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A simple and cost-effective qEEG evaluation shows marked differences between early Alzheimer's disease patients and controls

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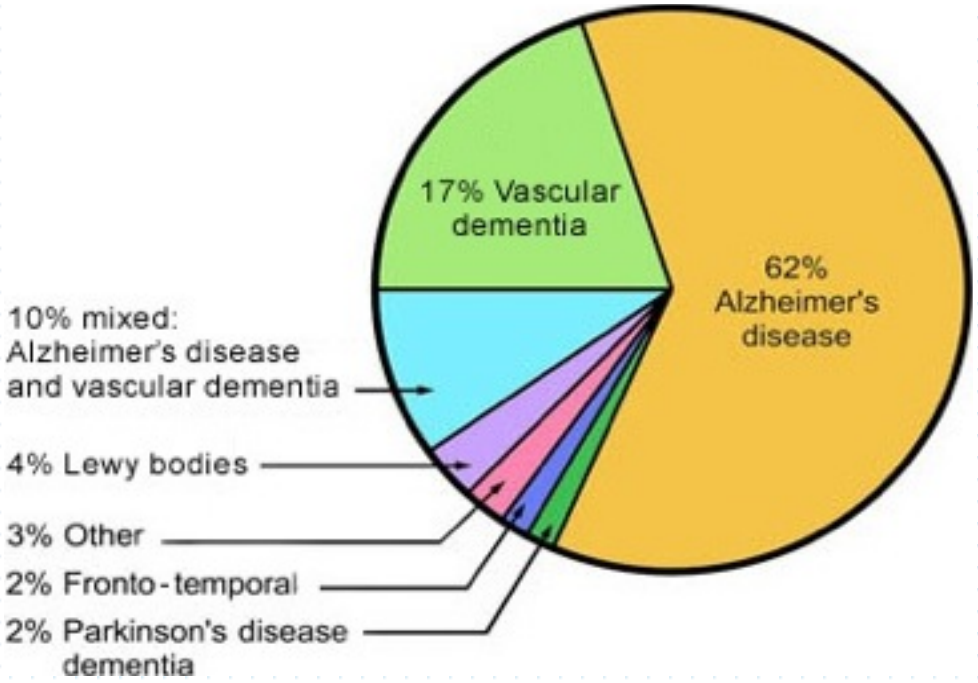
CONTENT

ALZHEIMER'S DISEASE

- 2006 - 26.6 million cases worldwide.
- 2050 - 106.8 million individuals.
- Prevalence doubles for each 5-year increase in age.
- 16.7% to 43% older than the age of 85 years meets criteria for AD.



Due to population ageing prevalence of Alzheimer's disease is expected to rise, therefore early diagnosis is paramount.

http://healthcaredir.com/category/brain/

WHY DO EARLY DIAGNOSIS OF AD?

NOW:

- for the patient and his family to prepare and plan for the future needs and care of the patient,
- to ensure prescription of symptoms-delaying medications when they are most useful,
- to allow prompt treatment of psychiatric symptoms (depression, psychosis),
- to decrease the societal cost of the disease, by preserving patient's independence longer and preparing families for the needs of AD patients.

FUTURE (when disease modifying treatments become available)

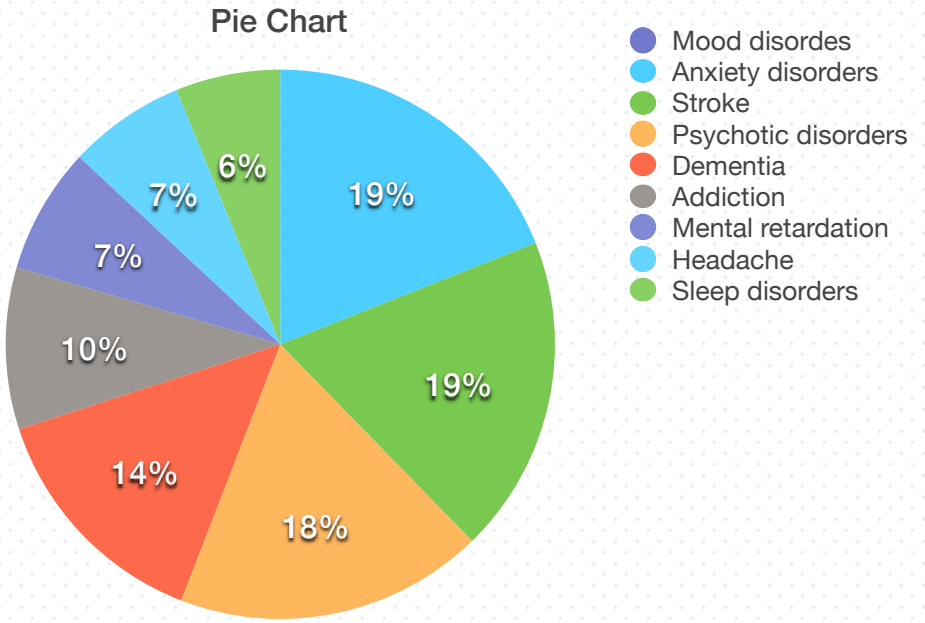
- to treat the disease at a nascent stage, before the patient suffers permanent brain damage

DISORDERS OF THE BRAIN AND ECONOMIC BURDON

Cost of disorders of the brain for Slovenia was estimated at €2,425 billion in 2010

The cost (in million €PPP for 2010) of the disorders of the brain:

Brain disorders	cost
Mood disordes	289
Anxiety disorders	285
Stroke	277
Psychotic disorders	215
Dementia	195
Addiction	145
Mental retardation	113
Headache	105
Sleep disorders	94



(J., B., B., K., et al. ,2013)

WHY CONSIDER EEG AS BIOMARKER for AD ?

- Non-invasive,
- simple in design and implementation,
- uncomplicated to use,
- relatively inexpensive (compared to MRIs, FDG-PET scans)
- and potentially mobile brain imaging technology with high temporal resolution.

SOME REPORTED EFFECTS OF AD ON EEG:

- slowing of the EEG,
- reduced complexity of the EEG,
- perturbations in EEG synchrony.

(Jeong, 2004)

Objective:

Can qEEG distinguish between AD patients and healthy subjects?

- Advantages of peak alpha frequency: easy to determine, no special equipment is needed, analysis is simple

Participants:

EEG recordings of **14 patients** with clinically diagnosed early AD and **37 healthy** controls

Group characteristics:

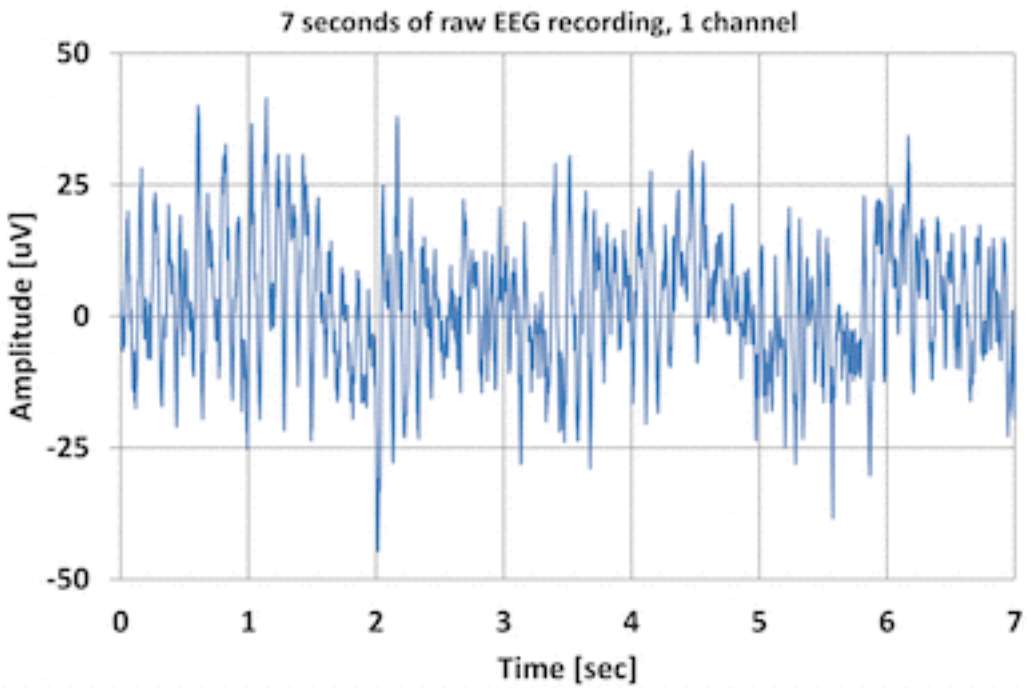
age **60-80**, no Parkinson's disease, MMSE 20-26 (early stage AD), multiple sclerosis, epilepsy, no history of head operations, strokes or heart attacks, no hospitalisation due to head injuries in the past 5-10 years

Methodology

64-channel
Resting state
- Eyes open (EO)
- Eyes closed (EC)

Time: 20 min

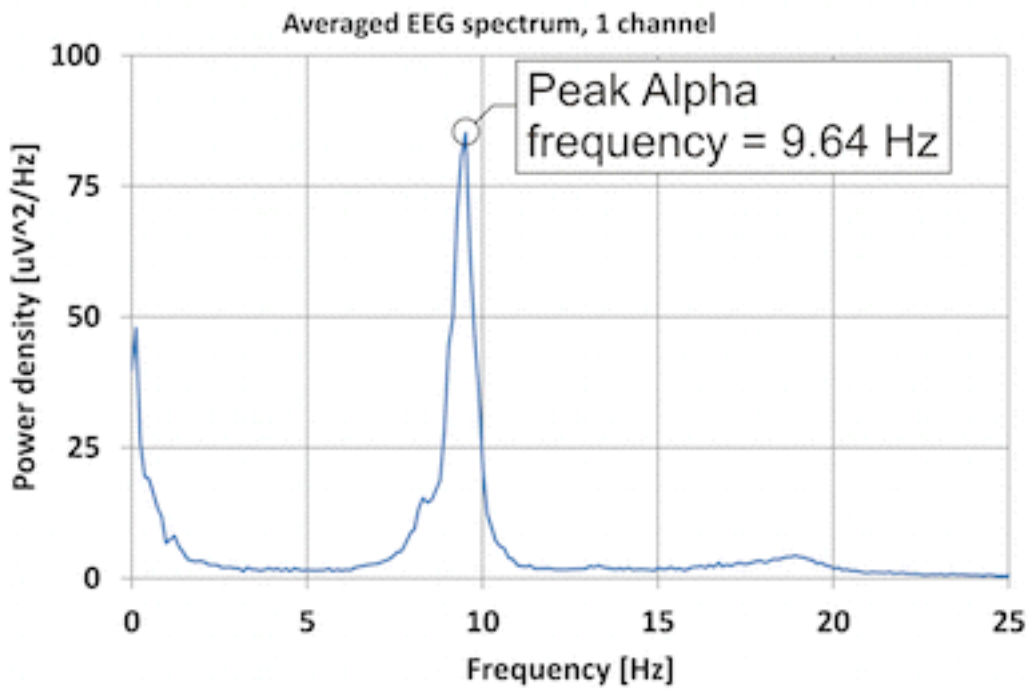
Segmentation: 10min per condition at 500Hz, 100 8-sec segments



Methodology

Segments were FFT transformed and averaged for EO and EC separately.

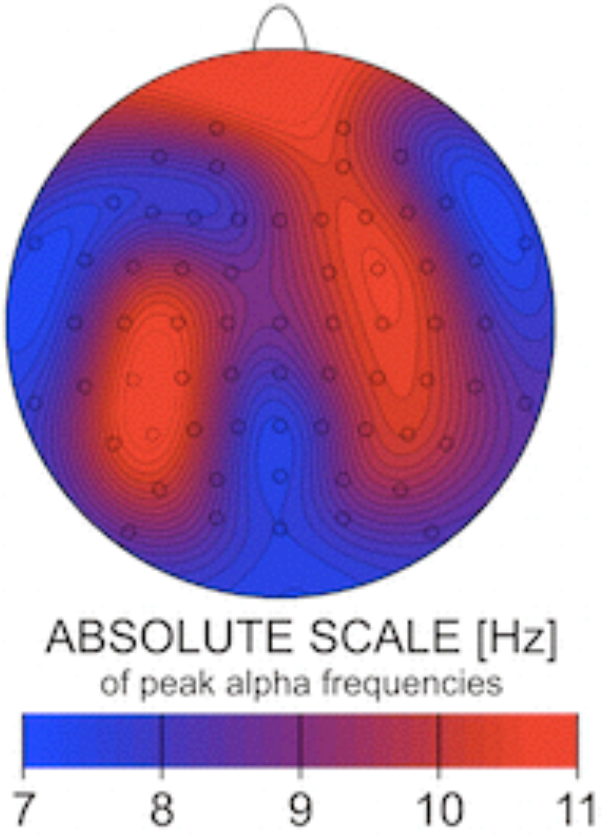
Peak alpha frequency (PAF), the frequency at which the alpha band (7-13 Hz) exhibits largest power, was determined for each channel.



Displaying PAF for all channels on scalp topographies

Comparing groups and conditions

T-test on the results

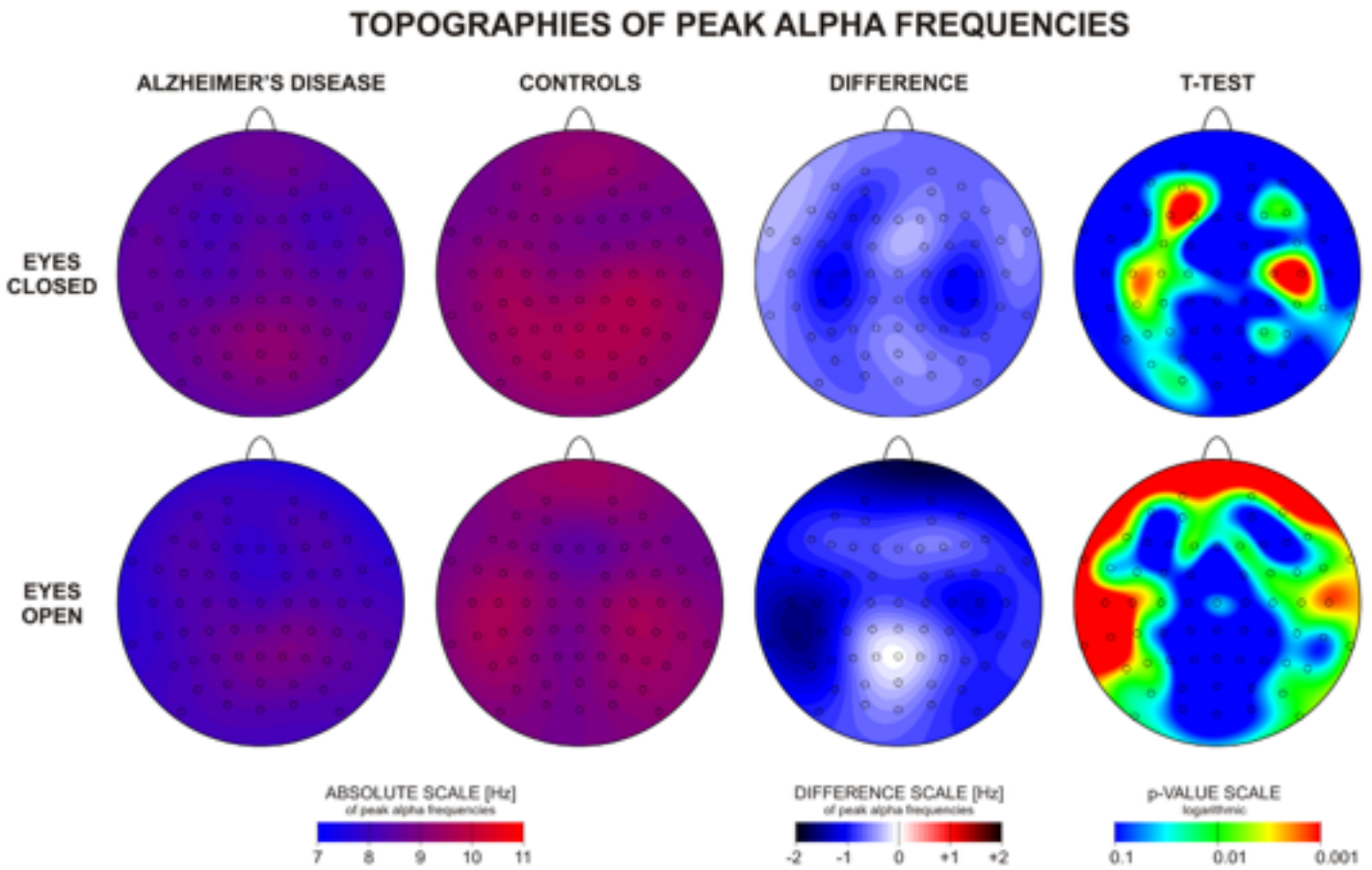


Peak alpha frequencies

Differences are most evident in EO ($p<0.001$) with patients having lower PAF than controls.

In EC slightly less pronounced but still significant ($p<0.01$).

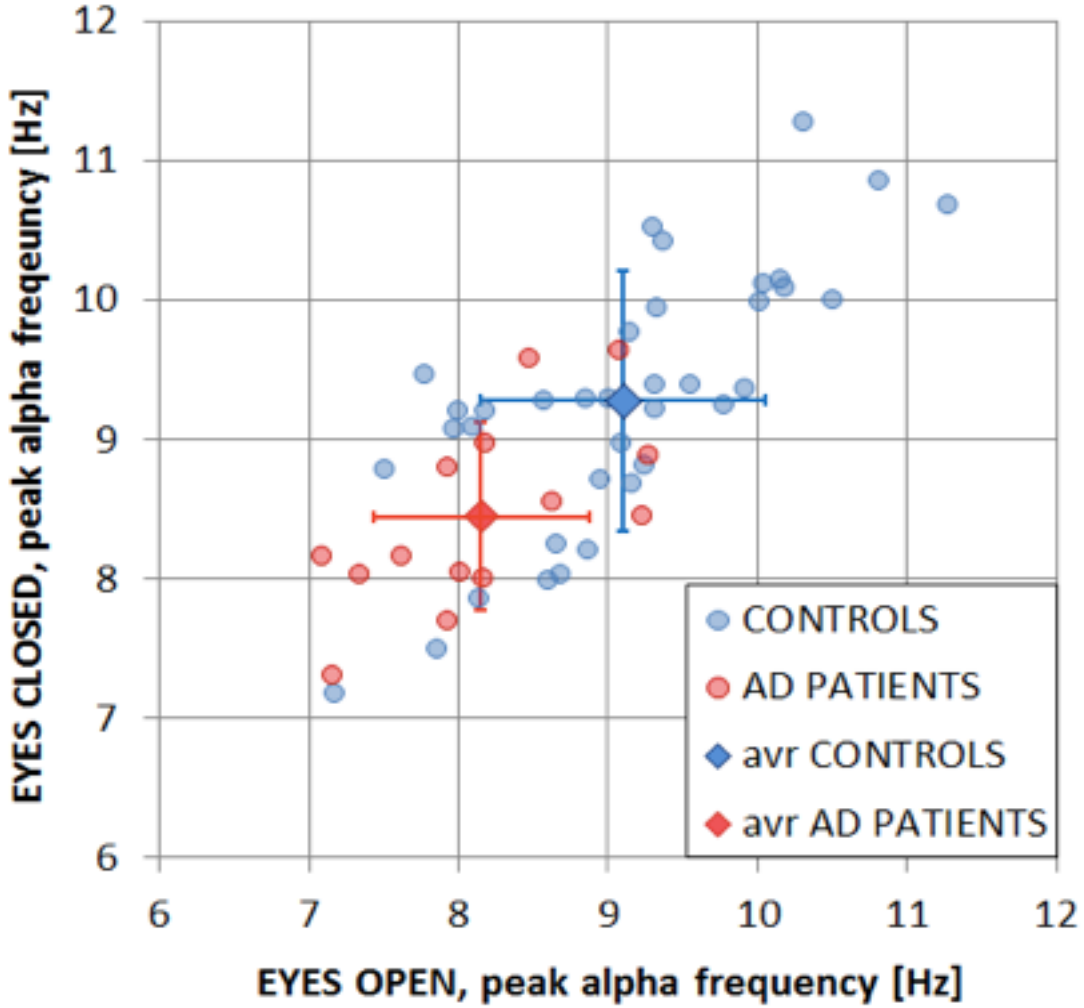
Patients consistently exhibited lower PAF across all scalp regions.



Discriminatory potential?

The ability of our test to discriminate between the two groups.

Effect size (Cohen's d) for
EO = 1.2
EC = 1.0



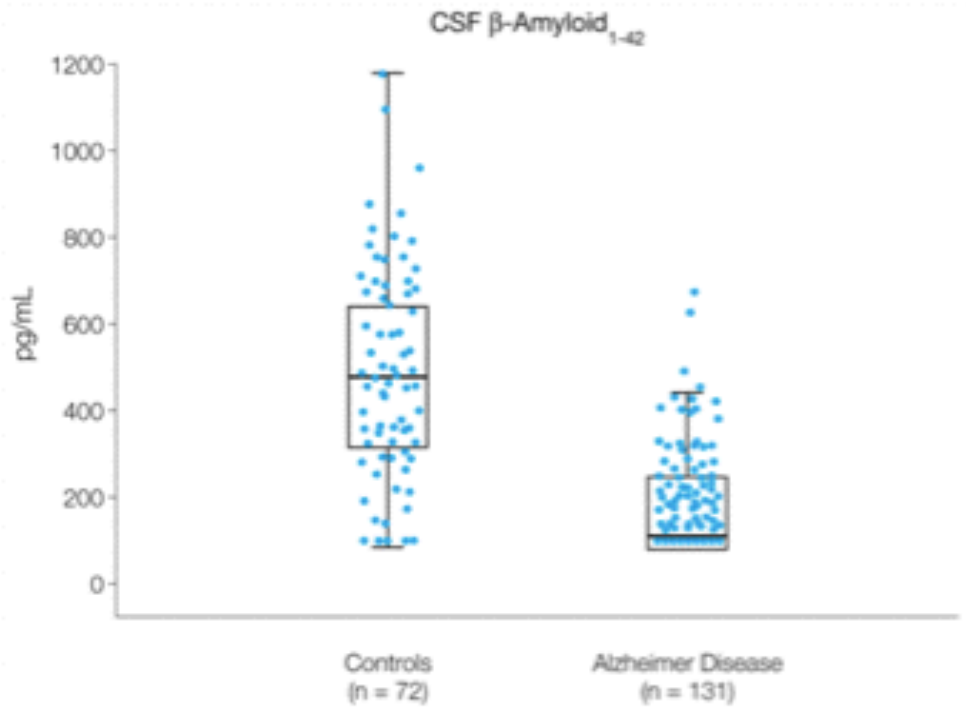
Comparable to commonly used lab test (CSF biomarkers for AD).

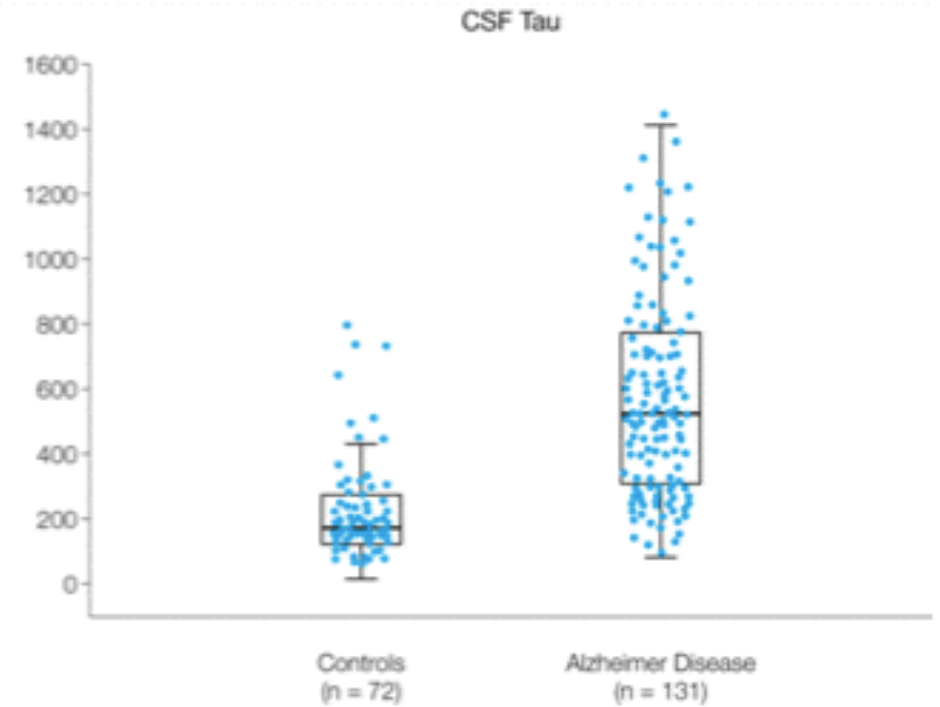
FDG-PET scans and MRIs have an effect size (Cohen's d) between 0.75 to 2.5

The JAMA Network

From: **Decreased β-Amyloid$_{1-42}$ and Increased Tau Levels in Cerebrospinal Fluid of Patients With Alzheimer Disease**

JAMA. 2003;289(16):2094-2103. doi:10.1001/jama.289.16.2094





LIMITATIONS OF CURRENTLY PRESENTED WORK

- Small sample size (N=51)
- Results need replication

However:
- Investigation of other frequency bands
- Inclusion of tasks (auditory and visual oddbal)
- Improved (more discriminating) peak frequency search algorithm
- reducing/excluding muscular noise
- other EEG markers (ERPs, coherence, band power ratios…)

MIGHT IT BE WORTH RE-CONSIDERING qEEG AS ANOTHER POTENTIAL DIAGNOSTIC TEST?

TAKE-HOME MESSAGES

- Significant differences in PAF for both conditions between patients and controls.
- Ability of our test to discriminate between the two groups is comparable to commonly used lab tests (such as CSF diagnostics).
- Cost-effective and non-invasive method

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Thank you for your attention!