

# Sleep And Intensity Of Cortical Arousals Associated With Periodic Limb Movements: A New Approach For Predicting Subjective Complaints

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## Introduction

- The majority of patients with RLS experience frequent periodic limb movements (PLMs), resulting in EEG arousals thought to contribute to a sense of poor sleep quality.
- Mendelson [1] however, reported no significant relationship between PLM arousal index (PLMAI) and next day reports of non-restorative sleep. This may relate to the fact that PLM-associated arousals are scored as either present or absent without accounting for differences in arousal intensity.
- Azarbarzin et al. have developed an automated method for quantifying cortical arousal intensity based on wavelet analysis of C3/A2 and C4/A1 EEG signal [2]. They visually scaled arousals using a 10-point range subjectively based on EEG appearance (Figure 1). They showed that cortical arousals vary greatly in their intensity and that average arousal intensity varies considerably within and between patients. This suggests that the intensity rather than the number of arousals may contribute to the subjective complaints.
- The Medical Outcome Study Sleep Scale (MOS-SS) is a self-report instrument consisting of 12 items that assess perceived initiation and maintenance of sleep, respiratory problems during sleep, sleep duration, perceived adequacy of sleep and daytime somnolence [3]. For 10 of the items, subjects respond to questions on how often each symptom or problem applies to them on a 6-point categorical scale ranging from "all of the time" to "none of the time". An item on quantity of sleep is reported as the average number of hours slept per night. Answers are based on retrospective assessment over the past 4 weeks.
- We explored the characteristics of AASM scored arousals associated with PLMs and their relationship to subjective sleep quality.

## Methods

- Twelve patients meeting the International Restless Legs Syndrome (IRLS) rating scale criteria for moderate to severe RLS underwent baseline PSG recordings.
- Records were scored for R&K parameters of sleep continuity (i.e., TST, WASO, NAASO, Arousal Index, PLMI, and PLMAI).
- Arousals associated with PLMs were scored according to the AASM criteria. Records were scaled for arousal intensity associated with PLMs using the method of Azarbarzin et. al.
- Arousals were classified on a 10-point scale (0-9), with 0 representing barely perceptible arousals and 9 representing very intense arousals.
- Subjective sleep disruption was assessed using the MOS-SS. The MOS scale was scored according to the Spritzer and Hays scoring manual, version 1.0 [5].
- Subjects responses to the MOS scale were aggregated into a 9-item Sleep Problem Index II score and 4 subscale scores: Sleep Disturbance (have trouble falling asleep, how long to fall asleep, sleep was not quiet, awoken during your sleep time and have trouble falling asleep again), Sleep Adequacy (get enough sleep to feel rested upon waking in the morning, get amount of sleep needed), Daytime Somnolence (drowsy during day, have trouble staying awake during the day, take naps), and Quantity of Sleep.
- The Quantity of Sleep subscale documented the number of hours of sleep per night (possible range from 0 to 24 h). The remaining subscales and Problem Index II are scored on a 0-100 possible range. For the Sleep Adequacy subscale, higher scores reflected more adequate sleep. For all other subscales, higher scores indicated more severe sleep dysfunction.

- Data was analyzed using the SPSS statistical software, version 20.

## Results

- Patients were 6 females and 6 males, mean age 53.7±8.6 years, and mean IRLS score 27.3±6.4 (Table 1).
  - Patients averaged 50.8±40.1 PLMs per hour of sleep and a mean nightly total PLMs with arousals of 9.21±8.35 (2.8-34.1). Patients showed significant sleep disturbance by objective and subjective sleep parameters (Table 2).
  - Mean arousal intensity was 3.26±0.63 (2.07- 4.50).
  - Arousal intensity values correlated with both objective TST ( $r = -0.72$ ,  $p < 0.01$ ) and subjective sleep quantity on the MOS subscale ( $r = -0.574$ ,  $p = 0.04$ ) (Figures 2 & 3).
  - None of the remaining sleep continuity parameters including PLMI and PLMAI correlated with subjective complaints.
- The results suggest that intensity of arousals associated with PLMs maybe more useful than PLMI and PLMAI in predicting subjective sleep complaints in RLS patients.
- Inclusion of arousal intensity among other variables that are commonly used to evaluate sleep quality (e.g., sleep efficiency, total sleep time, arousal index) may help explain instances of excessive daytime symptoms when other measures of sleep quality are relatively normal, and vice versa.

## Conclusion

Figure 1: Example of arousal with different intensity scales in the same patient [2].

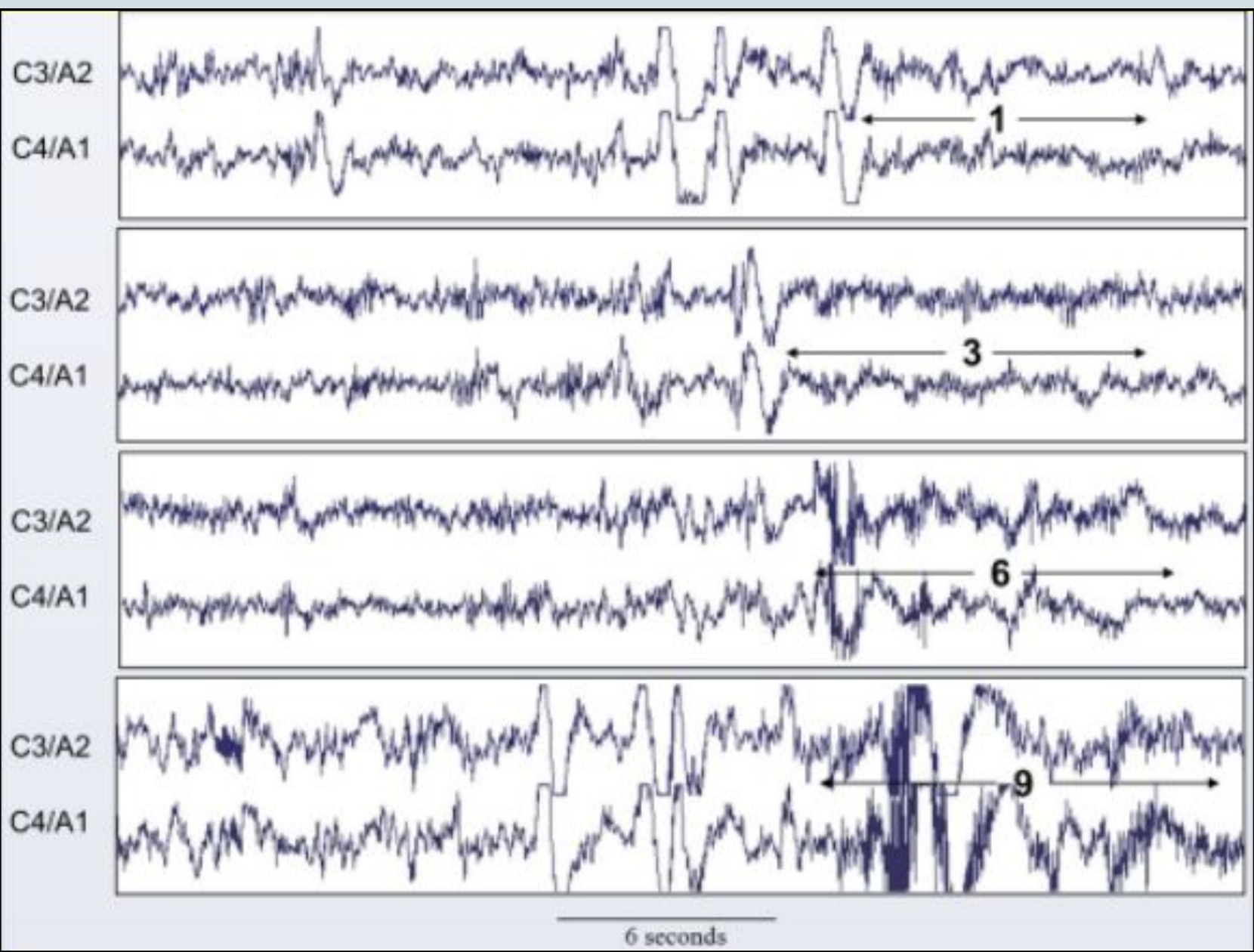


Table 1. Characteristics of RLS patients (n= 12)

Characteristics	Patients
Age (yrs) Mean (SD) Range	53.7 (8.6) 36-64
Sex (n [%]) Female Male	6 (50.0) 6 (50.0)
Weight (lb) Mean (SD) Range	171.2 (22.4) 98-188
IRLS Score Mean (SD) Range	27.3 (6.4) 1-24

Table 2. Objective and subjective sleep parameters of patients with RLS (n= 12)

Mean ± SD	
PSG parameters	
LSO, minutes	47.3 ± 26.9
TST, minutes	375.5 ± 62.8
WASO, minutes	98.4 ± 53.4
NAASO	31.4 ± 10.7
Sleep efficiency, %	77.0 ± 12.0
Arousal index [/hr]	31.6 ± 11.9
PLMI [/hr]	50.8 ± 40.8
PLMAI [/hr]	9.2 ± 8.3
PLM associated arousal scale	3.3 ± 0.6
MOS-SS	
Sleep Disturbance	73.3 ± 12.5
Sleep Somnolence	43.9 ± 18.1
Sleep Adequacy	32.5 ± 17.1
Sleep Problem Index 2	59.4 ± 8.2
Sleep quantity (hrs)	5.0 ± 1.2

Figure 2: Correlation between arousal scale and objective TST in patients with RLS

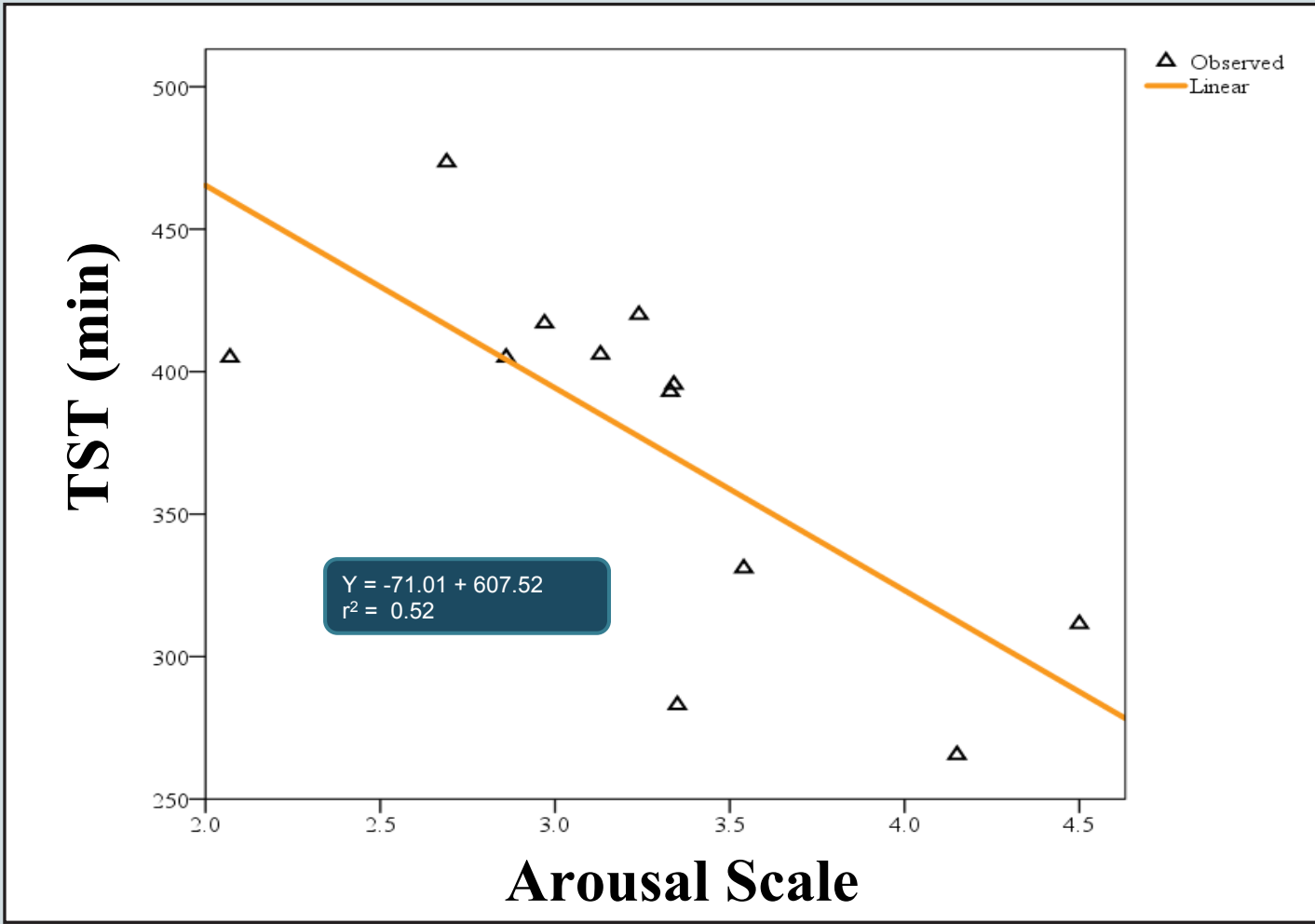
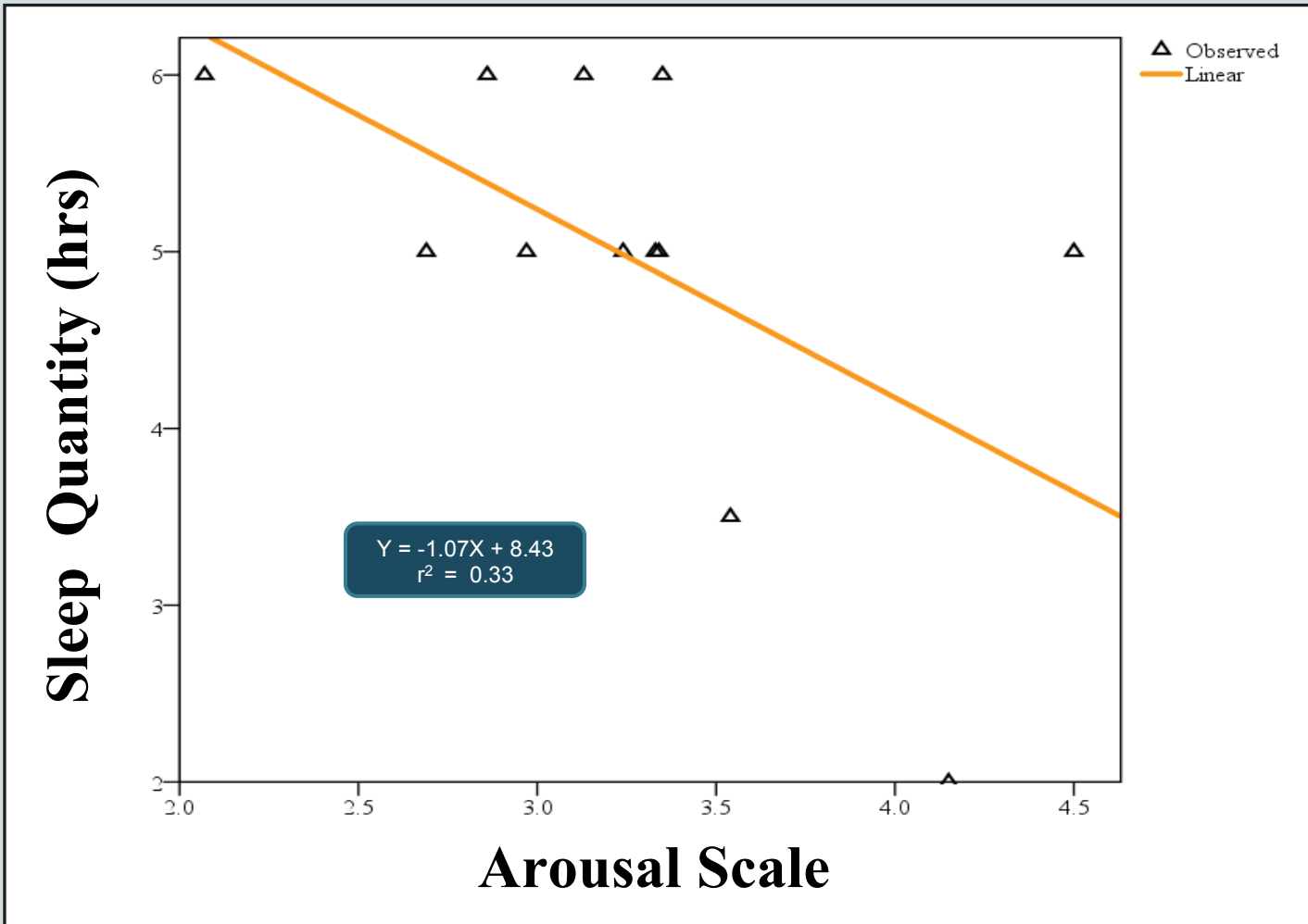


Figure 3: Correlation between arousal scale and sleep quantity (MOS-SS) in patients with RLS



## References

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