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Rapid Eye Movement (REM) sleep exhibits low voltage, mixed

frequencies, muscular atonia and REMs [4]. 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). The aim of this research was to

compare the proportion of stationarity of REM sleep vs non-REM

(NREM) sleep and wakefullness (W) using the Priestley-Subba

Rao (PSR) test. We also explore if this tool can be used to detect

the traditional indicators of sleep stages along the sleep

recording, focusing especially in REMs of REM sleep.

Five Old Adults (OA) [age: 68.2 ± 7.2; education: 9.2 ± 2.7] without

depression neither anxiety and with intact daily living activities

were selected. Also, evaluations with the Mini-Mental State Exami-

nation (MMSE, 29.4 ± 0.9) 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 filtered with

STL algorithm [1] and then subjected to PSR test (below).

The test introduced by Priestley and Subba Rao to detect non-

stationarity [2,3], estimates the spectral density function (SDF) and

then tests the hypothesis ''SDF does 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. PSG of one 30 s epoch, for one OA (Left). REM sleep is de-

tected by AASM standards and weak stationarity is detected using PSR test (Center). Compa-

rison of percentaje of stationary epochs at REM (green) and NREM (black), for one OA (Right).

Figure 2: Distribution of stationary epochs (black) over time,

for one OA. REM sleep is shown in green.

Figure 3: Mean ± 1 standar deviation (Left), for the percentage of stationary epochs calculated over REM

and NREM sleep. Asterisc represent significative differences found using paired one-tailed Wilcoxon t-test.

Diagram representing the zones where significant differences were found (Right).

The PSR test effectively showed different proportions

of stationary epochs, accoring to the classification of

REM sleep stages in each subject. In Figure 2, for one

OA, stationary epochs are shown in black and the

classification of REM sleep is shown in green. Clearly,

a lower proportion of stationarity was found in REM

sleep vs the other stages. These differences reached

significance in C3, C4, CZ, F7, Fp1,

LOG, ROG (p<0.05, Figure 3)

Figure 4: Distribution of stationary epochs for all 5 subjects, highlighting the found pattern which is asociable with REM sleep. (Up) Epochs corresponding to the full-night recordings. (Down) Zoom over the patterns,

highlighting details of them: a 'block of stationarity' [red] a 'blank' [blue] and a block containing REM sleep [green]

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.

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