The Effects of Posture on Respiration

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Introduction

Posture plays a major role in respiratory system. Head and neck posture have immediate influences on respiratory function (Zafar et al. 2018)

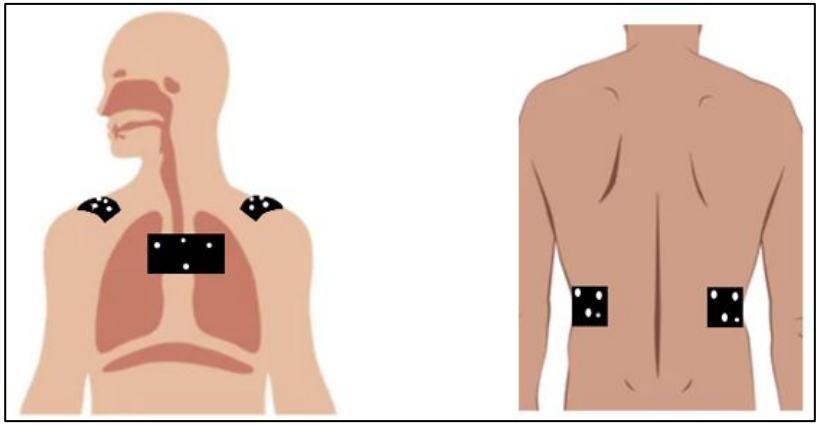
Initially the group wanted to create a device that would detect when a person was in a bad posture, and give feedback to the user indicating to fix their stance

While researching, the team members became more interested in the relation of respiration and posture

Purpose: To determine the correlation between posture and breathing and use the results to teach the public about their posture and how it affects their breathing.

Design

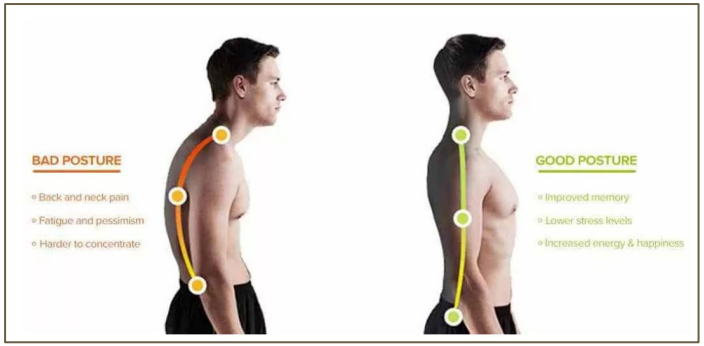
- **Hypothesis:** Poor posture while sitting would restrict respiration activity
- *Initial Design:* Both IMUs and motion capture
- *Current Design:* Using motion capture system to track chest cavity movement
    - Positions of orbs employed to create best fit ellipsoid



Placement of tracking orbs

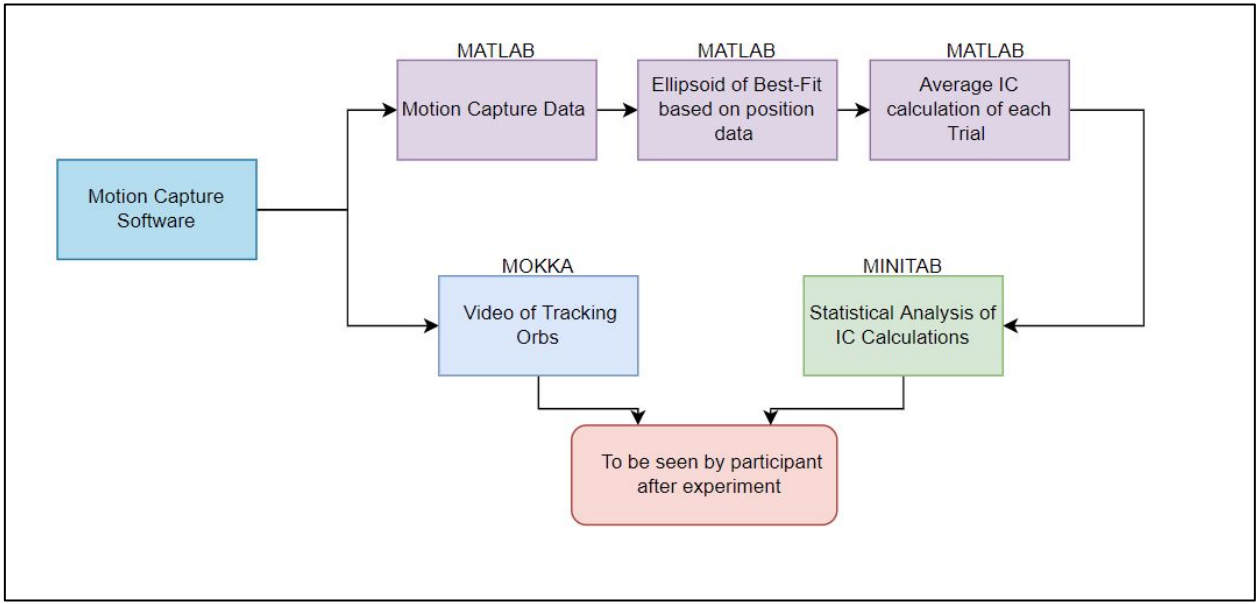
Design

- Five participants from Stevens community
- Different heights, weights, and gender
- Each does four trials: two with bad posture, two with good posture
- Each Trial is 30 seconds long
    - Good Posture: Back is 90 degrees to the stool, with head, neck and back at 180 degrees
    - Must be comfortable, measurements are only for guidance for person-specific best posture.
    - Bad Posture: Slouching, head down, shoulders not balanced, back bending

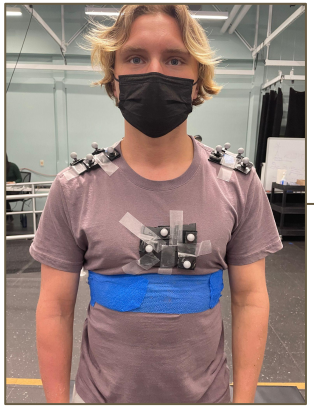


Methods

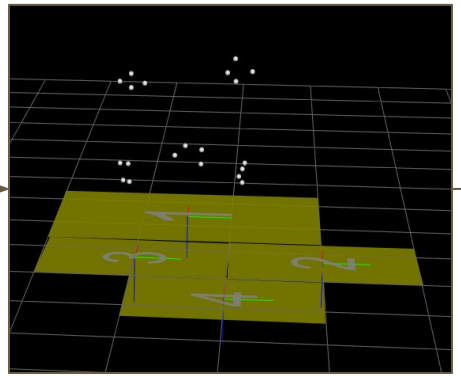
Overall Experiment Workflow



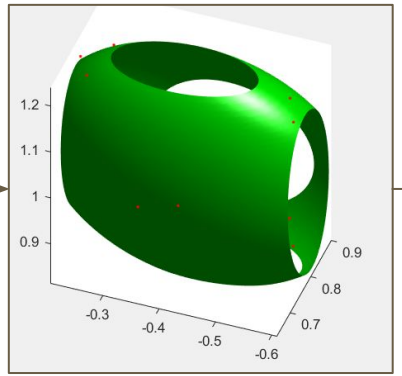
Methods



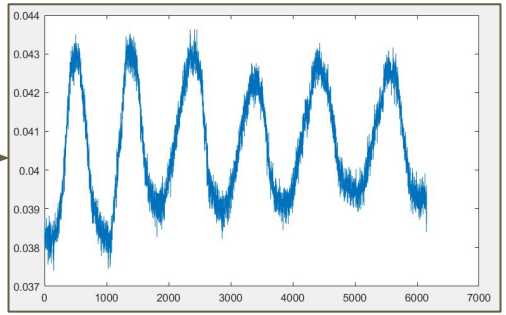
Tracker Placement



Motion Capture Data



Best Fit Ellipsoid

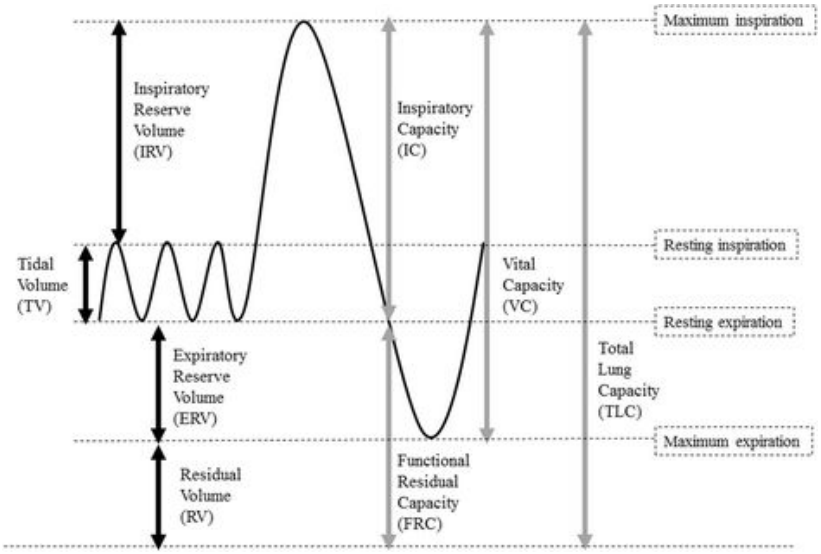


Volume of Ellipsoid over time

Methods

Data Processing

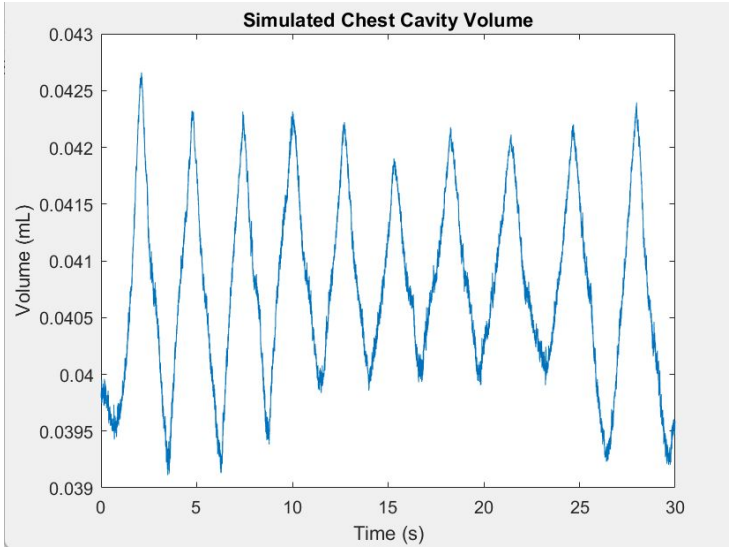
- Team decided to make the protocol to measure Inspiratory Capacity
  - Easiest & clearest to measure
  - Best indication of respiratory function
- Volume of the best fit ellipsoid was tracked throughout the 30 seconds of each trial
- The average of the distance between each peak and trough was taken for each trial to come up with an inspiratory capacity



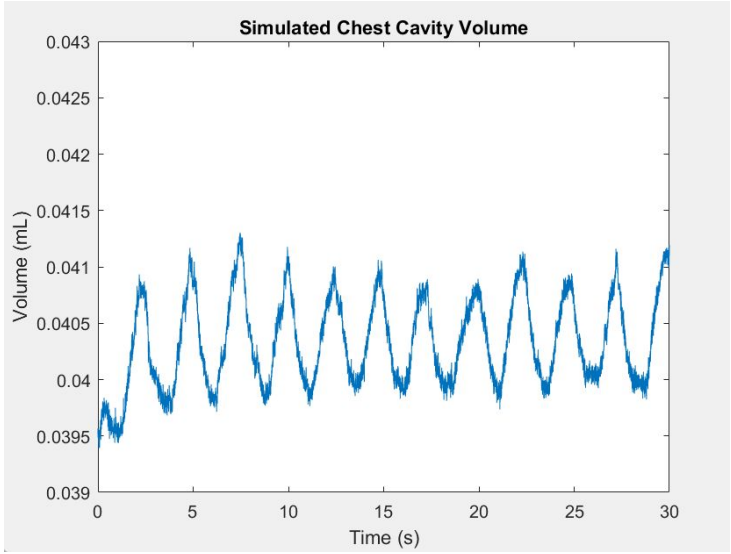
Results

Detailed Example of Participant 1 data

- Constant breath rate
- Increase in Inspiratory Capacity in person-specific best posture
- IC 2713.505 ml vs 1308.531ml



Participant 1: Good Posture (Trial 1)

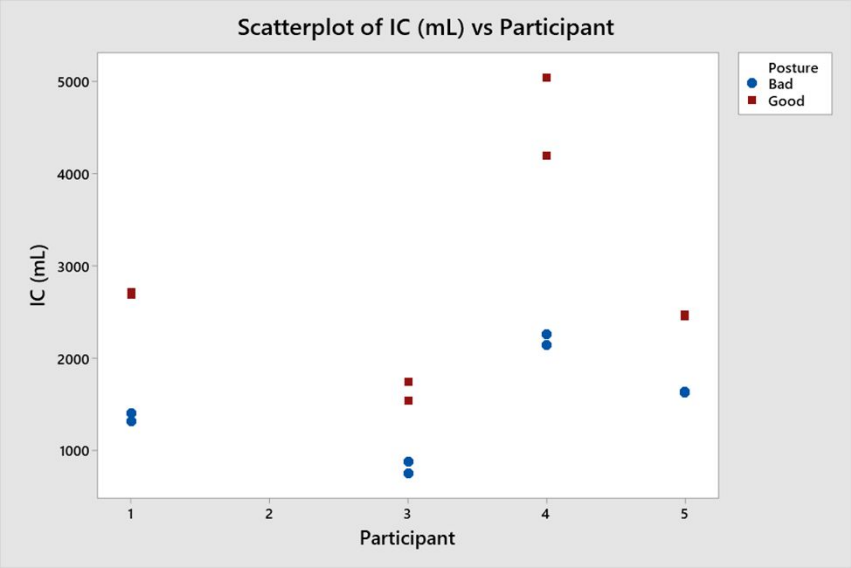


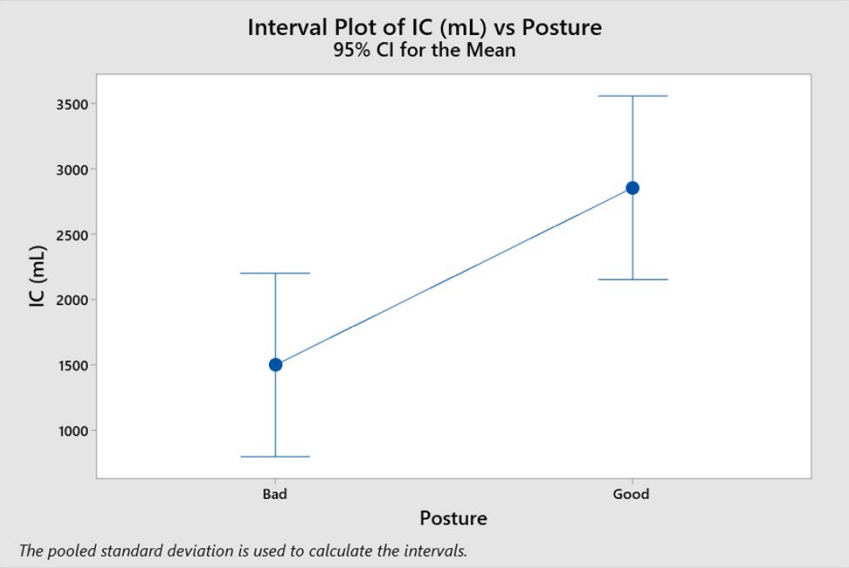
Participant 1: Bad Posture (Trial 3)

Results

Summary of Findings

- Utilized Minitab 19 to create a scatterplot and conduct a one way ANOVA test
- In all cases, IC was higher in a person-specific best posture
- Participant 2 data was deemed unreliable after data processing and further investigation

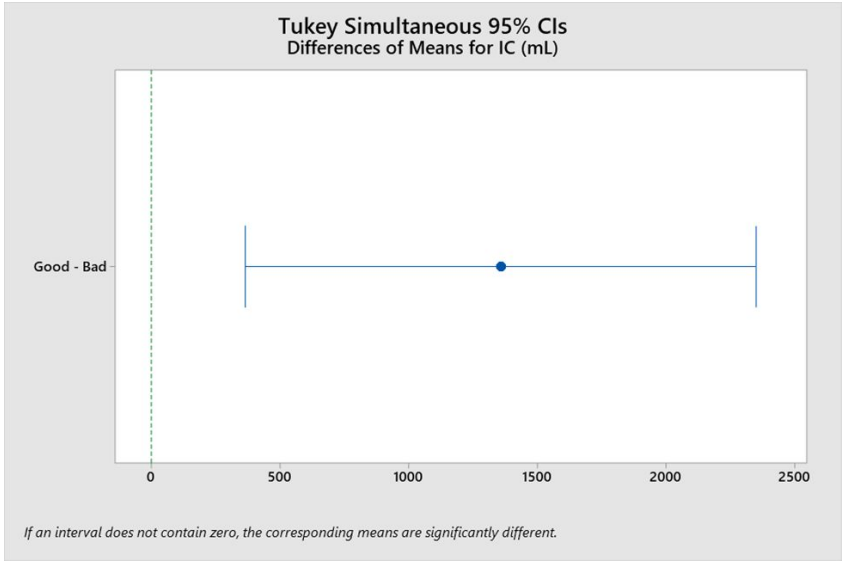


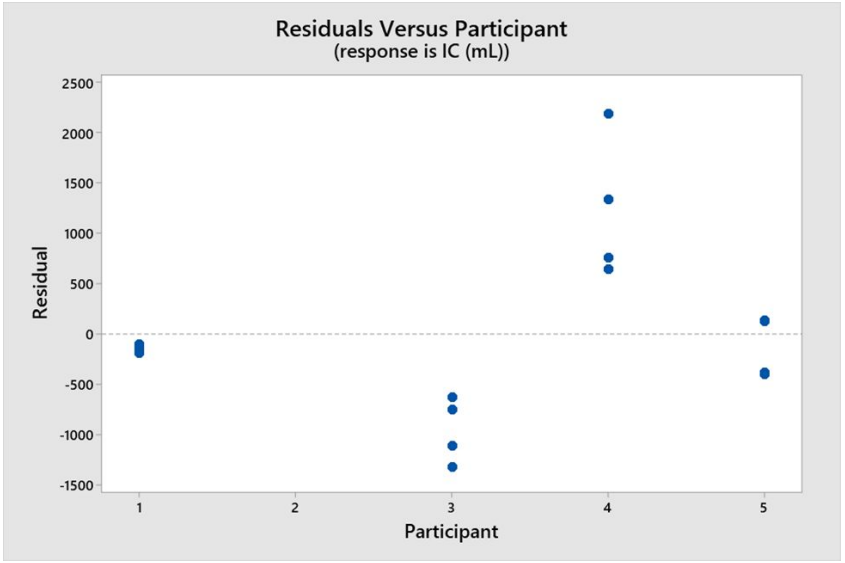


Results

Summary of Findings

- Average differences of means was around 1450 ml
- The difference in means are statistically significant
- Data varied among participants based on gender, body build, etc.





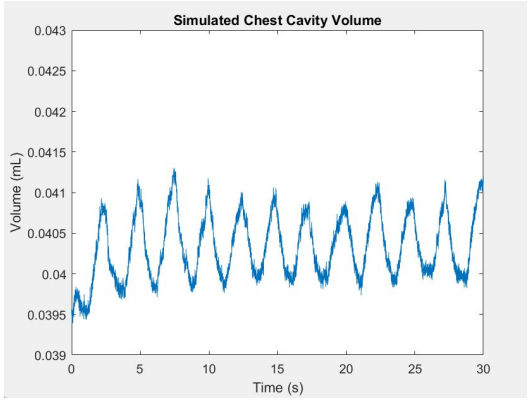
Discussion

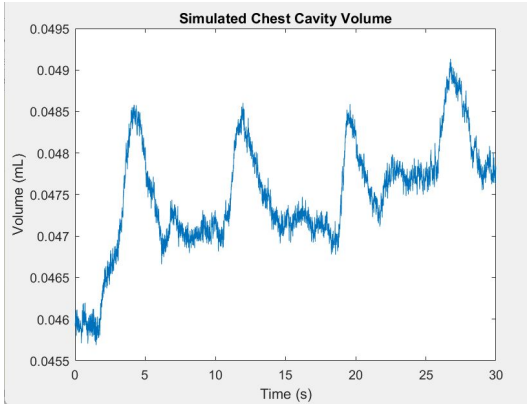
- Our hypothesis was confirmed based on the results we gathered. When each person was in a typical “bad posture” head down, slouched, etc, their level of inspiratory capacity decreased
- There was a larger difference than the team expected between the means of Inspiratory Capacity
- Body type played major role in differing IC
- Results are statistically significant, and clinically meaningful
- Participants were surprised at the difference in inspiration capacity with each posture
- Verbally said “Oh wow, I should really start sitting more straight up”

Discussion

Takeaways and Future Experiments

- Public engagement taught the value in showing off a project / study to people who have no experience with it.
- Valuable feedback
  - Response to instruction
  - Views on the outcome of the study
- Further detailed instructions required
  - “Heavy breathing” too vague & interpreted differently
  - Not uniform across participants but uniform within participant
  - 4-12 breaths each trial
  - Participant 4 inhaled as much as possible
  -
- Collect more data from more participants to further improve study
- create a device that actually detects when a person's starts positioning themselves in a “bad” posture.





Participant 5 vs 1 interpretation of protocol

Big Picture

- Learned about biomechanical sensors
  - Motion Capture
  - Force Plates
  - IMU
  - EMG
- Matlab Skills
- First “study” with public engagement
- Interest in Research Topic

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Thank you!

Any Questions?