

Acoustic rhinometry in the diagnosis of pediatric sleep apnea



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Introduction

- **Obstructive sleep apnea syndrome (OSAS):** breathing disorder characterized by repetitive episodes of upper airway obstruction during sleep, associated with gas exchange abnormalities and sleep fragmentation. Gold standard for diagnosis of OSAS is polysomnography (PSG).
- **Acoustic rhinometry (AR):** non-invasive technique that measures nasal airway distances and cross-sectional areas (CSA) and volumes by sending an acoustic pulse down the airway and recording the cross-sectional area at discrete distances from the device (see image 1)
- **Aims:** measure 1) association between AR measurements and OSAS severity, 2) difference between AR measurements in children treated with intranasal corticosteroids (NCS)
- **Hypotheses:** 1) AR cross-sectional areas will correlate with OSAS severity, 2) Following treatment, CSA of the nose will be increased compared to placebo

Methods

- Secondary analysis of a randomized controlled trial aimed at determining the usefulness of NCS for the treatment of childhood OSAS
- **Participants:** children age 5 -12 with mild to moderate OSAS from CHOP
- Eligible participants were invited for the baseline visit; then, participants were initially randomized to either the drug (NCS) or the placebo blindly in a 2:1 ratio
- Participants were to have taken the medicine (NCS or placebo) once a day for 3 months, and, after re-randomization, for 9 months in a 1:1 ratio (see Flowchart 1)
- Sound waves corresponding to the distance of anatomical structures in the nasal passageway were used to determine diameters of these areas
- **Output of device-** series of CSAs at each discrete intervals; 4 trials for each measurement
- Data visualized using **MATLAB**
- Output was analyzed using **Stata**; focused on CSA correlating to demographic data and NCS

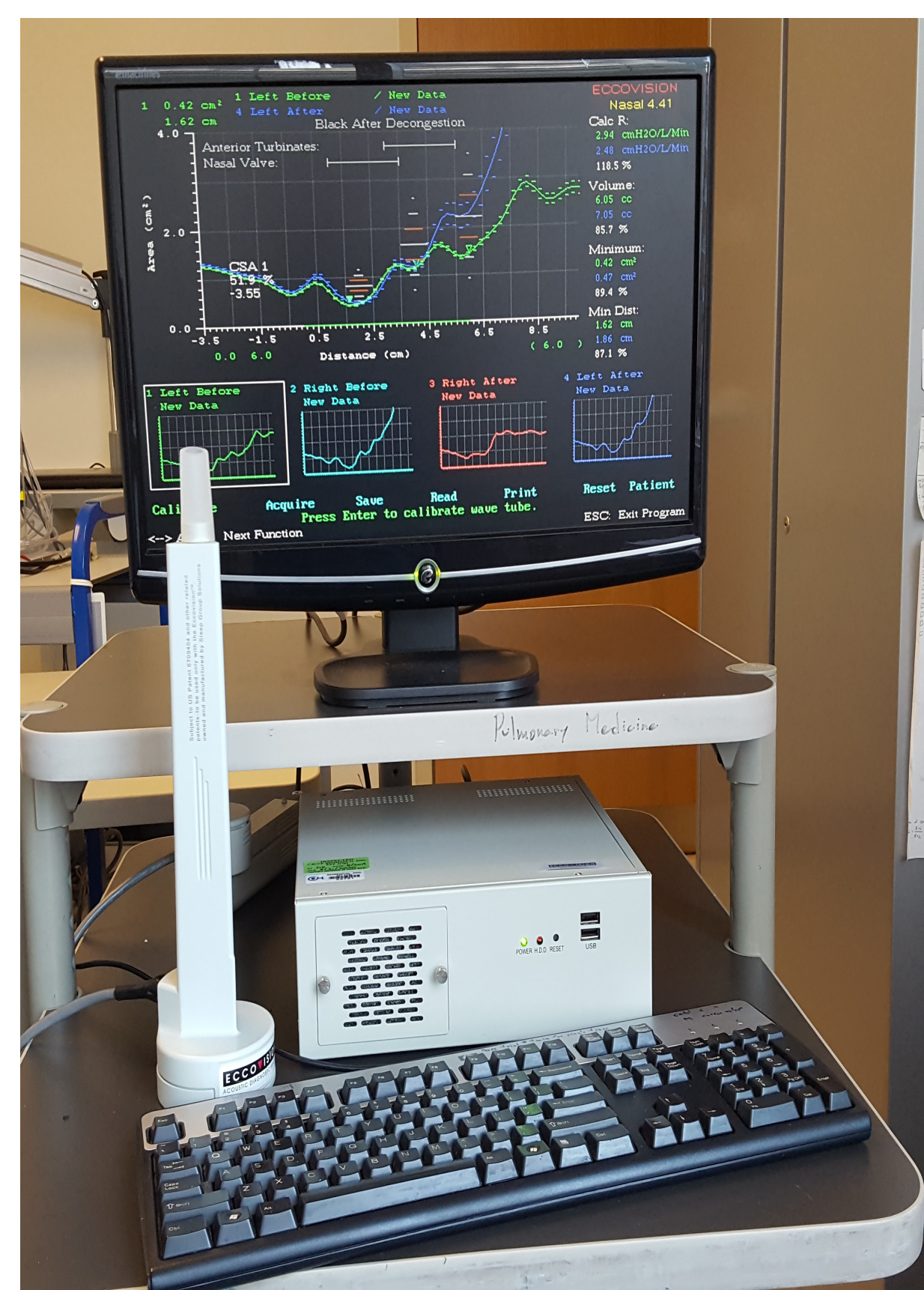
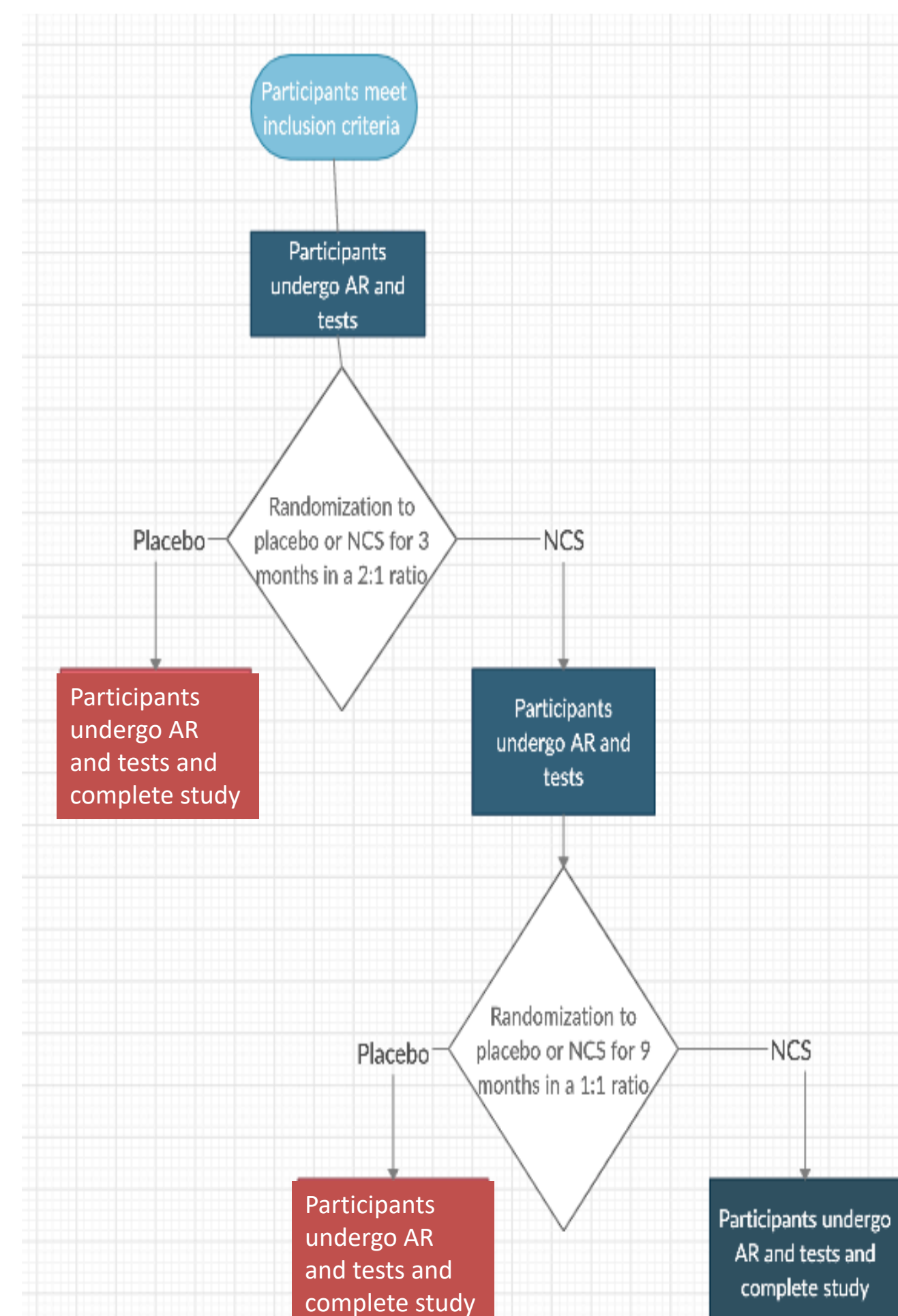


Image 1: Picture of Rhinometry Device and Graphical Output of the measurements



Flowchart 1: Randomization process of this study at 3 months, 9 months and 12 months

Results

	Number (n = 133)
Gender	
Male	67 (50.4%)
Race	
White	23 (17.3%)
African American	108 (81.2%)
More than 1 race	1 (0.75%)
Asian	1 (0.75%)
Ethnicity	
Hispanic	12 (9.0%)
Non-Hispanic	121 (90.9%)
Age (years)	
Median (range)	7.89 (6.34–9.87)
BMI (percentile)	
Median (range)	87 (58–98)
OAH (events per hour)	
Median (range)	6.08 (3.58–9.65)

Table 1: Demographics of eligible participants

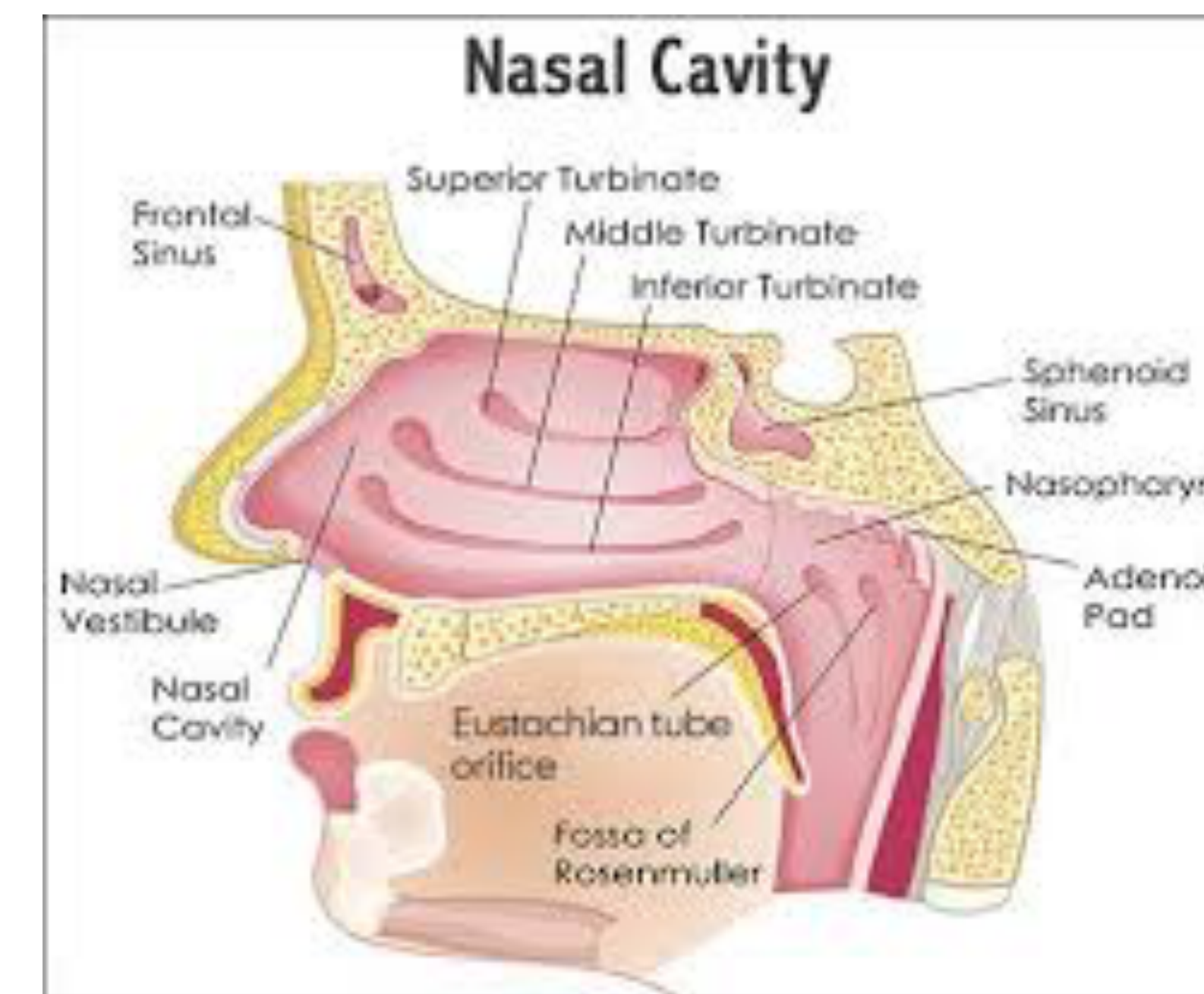
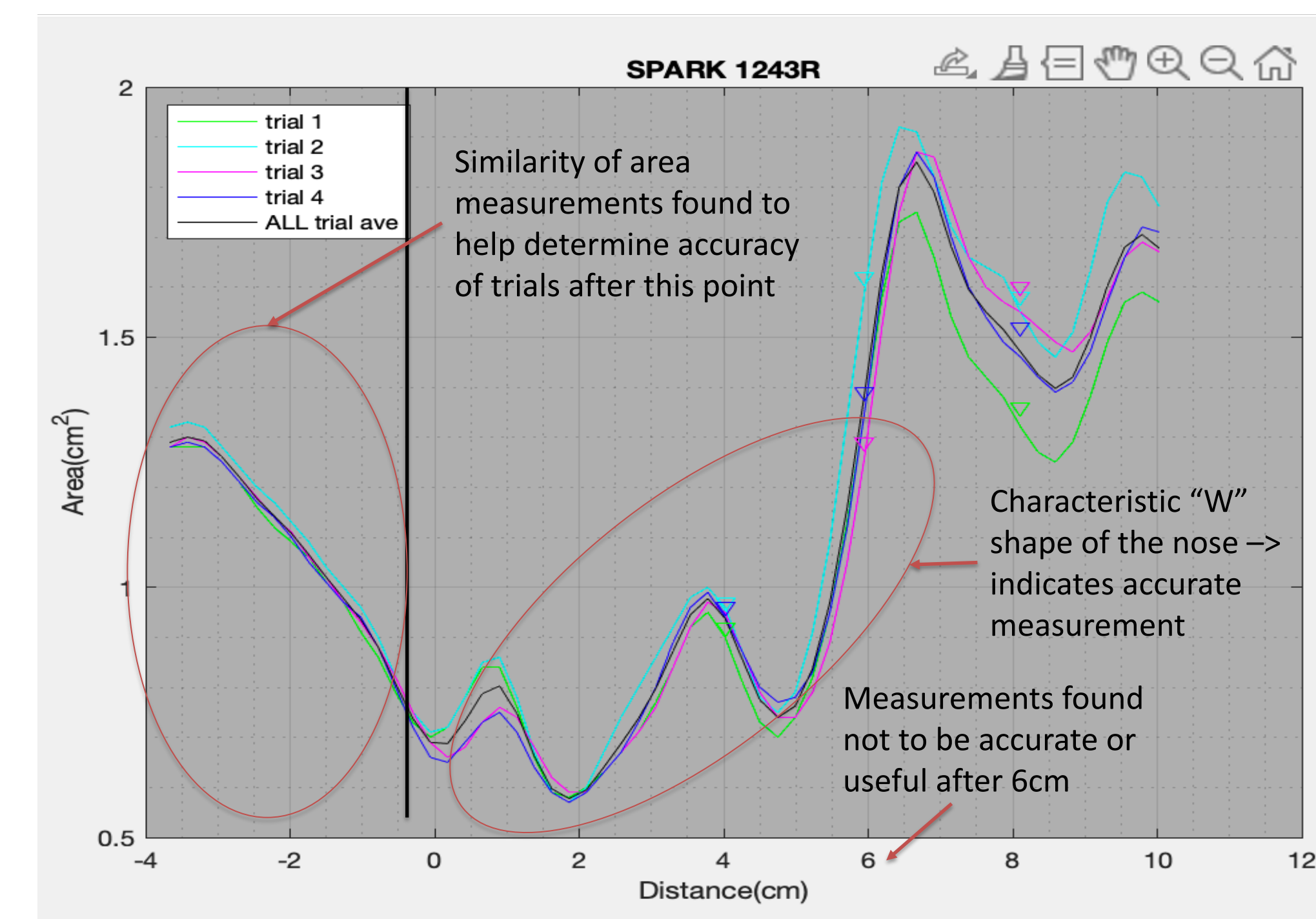


Image 2: Cross sectional anatomy of the nasal passageway corresponding to the rhinometry measurements in children

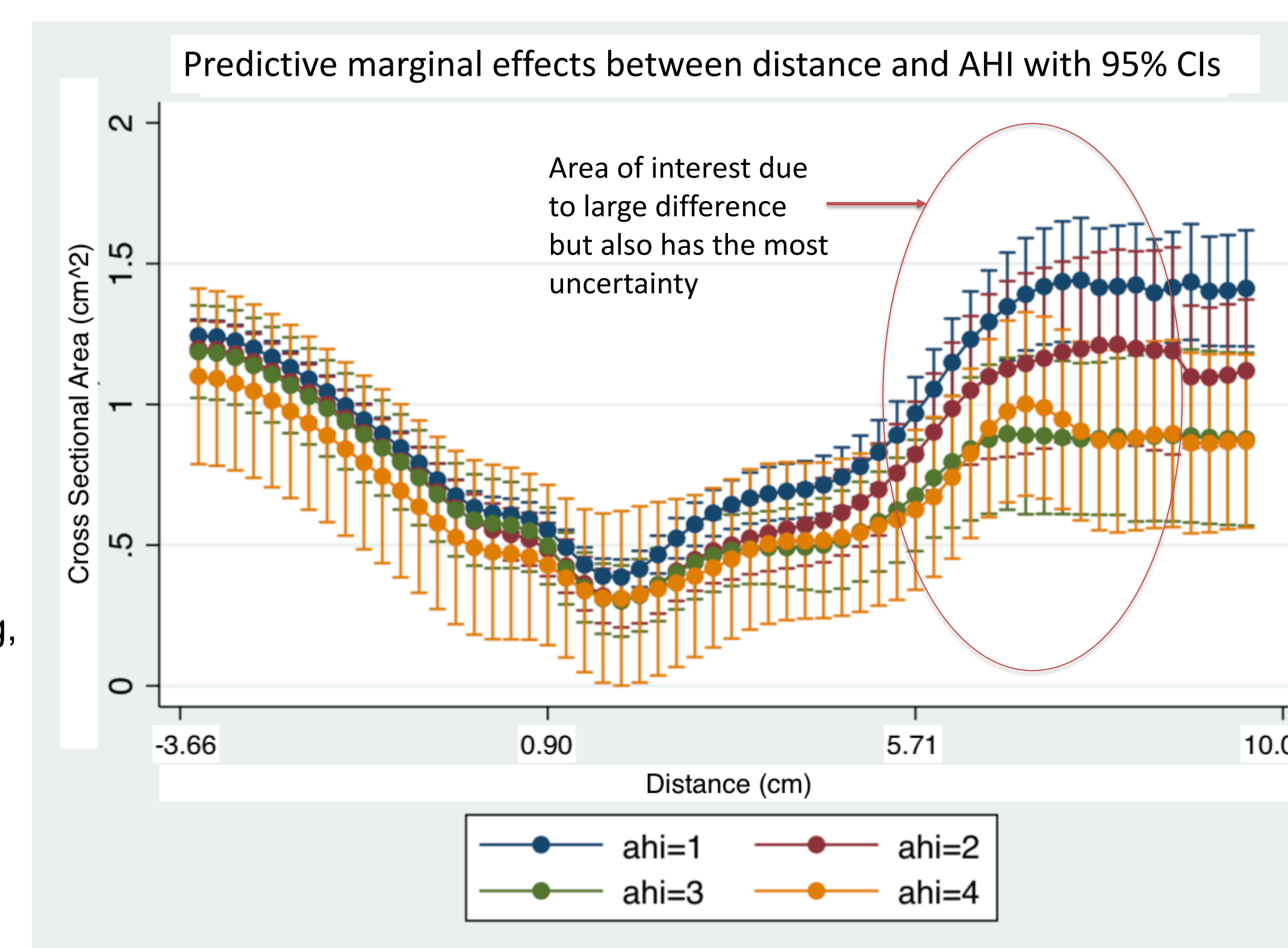


Graph 1: Example of reliable measurements of output graph of MATLAB program with distance from device on x-axis and CSA on y-axis

Analysis done using Stata after verifying data through MATLAB

- Moderate trend towards association between the OAH and the CSA ($P = 0.083$)
- No significant difference ($P > 0.05$) in the CSA between placebo and NCS groups
- Significant correlation ($P = 0.046$) was found between the CSA measurements and the age of the participants

Graph 2: Pairwise comparison model from Stata that shows the different average CSA values across the 4 quartiles of AHI values, adjusted for age, administration of the drug, and any other difference



Conclusions

- Moderate trend between OAH and CSA suggests that there may be a relationship between sleep apnea and CSA of nose anatomy; therefore, may be able to use rhinometry as a supplementary diagnostic tool
- Possible error with including trials that had truncations as these may have reduced the margin of significant difference between the placebo and NCS groups
- Moderate number of trials may be unreliable due to the young age of the children or the rounding errors of the machine
- Large difference between AHI = 1 and AHI = 4 after 6 cm found but may not as confident because of uncertainty of measurements after 6 cm and noise of the analysis

Next Steps

- Will be continuing with the Sleep Lab group at CHOP in the Fall on this project
- To focus on significant biomarkers of the rhinometry waveform and the changes of these features based on age and the use of the NCS
- To expand analysis by defining difference between the slopes of the linear models that correlate age, AHI and the CSA values at discrete intervals
- Publication is expected in beginning of 2021

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