Stationarity during REM sleep in Old Adults

(Nombres y grados académicos)

Introduction

Rapid Eye Movement (REM) sleep exhibits electroencephalographic low voltage, mixed frequencies, muscular atonia and REMs.
When quantitative analyses of the signals are carried out, usually, non-linearity and non-stationarity are assumed without an adequate analysis, especially in Old Adults (OA). Weak stationarity is found to be statistically less present on EEG records during REM sleep, compared to NREM. Graphical representation of stationarity revealed some patterns, which are possibly...

Methods - Subjects

Nine Old Adults (OA) [age: 67.3 ± 5.5; education: 8.8 ± 2.6) without depression neither anxiety and with intact daily living activities were selected. Also, evaluations with the Mini-Mental State Examination (MMSE, 28.1 ± 1.8) and a one night polysomnography were performed. 30 second epochs were classified according to the AASM[] and every epoch of W, NREM and REM sleep was subjected to PSR tests (below).

Priestley-Subba Rao (PSR) test

Stationarity (in the wide sense) implies a process' mean, variance and autocorrelation function doesn't depend on time.
The test introduced by Priestley and Subba Rao to detect non-stationarity[], estimates the spectral density function (SDF) and then tests the hypothesis "SDF doesn't vary over time" --which is equivalent to nonstationarity.
Percentages of stationary epochs were calculated with respect to each stage, and Wilcoxon t-tests were used to compare them.

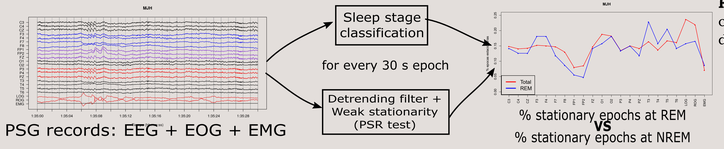


Figure 1: Diagram of the method. (Left) PSG register of one epoch, for one OA. (Center) REM sleep is detected by AASM standards, weak stationarity is detected using PSR test. (Right) Comparision of percentaje of stationary epochs at REM (blue) and NREM (red), for one OA.

Results

These differences reached significance in CZ, F7, F8, Fp1, Fp2, O2, P4, LOG and ROG.

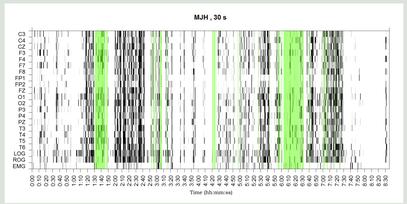


Figure 2: Distribution of the PS epochs (black) for one single subject. REM sleep is shown in green.

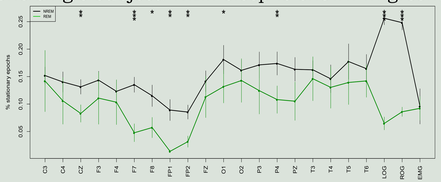
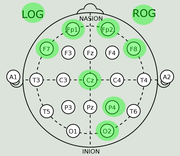


Figure 3: Mean ± 1 standar deviation, for the percentage of stationary epochs, calculated over REM and NREM. Asterisc represent level of acceptance for differences found using paired Wilcoxon t-test (*=0.1, **=0.05, ***=0.01).



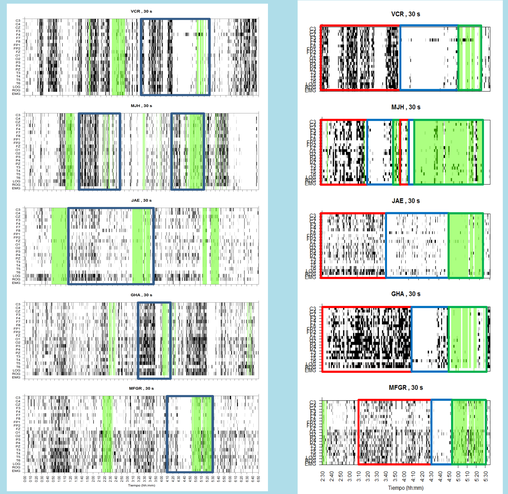


Figure 4: (Left) Distribution of stationary epochs for 5 OA, highlighting a vague consistent pattern, which is asociated with REM sleep. (Right) Zoom over the patterns showing details of it: a 'block of stationarity' [red] a 'blank' [blue] and a block containing REM sleep [geen]

Discussion

When the epoch length is changed, the results of this analyssis vary dramatically. This effect could be explained if the PSG records are locally stationary: is nonstationary by definition, but small samples are most likely stationary.

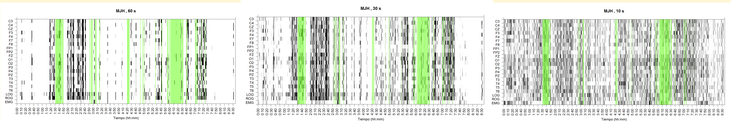


Figure 5: kStationary epochs distribution for one OA using different epoch lengths: 60 s, 30 s, 10 s

Conclusions

In Old Adults, REM sleep showed lower proportions of epochs with weak stationarity compared to W and NREM sleep at anterior areas, a result that could be explained by the tonic and phasic REM sleep. The graphic method described seems to be a suitable way to detect REM sleep in OA.

Aknowledgements

References

> R. B. Cleveland, W. S. Cleveland, J. E. McRae, I. Terpenning. STL: A seasonal-trend decomposition procedure based on loess. Journal of Official Statistics, 6:3–73, 1990.
> M. B. Priestley. Spectral Analysis and Time Series, volume 1,2. Academic Press,1981.
> M. B. Priestley and T. S. Rao. A test for non-stationarity of time-series. Journal of the Royal Statistical Society: Series B (Methodological), 1(31):140–149, 1969.
> Rosales-Lagarde A., Yolanda-del-Río-Portilla I., Guevara M., Corsi-Cabrera M. Caída abrupta del tono muscular al entrar a sueño MOR en el ser humano. Salud Mental. 2009; 32(2): 117-123