The Effect of Treatment of Sleep Disordered Breathing on Sleep Quality in Children with Down syndrome

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Background

Sleep disordered breathing (SDB) is much more common in Down syndrome (DS) children due to their unique craniofacial characteristics and reduced muscle tone, which can cause sleep disruption and affects daytime functioning.[1,2]

- The primary treatment of SDB in children is adenotonsillectomy.[3]
- Assessing sleep quality may provide a better understanding to maximise daytime functioning and quality of life.

Sleep quality can be identified by assessing:

- **Sleep macro-architecture**: conventional sleep analysis by analysing time spent in various sleep states using standard criteria.
- **Sleep micro-architecture**: quantification of electroencephalograph (EEG) activity in different sleep states and stages using EEG spectral analysis.

- To date, no studies have examined the effects of treatment of SDB on sleep quality in children with DS.

Aim and Hypothesis

- To compare SDB severity and sleep quality in children with DS who were treated and not treated for SDB.
- Treatment of SDB will improve SDB severity and sleep quality in children with DS.

Methods

Baseline and follow up study: Children with DS (n= 24)
- Treated group (n= 9)
- Untreated group (n= 15)

- All children completed an **overnight polysomnographic (PSG)** study to obtain sleep and respiratory data
- **Change in SDB severity** was determined using the **obstructive apnoea hypopnoea index (OAHI)**
- **Sleep macro-architecture** was assessed using **conventional PSG** by looking at total sleep time, wake after sleep onset and % time spent in each sleep state across the night.
- **Sleep micro-architecture** was assessed with **EEG power spectral analysis** of delta (0.5-3.9 Hz), theta (4-7.9 Hz), alpha (8-11.9 Hz), sigma (12-13.9 Hz), and beta (14-30 Hz) frequencies during NREM and REM sleep.
- **Statistical analysis:** all data between baseline and follow up for both groups were compared using the Wilcoxon signed rank test. Mann-Whitney U tests were used to compare data between treated and untreated groups at baseline and follow up.

Results

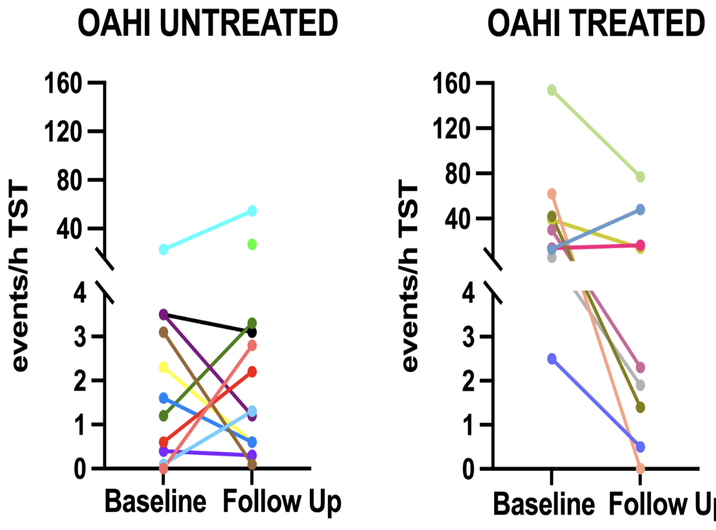

Figure 1. The OAHI characteristics from baseline to follow up in children with DS who were treated and untreated.

- Children with DS at baseline who were treated had more severe OSA (30.0 (0.5, 52.0 events/h TST) compared to children who were untreated (3.1 (0.6, 5.7) events/h TST) at baseline.
- SDB severity was significantly improved in children with DS following treatment; 2.3 (1.0, 32.2) events/h TST with p<0.001.

Sleep Macro-architecture

- There were no significant differences in sleep macro-architecture parameters from baseline to follow up in either the treated or untreated group.

Sleep Micro-architecture

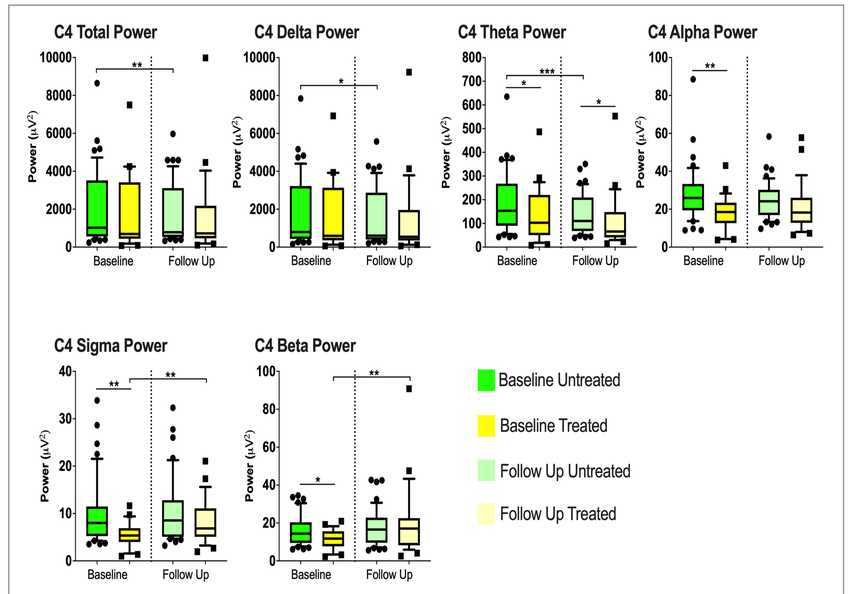

Figure 2. EEG spectral power analysis on C4 channel in all NREM sleep stages
The horizontal line represents the median, the ends of the boxes represent the 25th and 75th quartiles, and the whiskers indicate 10th and 90th percentile. Statistical significance difference is marked by *p<0.05, **p<0.01, ***p<0.001.

- Children who were treated had lower theta, alpha, sigma and beta power at baseline compared to the untreated group suggesting more sleep disruption.
- The children who were treated had increased sigma power at follow up that which indicates sleep improvement.
- In REM sleep, at baseline children who were treated had lower theta and sigma power which indicates more disrupted sleep compared to the untreated group.

Conclusion

- Treatment of SDB was effective in reducing SDB severity in children with DS as indicated by the significant improvement of OAHI.
- Treatment of SDB improved sleep quality as indicated by increased sigma power, which indicates more sleep spindles.
- Increased sleep spindles indicates repaired sleep maintenance which has been associated with improved daytime functioning.

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- **References** [1]Jayabheri S et al. J Am Coll Cardiol. 2017. [2]Horne R, et al. Sleep Medicine Reviews. 2019. [3]Lal C et al. Chest. 2015.