Using Actigraphy Watches to Measure Sleep Activity in Subjects with Obstructive Sleep Apnea

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Background Information

- Obstructive Sleep Apnea (OSA) literally translates to “without breath during sleep” where the upper airway repeatedly closes throughout a sleep interval.
- The airway consists of the:
  - Nose
  - mouth
  - throat
  - windpipe
- Various risk factors could have a possible relation to a person eventually developing this chronic illness which can include:
  - obesity,
  - high blood pressure,
  - heart disease,
  - Diabetes
  - Smoking
- OSA has been proven to lead to higher risk of stroke or death

Background Continued

- The airway works a system to keep the pressure balanced.
  - Oxygen enters
  - Carbon Dioxide exits
- It consists of all compliant structures
  - A negative transmural pressure will result in the airway closure
  - A positive transmural pressure means an open airway

More Background

- Episode of Obstruction: when a signal should be sent to the brain so that the person will gasp and increase the amount of air into the lungs
- Sleep Apnea ranges from mild to severe.
- The difference between a person with a mild condition and a severe condition usually entails the amount of episode occurrences.
- Descriptive Video OSA

CPAP

- Continuous Positive Airway Pressure (CPAP) machine is a common treatment for a person with sleep apnea.
- Approximately after the first week within the study, OSA subjects began using CPAP devices to treat their condition.

Data

- 16 control subjects
- 30 subjects with Obstructive Sleep Apnea.
- All subjects who were selected wore wrist actigraphy watches with built-in accelerometers to objectively monitor sleep patterns over a 3-month period.
- Collected data was then sorted by time intervals :
  - Sleep (Our Focus)
  - Awake

Actigraphy Watch

Data Continued

- Objective: To use actigrahy watches to find a significant improvement of the sleep patterns in sleep apnea patients with treatment in comparison to control patients.
- The data collected:
  - recorded wake time
  - snooze time
  - average sleep time
  - average wake time
  - sleep bouts
  - wake bouts
  - efficiency

More Data

- Efficiency was the main observation for data interpretation.
- Sleep efficiency: The ratio of actual sleep time to total time in bed.
- Average sleep efficiency was then calculated for data interpretation:
  - First 7 days
  - First 14 days
  - between the 60+ days of the trial relative to the first week
  - All days

Research Questions

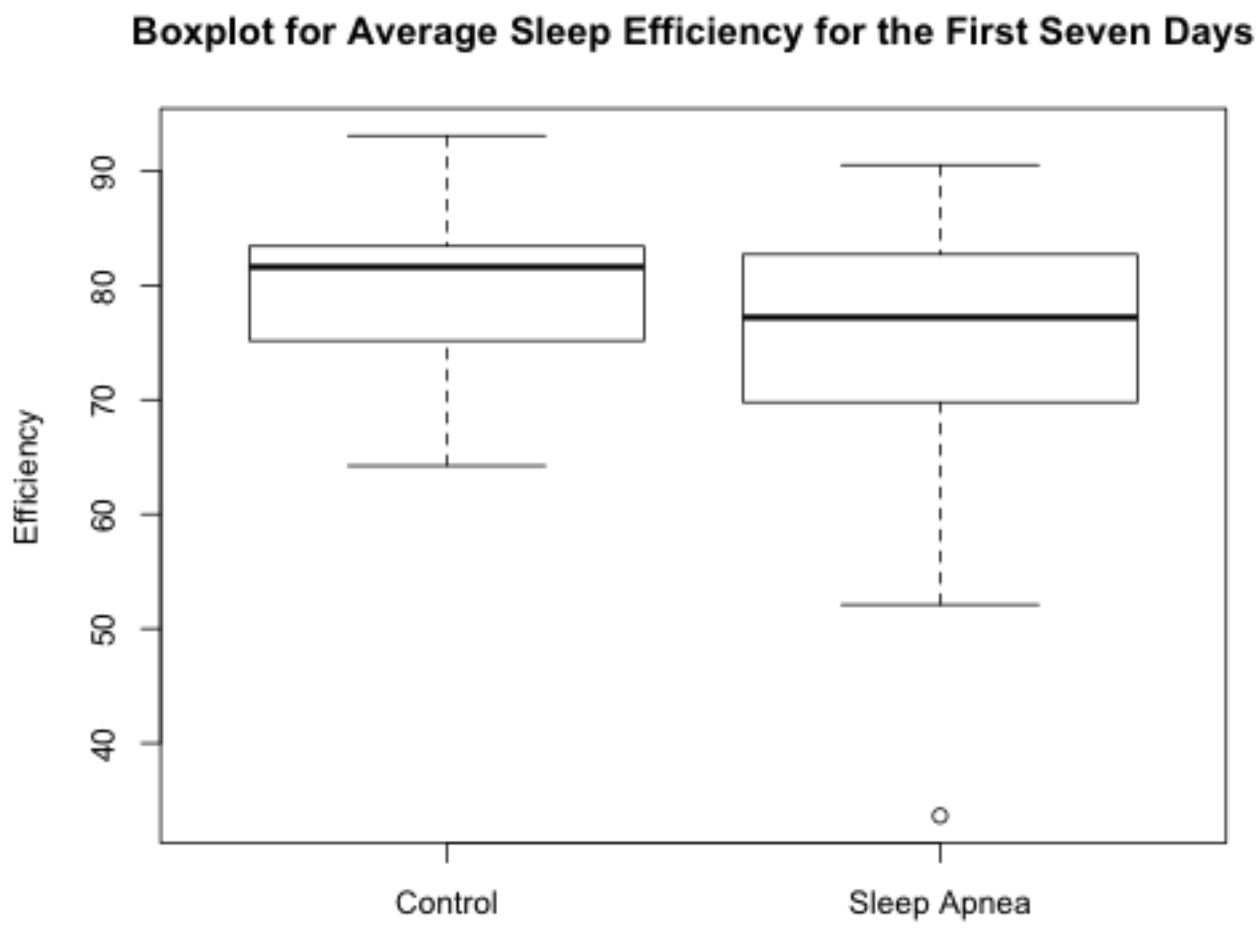
- 1. Are the two groups similar or different during the 1st week?
  1. 2 sample t-test between the 2 groups (OSA and Control) for average efficiency
  2. Wilcoxon rank-sum tests for the 2 groups for average efficiency
- 2. Are the two groups similar or different during the 2nd week?
  1. Repeated steps from question above
- 3. Did the groups change over time (60+days vs. first week)?
  1. Paired t-test within each of the groups for average efficiency
  2. Wilcoxon signed-rank tests for the 2 groups for average efficiency

1. Results: First Week Comparison

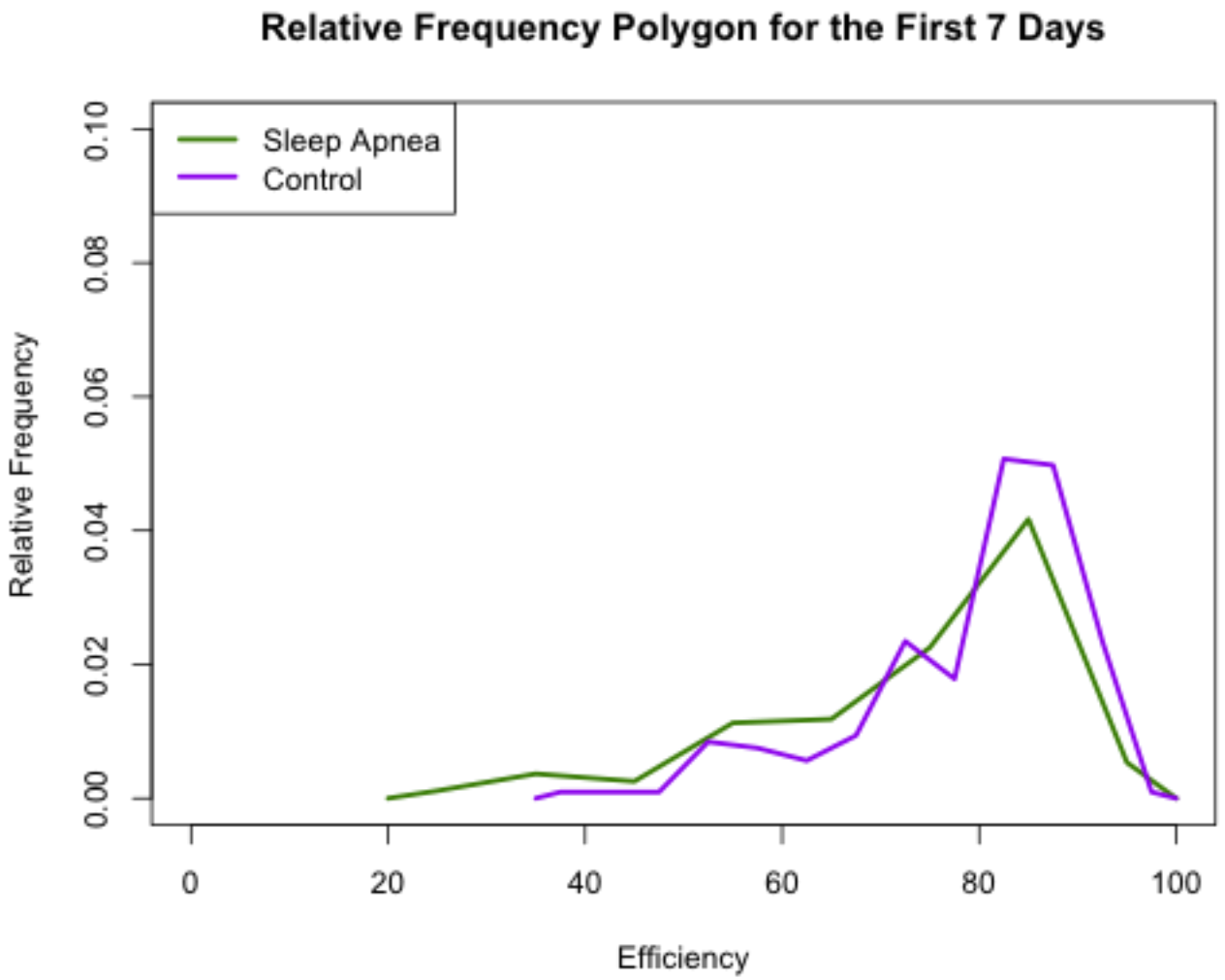
Group	Mean (SD)	Median	T-test p-value	Wilcoxon Rank-Sum p-value
Control	79.4 (11.2)	82.38	0.0012	0.0016
OSA	74.61 (13.9)	78.46		

a) 95% confident that the average efficiency in OSA group is between 1.9 - 7.7 lower than control group
b) If no difference in population means for the 2 groups then the observed value would only occur 0.1211% of the time

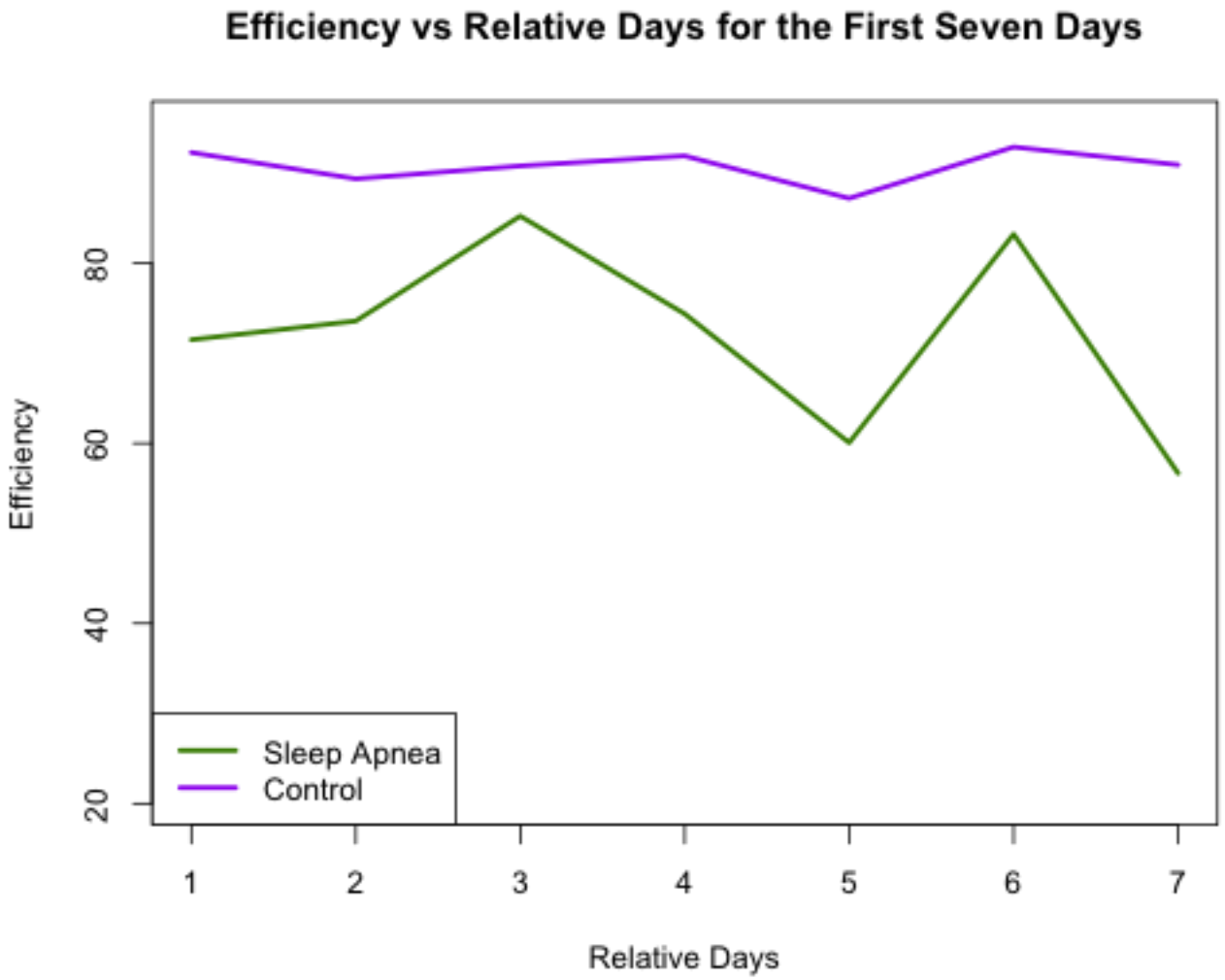
Boxplot: Control & OSA Efficiencies



Relative Frequency Polygon First Week



Efficiency vs Relative Days

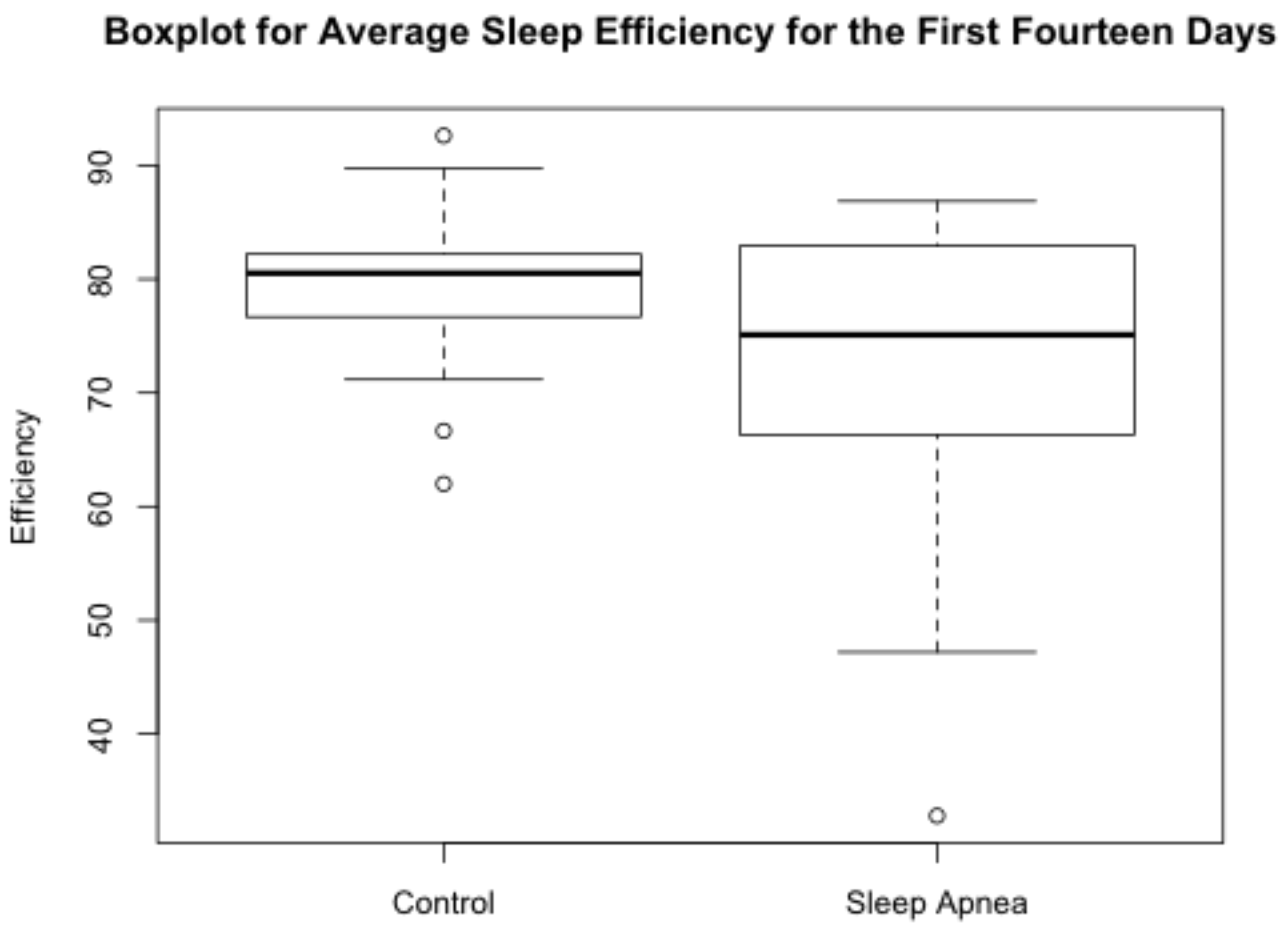


2. Results: First Fourteen Days Comparison

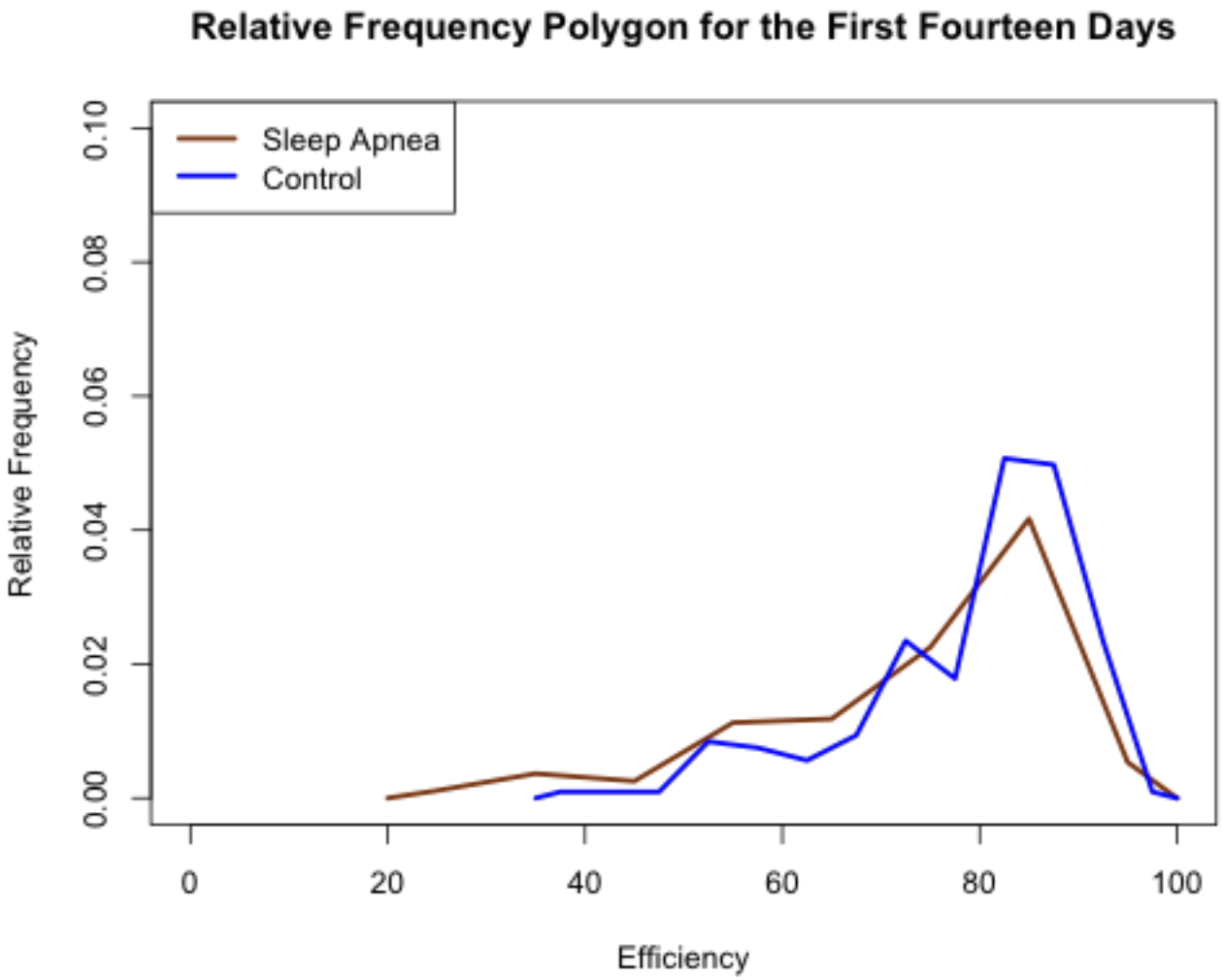
Group	Mean (SD)	Median	T-test p-value	Wilcoxon Rank Sum p-value
Control	79.3 (11.3)	82.45	1.445e-06	1.76e-05
OSA	73.9 (14.9)	78.65		

a) 95% confident that the average efficiency in OSA group is between 3.2 and 7.6 lower than control group

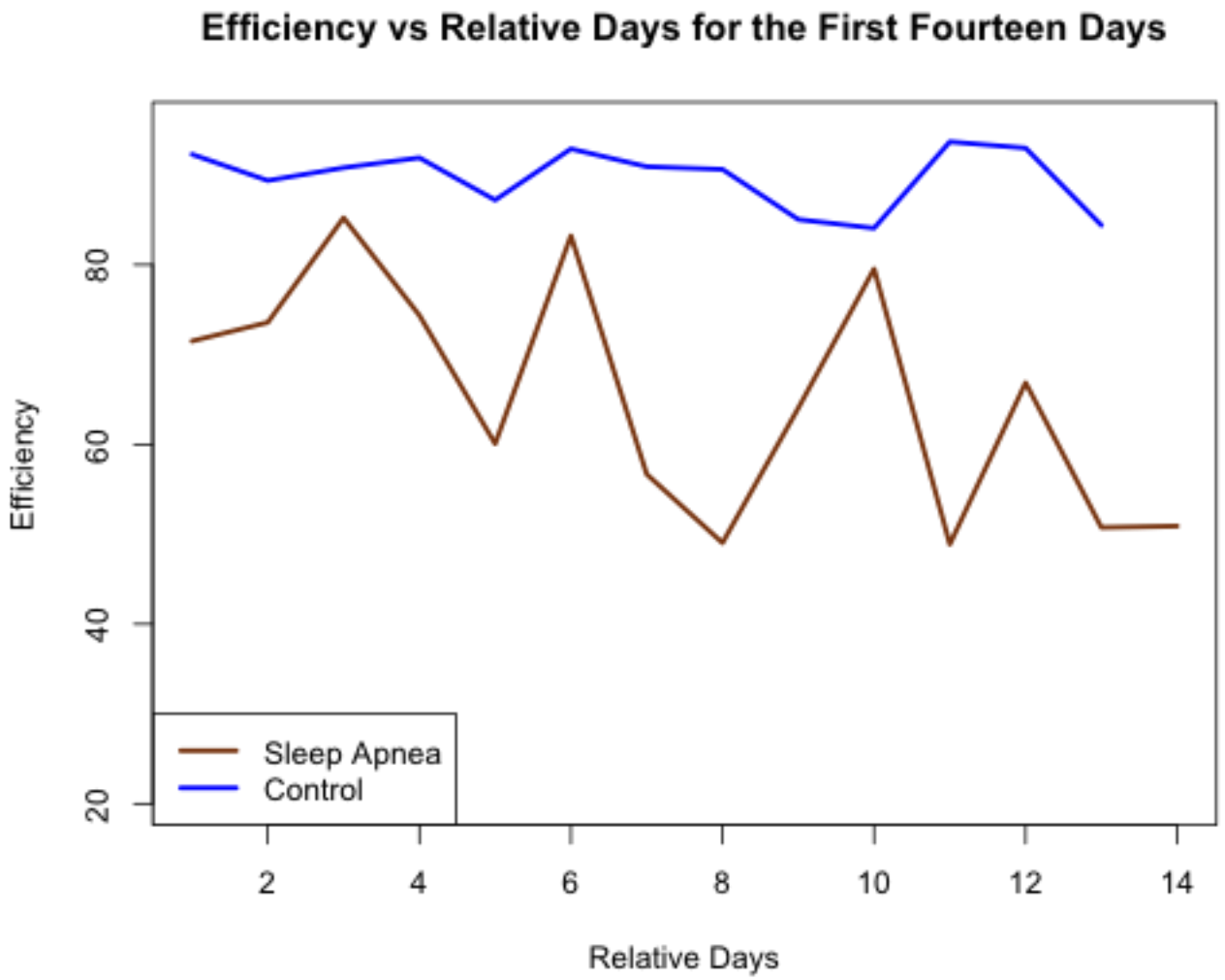
Boxplot: Control & OSA Efficiencies



Relative Frequency Polygon for First Fourteen Days



Efficiency vs Relative Days



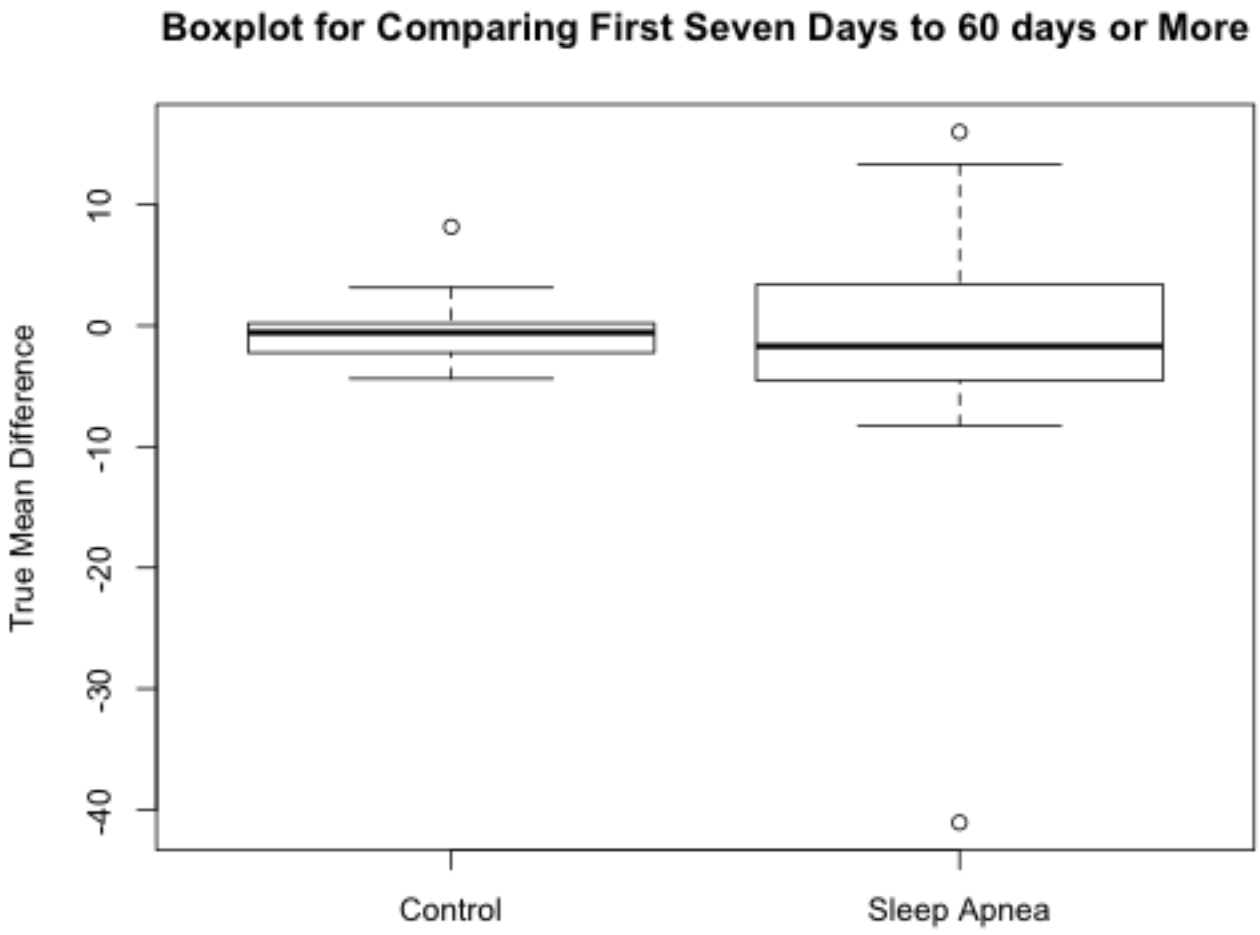
3. Results for Within Group Comparisons

$60^{+} - (1\text{-}7)$

Group	Days 1-7 Mean (SD)	Days 60+ Mean (SD)	Difference 60+ - (1-7) Mean (SD)	Paired T-test P-value	Wilcoxon Signed-Rank Test P-value
Control	79.4 (7.9)	78.9 (6.6)	-0.48 (3.1)	0.5422	0.1928
OSA	74.5 (12.1)	73.4 (10.3)	-1.07 (9.8)	0.5942	0.5291

a) 95% confidence interval of (-2.1, 1.2) for the average efficiency of the control group.
b) 95% confidence interval of (-4.7, 2.6) for the average efficiency of the OSA group.

Boxplot: Comparing within groups of days 60^{+} – (1-7)

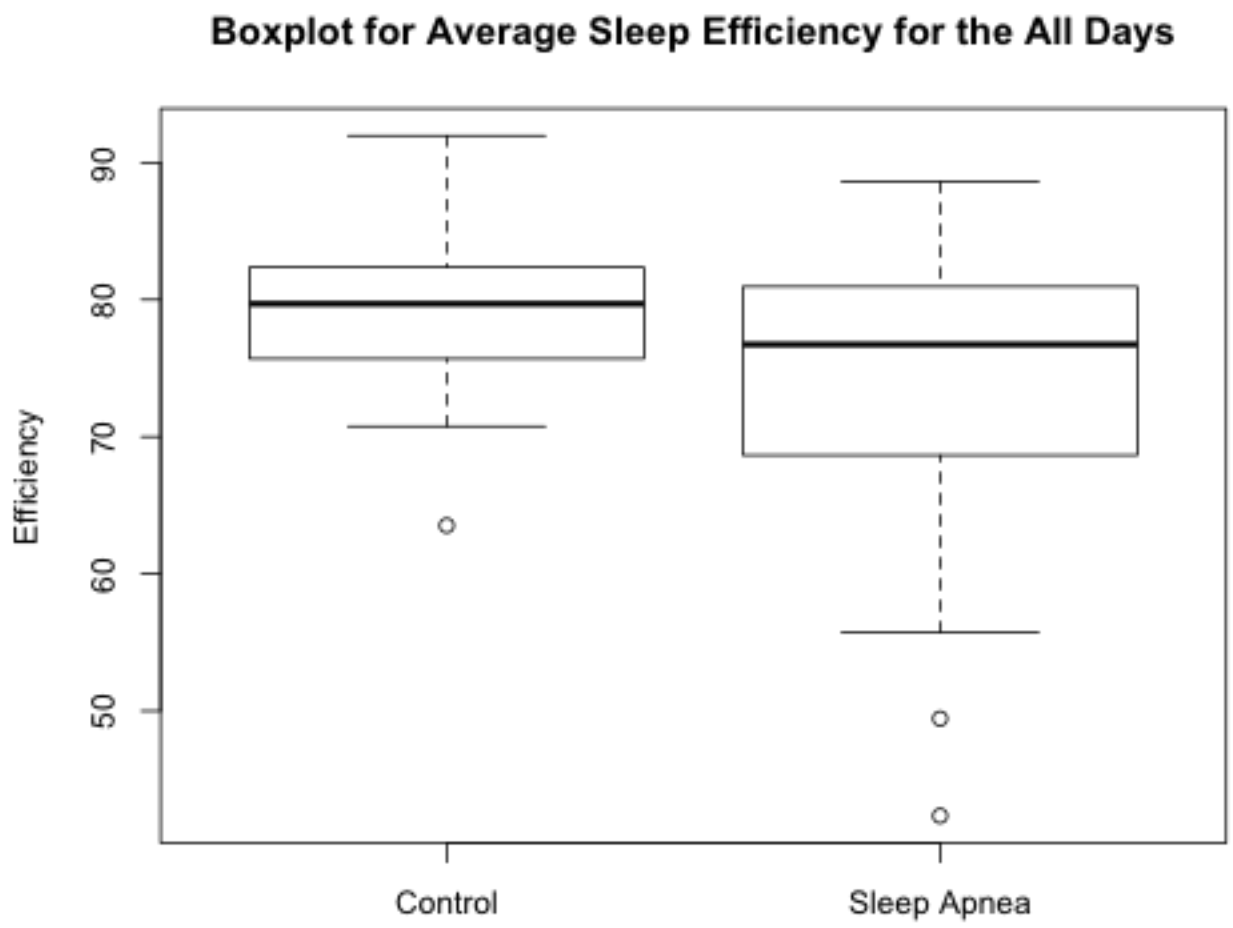


Results: Comparison between groups of days 60^{+} – (1-7)

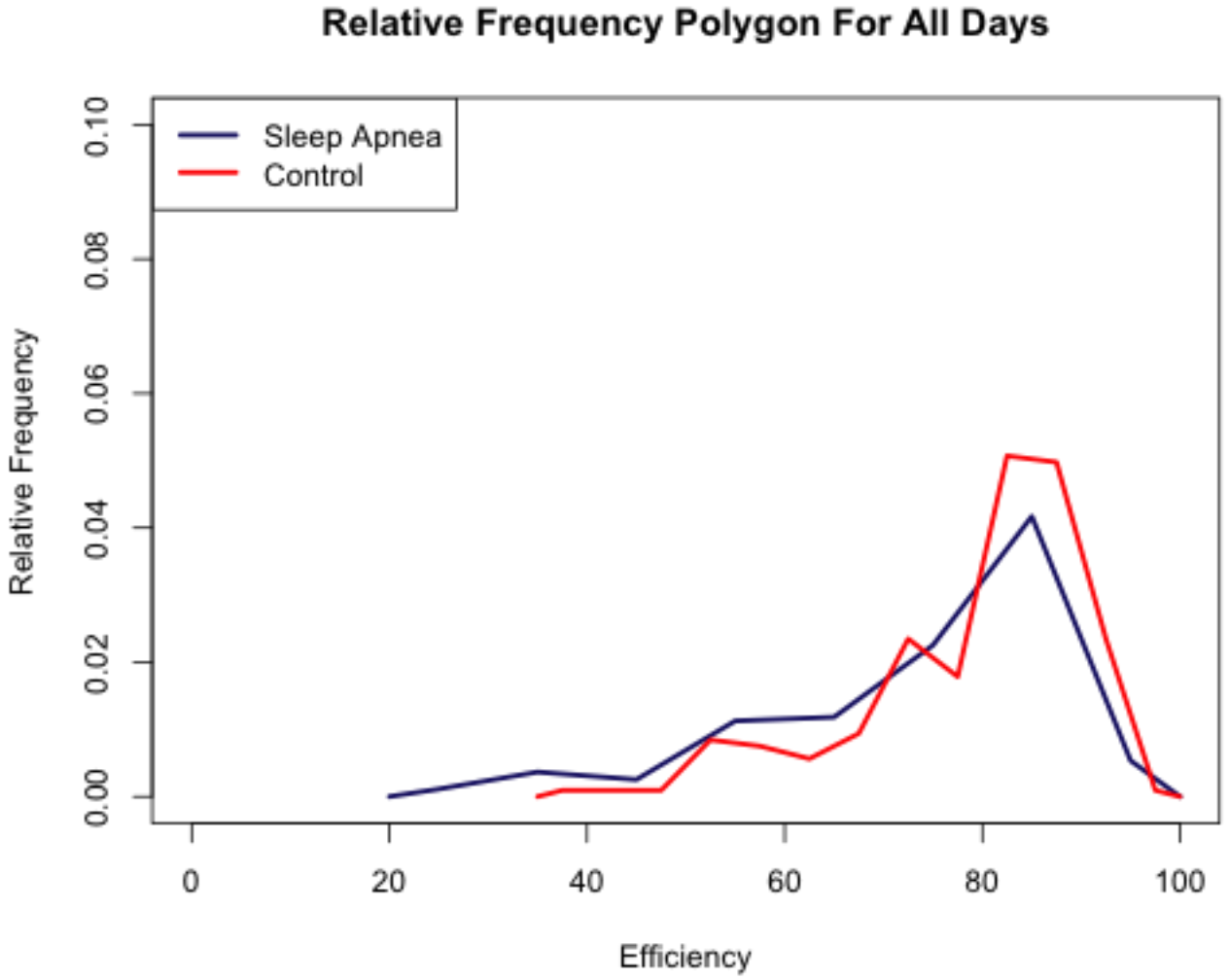
Group	Difference 60+ - (1-7) Mean (SD)	Median	T-test p-value	Wilcoxon Rank Sum Test p-value
Control	-0.48 (3.1)	82.7	0.7621	0.5759
OSA	-1.07 (9.8)	77.4		

a) The mean efficiency is not statistically different between the control and OSA group.
b) 95% confidence interval (-4.53, 3.34)

Boxplot: Control & OSA Efficiencies



Relative Frequency Polygon



Limitations

- Data collected from the actigraphy watches was not always consistent. There are various days missing for certain patients for unknown reasons.
- Sleep is not a constant activity for any subjects, the amount changes day-to-day

Future Works

- If this study was to be more longitudinal, data interpretation comparing the last month to the first seven days could be more significant
- Intervention time would be much longer, more treatment would most likely mean increased sleep efficiency for OSA subjects.

Conclusion

- We found that the OSA group did have less efficient sleep patterns pre-treatment, and that these did not improve significantly over the course of the study.

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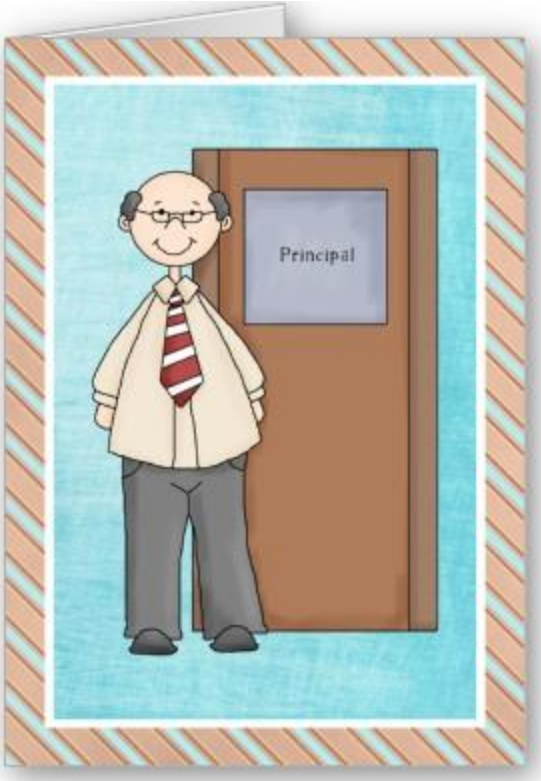

Thank You!