**Influence of muscle movement on Brain - Heart interactions during sleep**

This report presents an analysis of the influence of Electromyography (EMG) on brain-heart interactions during sleep, focusing on the effects of gender, hypertension, and sleep apnea conditions.

The study groups are formed based on 3 conditions:

**Gender** (M/F), **Hypertension** (1-Yes/0-No), **Sleep** **Apnea** (Normal, moderate, severe)

The severity of sleep apnea is categorized based on the Apnea-Hypopnea Index (AHI) scores.

|  |  |
| --- | --- |
| **AHI** | **Group** |
| <5 | Normal Sleep Apnea |
| 5-15 | Moderate Sleep Apnea |
| >15 | Severe Sleep Apnea |

All the samples taken are from SHHS1 (Sleep Heart Health Study 1) study.

Groups considered:

* Healthy\_female\_SHHS1
* Healthy\_male\_SHHS1
* Hypertension\_female\_SHHS1
* Hypertension\_male\_SHHS1
* Mod\_OSA\_female\_SHHS1
* Mod\_OSA\_male\_SHHS1
* Sev\_OSA\_female\_SHHS1
* Sev\_OSA\_male\_SHHS1
* Mod\_OSA\_Hypertension\_female\_SHHS1
* Mod\_OSA\_Hypertension\_male\_SHHS1
* Sev\_OSA\_Hypertension\_female\_SHHS1
* Sev\_OSA\_Hypertension\_male\_SHHS1

20 patients are considered from each group for the analysis.

**Methodology:**

Step 1: Using TDS method to determine the strength of the links between EEG and HR.

Step 2: Using LSTMCGC to determine the directionality of the links between EEG and HR:

* calculating two errors ErrorXY\_X and ErrorXYZ\_X
* ErrorXY\_X is the forecasting error of the model considering X(t) and Y(t) as input and predicting X(t+1)
* ErrorXYZ\_X is the forecasting error of the model considering X(t), Y(t), Z(t) as input and predicting X(t+1)
* Now, we calculate the difference between these errors. If difference (ErrorXY\_X - ErrorXYZ\_X) is positive, that means adding variable Z (EMG) has an impact on correlation between EEG and HR.

Following are the brain-heart interactions for each of the groups influenced by EMG:

Healthy female:

A diagram of a sleep stage

Description automatically generated with medium confidence

Healthy male:

A diagram of different steps

Description automatically generated with medium confidence

Hypertension Female:

A diagram of a brain sleep stage

Description automatically generated with medium confidence

Hypertension Male:

A diagram of a sleep cycle

Description automatically generated with medium confidence

Moderate Sleep Apnea Female:

A diagram of a brain heart

Description automatically generated

Moderate Sleep Apnea Male:

A diagram of different types of sleep stages

Description automatically generated with medium confidence

Moderate Sleep Apnea, Hypertension Female:

A diagram of a brain heart connections

Description automatically generated with medium confidence

Moderate Sleep Apnea, Hypertension Male:

A diagram of a diagram

Description automatically generated

Severe Sleep Apnea Female:

A diagram of a brain heart

Description automatically generated

Severe Sleep Apnea Male:

A diagram of a brain heart

Description automatically generated

Severe Sleep Apnea, Hypertension Female:

A diagram of different stages of sleep

Description automatically generated

Severe Sleep Apnea, Hypertension Male:

