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## Neural Resilience in Centenarians: Electroencephalography Insights into Decelerated Neurophysiological Brain Aging

Centenarians offer a unique model for exploring successful ageing. By investigating their electroencephalographic (EEG) profiles, this study aims to elucidate the neural underpinnings of cognitive resilience and preserved brain function despite advanced chronological age.

A total of 150 participants were recruited and divided into five groups: Young subjects (n=30, age=30.03±4.23years, MMSE=29.63±0.72), Adults (n=30, age=51.47±6.27years, MMSE=29.27±1.14), Elderly individuals (n=30, age=69.63±5.04years, MMSE=28.27±2.02), Centenarians (n=30, age=100.5±3.6 years, MMSE=13.50±7.20) and patients with AD (n=30, age=69.57±.46, MMSE=21.90±2.95). Eyes-closed resting-state EEG recordings were acquired using 27 electrodes. EEG signals were processed to compute the power spectral density (PSD) across seven frequency bands delta (2–4 Hz), theta (4–8 Hz), alpha 1 (8–11 Hz), alpha 2 (11–13 Hz), beta 1 (13–20 Hz), beta 2 (20–30 Hz), and gamma (30–45 Hz). Statistical analyses, pairwise t-tests and regression analysis, were performed to compare the topographical distribution of spectral power among the groups.

The research demonstrates that Centenarians have an EEG signal more similar to Elderly than expected, even if difference between the mean age of the two groups is approximately 30 years. Centenarians EEG signal was expected to progressively approach AD one, but surprisingly they seem to slow down their ageing and maintain non-pathological and resilient brain patterns, particularly in Alpha 1 and Alpha 2 frequency bands. In these bands, Centenarians PSD in occipital region has lower values than Young and Adults but not than Elderly, and higher values than AD subjects.

The unique EEG characteristics observed in centenarians indicate preserved neural function and cognitive resilience, supporting the concept of decelerated neurophysiological ageing. These insights highlight the potential of EEG biomarkers in understanding and promoting healthy brain ageing.

**Keywords:** Ageing, Centenarians, Electroencephalography (EEG), Power Spectral Density (PSD), Regression Analysis.

**Biography**

Since 2013, Professor Fabrizio Vecchio has been the head of the Brain Connectivity Laboratory. He is a biomedical engineer with expertise in neurophysiological assessment and human performance, and has conducted extensive research on the application of physiological measures-particularly EEG recordings-in various settings.

He is also an Associate Professor of Physiology at eCampus University and the author of over 180 peer-reviewed manuscripts (more than 60 as first or senior author). He has an h-index of 55 (Scopus) and has been invited to numerous national and international symposia and research groups, many of which he also helps organize and lead. Throughout his career, he has focused on identifying neurobiomarkers of physiological and pathological conditions through innovative algorithms based on connectivity and complexity analysis.

