimum Temperature	71.6°/ 73.0°	69.8°/ 75.9°	70.7°/ 72.0°	68.9°/ 71.1°	70.7°/ 73.0°
Humidity	71.5	63.1	67.2	63.2	68.7

MSU	Monday 7/18	Tuesday 7/19	Wednesday 7/20	Thursday 7/21	Friday 722
Average Temperature	85.1°/ 91.0°	85.1°/ 92.6°	81.0°/ 86.5°	86.9°/ 96.1°	80.4°/ 92.2°
Max Temperature	101.5°/ 95.0°	106.7°/ 95.0°	96.8°/ 95.0°	102.4°/ 102.2°	99.5°/ 98.6°
Minimum Temperature	70.7°/ 82.4°	65.3°/ 86.0°	66.2°/ 78.8°	65.3°/ 87.8°	65.3°/ 85.4°
Humidity	51.0	51.8	62.9	46.3	55.8

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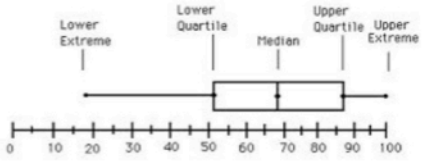
Figure A1. Individual Results Packet, Page 2: Summary tables of site-specific maximum, minimum, and average measured temperature.

A Guide to Reading How Results at ASU Campus Compared to Workers at NCSU and MSU

The following page contains a box and whisker plot show the spread of your individual experienced temperature in relation to the observations at your local weather station. This type of plot provides a way to show groups of numerical data based on five summary measures: *lower extreme* (minimum value), *lower quartile* (25% of data lower than this value), the *median* (middle 50% of data), the *upper quartile* (25% of data higher than this value), and the *upper extreme* (maximum value).



Use this plot to:

- Better understand how the temperatures experienced by workers at ASU compared to the temperatures experienced by workers at MSU and NCSU for the entire study period (July 11 - Aug 5th)
- On average, individual temperatures experienced by workers at MSU and NCSU were higher than temperature experiences for ASU workers.

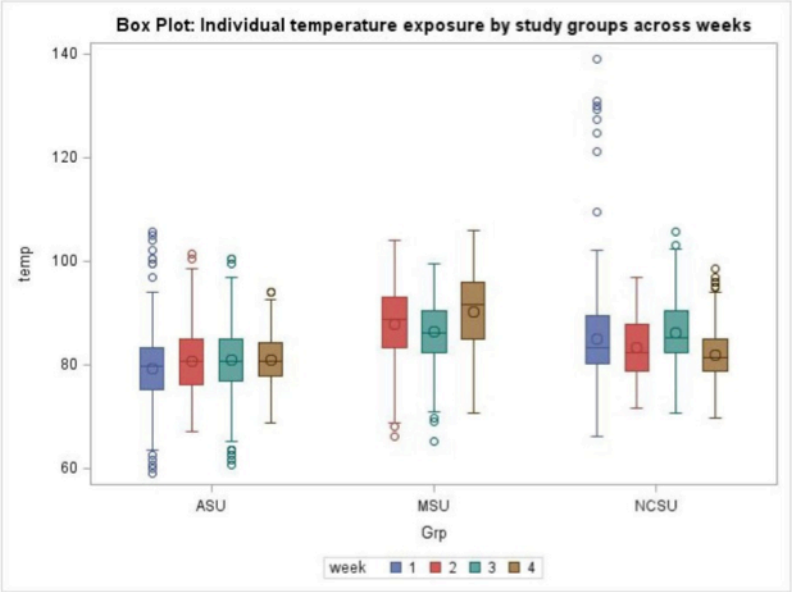


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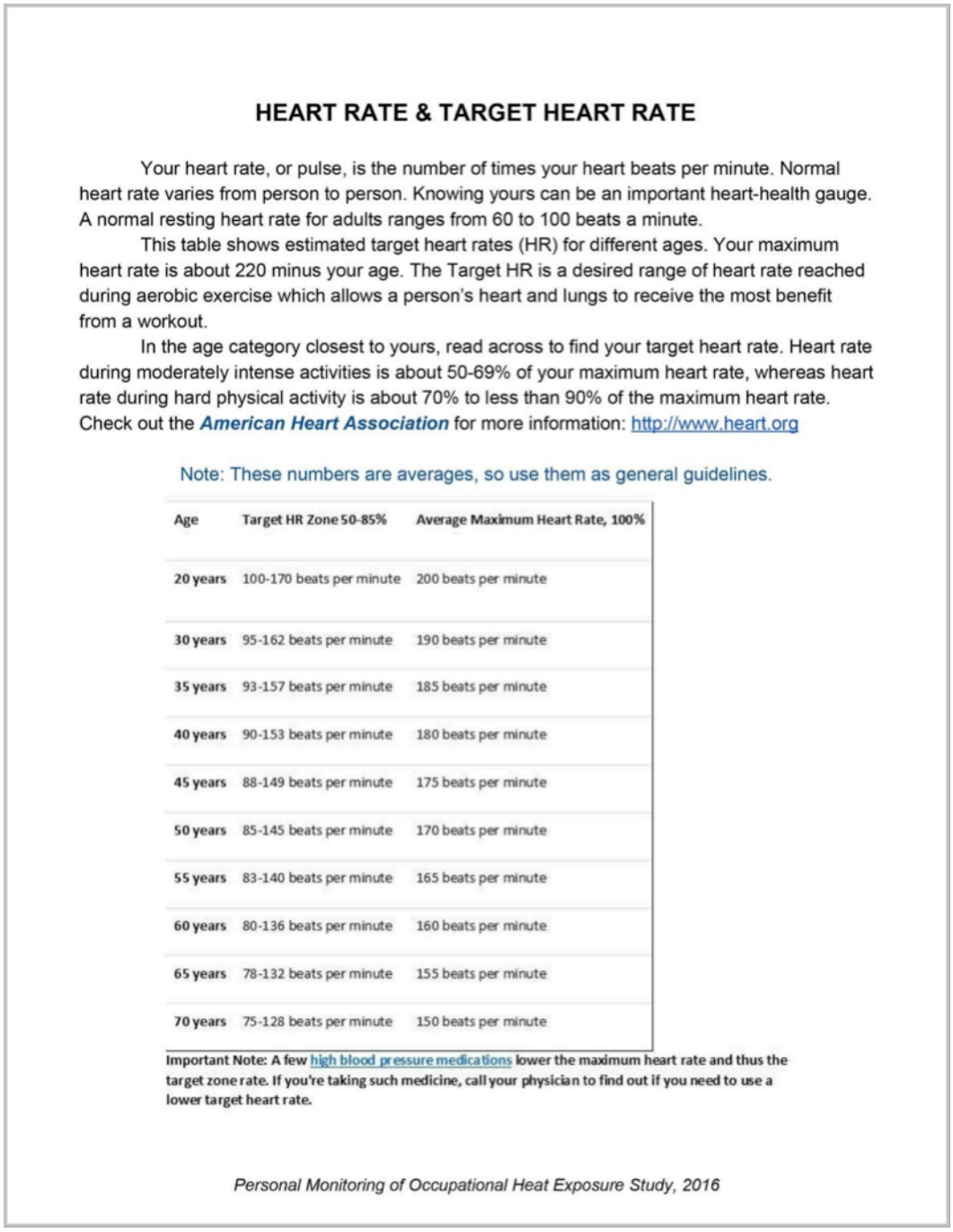
Figure A2. Individual Results Packet, Page 3: Box plot of temperature exposure by study groups across weeks.



HEART RATE & TARGET HEART RATE

Your heart rate, or pulse, is the number of times your heart beats per minute. Normal heart rate varies from person to person. Knowing yours can be an important heart-health gauge. A normal resting heart rate for adults ranges from 60 to 100 beats a minute.

This table shows estimated target heart rates (HR) for different ages. Your maximum heart rate is about 220 minus your age. The Target HR is a desired range of heart rate reached during aerobic exercise which allows a person's heart and lungs to receive the most benefit from a workout.

In the age category closest to yours, read across to find your target heart rate. Heart rate during moderately intense activities is about 50-69% of your maximum heart rate, whereas heart rate during hard physical activity is about 70% to less than 90% of the maximum heart rate. Check out the ***American Heart Association*** for more information: http://www.heart.org

Note: These numbers are averages, so use them as general guidelines.

Age	Target HR Zone 50-85%	Average Maximum Heart Rate, 100%
20 years	100-170 beats per minute	200 beats per minute
30 years	95-162 beats per minute	190 beats per minute
35 years	93-157 beats per minute	185 beats per minute
40 years	90-153 beats per minute	180 beats per minute
45 years	88-149 beats per minute	175 beats per minute
50 years	85-145 beats per minute	170 beats per minute
55 years	83-140 beats per minute	165 beats per minute
60 years	80-136 beats per minute	160 beats per minute
65 years	78-132 beats per minute	155 beats per minute
70 years	75-128 beats per minute	150 beats per minute

Important Note: A few high blood pressure medications lower the maximum heart rate and thus the target zone rate. If you're taking such medicine, call your physician to find out if you need to use a lower target heart rate.

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Figure A3. Individual Results Packet, Page 6: Explanation of Heart Rate and Target Heart Rate.

A Guide to Reading Your Personal Heat Exposure Map

The following page contains 3 maps displaying your recorded temperatures throughout campus. Temperature recordings are overlaid in color on top of an aerial photo of campus. Areas that are more red in color represent hotter temperatures and cooler temperatures are represented in blue. The workday (between 6am and 3pm) has been divided into three separate maps. For example, the top map shows your average recorded temperature for the hours from 6am-9am for all 5 days of your study participation. The legend, located at the bottom left of the page, shows what temperature values each color represents. Note: Areas without temperature data are not depicted in your map.

Use these maps to:

- Better understand where and when your temperature was the highest.
- Consider what you might have been doing in areas where your highest temperatures were recorded.
- On average (as you would expect), you experienced the warmest temperatures in the afternoon (1-3pm) ranging between 90°F and 100°F+.

Figure A4. Individual Results Packet, Page 7: Explanation of personal heat exposure map.

More Information about Heat Exposure

Occupational Exposure to Heat	• Workers exposed to extreme heat or who work in high heat environments may be at risk of heat stress • Workers at great risk of heat stress include those who are age 65 years and older, are overweight, have heart disease or high blood pressure, or take medications that may be affected by exposure to extreme heat
Possible health concerns	• Occupational illnesses and injuries including: ○ ***Heat exhaustion*** - body's response to excessive loss of water and salt ○ ***Rhabdomyolysis*** - caused by prolonged physical exertion and associated with heat stress, results in rapid breakdown, rupture, and death of muscle. ○ ***Heat syncope*** - is a fainting episode or dizziness following prolonged standing or sudden rise from sitting or lying position ○ ***Heat cramps*** - caused by body's loss of salt and moisture levels ○ ***Heat rash*** - skin irritation caused by excessive sweating
Possible ways to reduce exposure at work	• Limit time in the heat and/or increase recovery time in a cool environment • Reduce energy expenditure demands of the job to generally cooler times of the day • Conduct trainings about heat stress and how to recognize the signs/symptoms at work • Increase rest breaks and shorten work periods during extreme heat periods • Develop and use heat acclimatization plan at work • Increase physical fitness outside of work • Implement a buddy system where workers observe each other for signs of heat intolerance • Require workers to conduct self-monitoring • Drink water frequently ○ During prolonged sweating lasting several hours, drink sports drinks containing balanced electrolytes and water regularly (every 15-20 minutes) ○ Avoid alcohol and drinks with high caffeine or sugar

For More Information

CDC NIOSH https://www.cdc.gov/niosh/topics/heatstress/

OSHA https://www.osha.gov/SLTC/heatstress/

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Figure A5. Individual Results Packet, Page 9: Additional heat exposure information.