UNIVERSITÀ DEGLI STUDI DI BRESCIA

UNIBS DIGITAL NEURO LAB

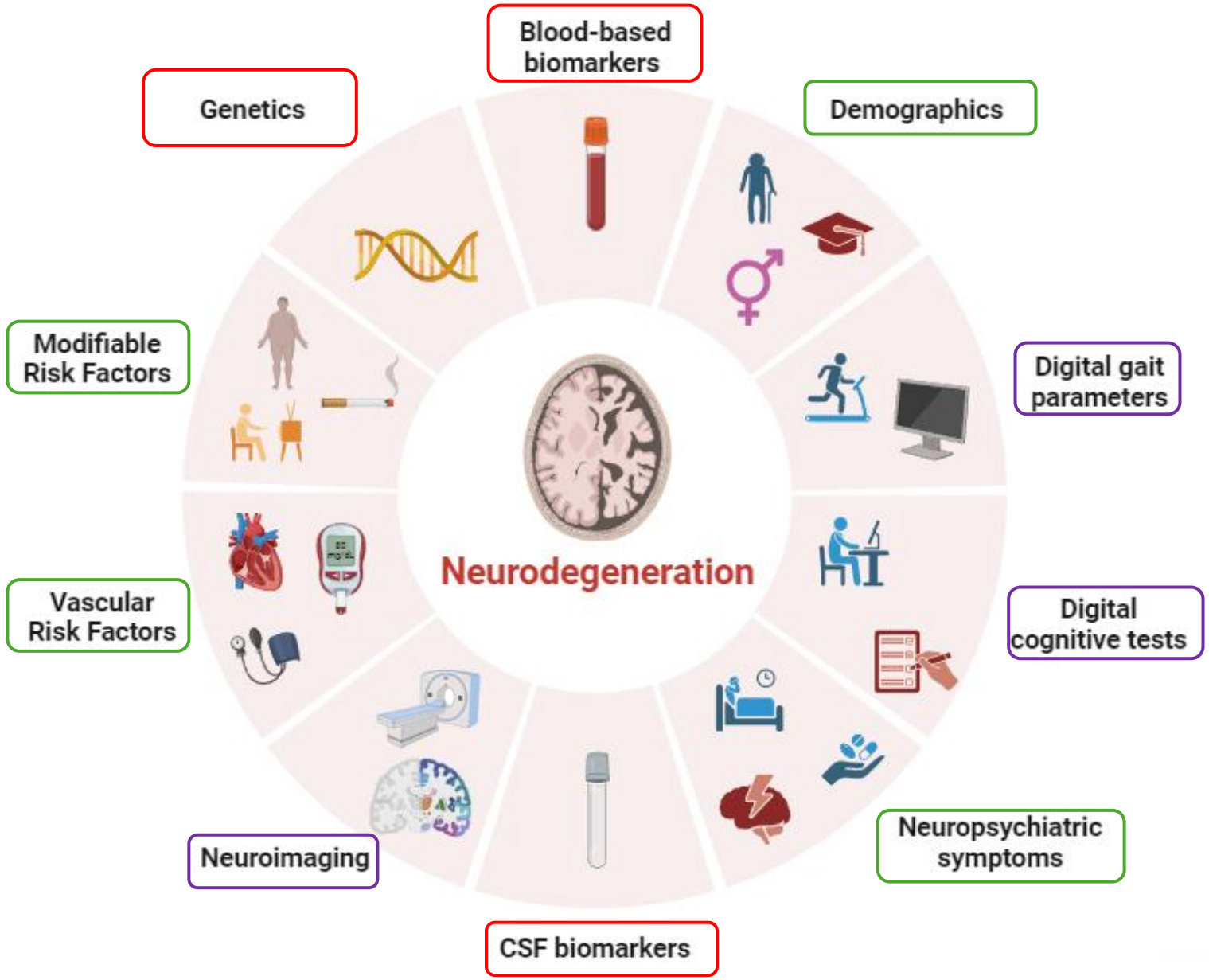
Artificial intelligence application for the individualized multimodal assessment and management of neurodegenerative and neuropsychiatric syndromes

PhD programme in IAMED (XXXIX cycle)

Coordinatore: Prof. Domenico Russo

PhD student: Galli Alice
Supervisor: prof.Andrea Pilotto

Neurodegenerative diseases



Unmet needs

Best combination of multi-modal markers for early diagnosis and prognosis of neurodegenerative conditions.

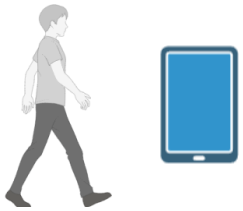
Comprehensive multimodal assessment for early diagnosis and prognosis to better describe vulnerabilities underlying neurodegeneration.

Single-subject markers of vulnerability to neurodegeneration, useful for precision medicine and tailored treatments.

Objectives

1 Evaluate the single-markers construct validity for vulnerability assessment, diagnosis and prognosis.

Clinical assessment



Digital assessment

Neuroimaging

Biological Assessment

2 Evaluate the potential role of multi-modal markers (clinical data, plasma biomarkers, digital assessment, neuroimaging data) in predicting diagnosis and clinical trajectories in well defined cohorts of subjects at risk or patients in the prodromal phases of neurodegeneration.

3 Develop a disease-independent model of normal brain ageing to define degree of vulnerability to neurodegenerative processes at group level.

Methods

Patients with neurodegenerative diseases

Healthy Elderlies

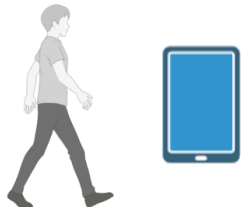
INCLUSION CRITERIA	
Patients	***Healthy Elderlies***
Age >55 y	
Absence of other neurological conditions	Absence of neurological diseases
Availability of at least clinical, biological and imaging assessment	
Absence of brain tumours	

Methods

DATA HARMONIZATION AND PATIENTS RECRUITING

MULTIMODAL ASSESSMENT

Clinical assessment



Digital assessment

Neuroimaging

Biological Assessment

Methods

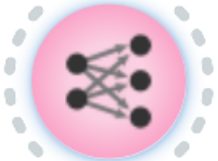
1. **Data pre-processing**

Imputation of missing values

Data scaling

2. **Model selection and implementation**

Support Vector Machine



Artificial Neural Network

3. **Model evaluation**

Prediction evaluation

Feature importance

Study 1 – Digital cognitive assessment

Neurological Sciences (2025) 46:697–704
https://doi.org/10.1007/s10072-024-07775-3

ORIGINAL ARTICLE

Validation and convergent validity of the Boston cognitive assessment (BOCA) in an Italian population: a comparative study with the Montreal cognitive assessment (MoCA) in Alzheimer's disease spectrum

Alessandro Padovani[1,2,3,4,5] · Salvatore Caratozzolo[1,2,8] · Alice Galli[1,2,3,4] · Luca Crosani[2] · Silvio Zampini[1,2] · Maura Cosseddu[1,2] · Rosanna Turrone[1,2] · Andrea Zancanaro[1,2] · Bianca Gumina[1,2] · Barbara Vicini-Chilovi[1,2] · Alberto Benussi[1,2] · Andrey Vyshedskiy[6,7] · Andrea Pilotto[1,2,3,4]

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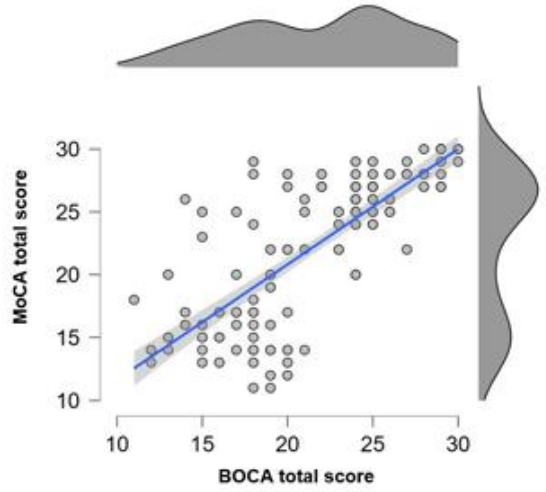


Fig. 1 Correlation between MoCA and BOCA tests. Scatterplot representing the Spearman's correlation between the two tests in the whole sample

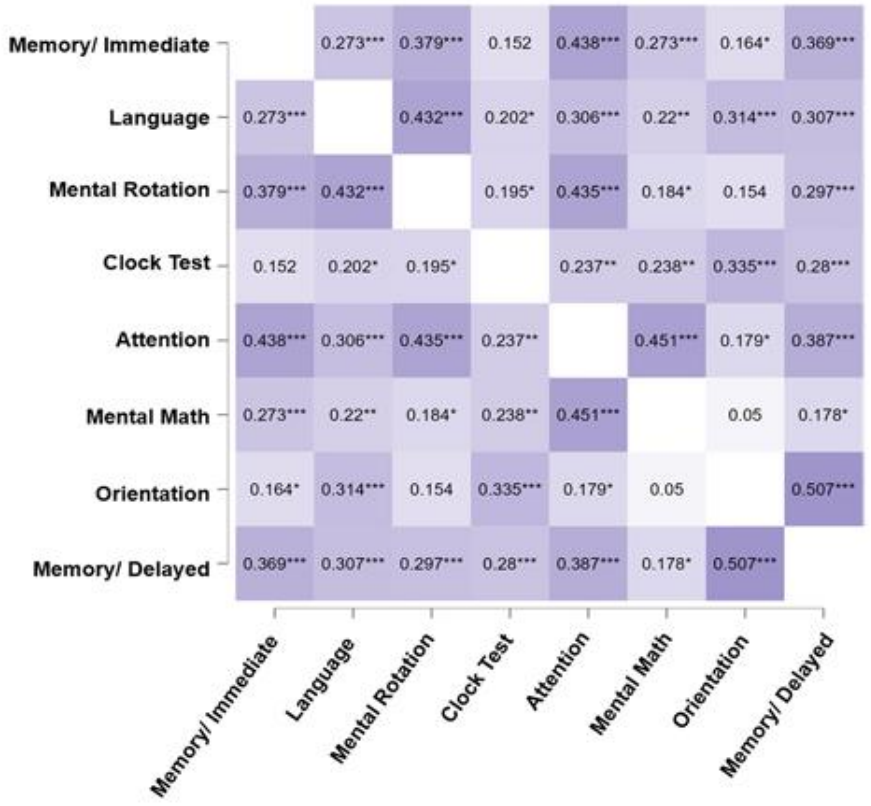


Fig. 2 BOCA subscales correlation matrix. Heatmap representing significant Spearman correlations between BOCA subscales. Darker color represents a stronger relationship between variables. * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$

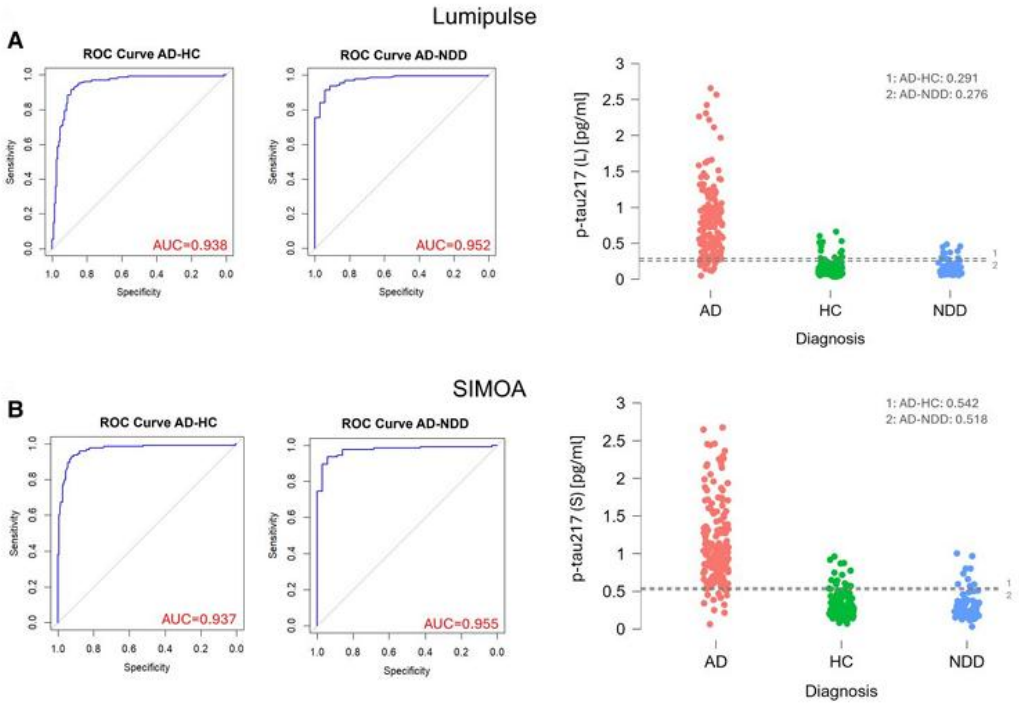
Study 2 – Blood-based biomarkers

https://doi.org/10.1093/brain/awae368 BRAIN 2025: 148; 408–415 | 408

BRAIN REPORT

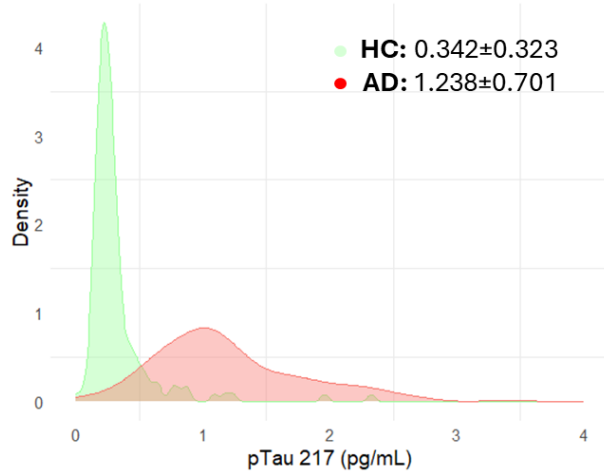
Plasma p-tau217 in Alzheimer's disease: Lumipulse and ALZpath SIMOA head-to-head comparison

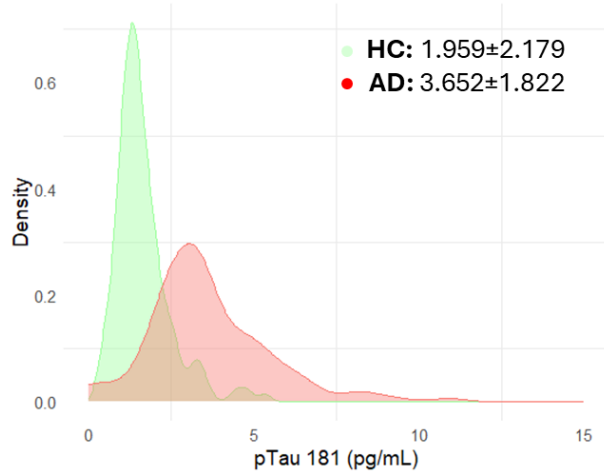
Andrea Pilotto,[1,2,3,†] Virginia Quaresima,[1,2,3,4,5,†] Chiara Trasciatti,[1,2,3,4] Chiara Tolassi,[1,2,3,4] Diego Bertoli,[5] Cristina Mordenti,[5] Alice Galli,[1,2] Andrea Rizzardi,[1,2] Salvatore Caratozzolo,[1,2] Andrea Zancanaro,[1,2] José Contador,[6,7,8] Oskar Hansson,[9,10,11] Sebastian Palmqvist,[9,10,11] Giovanni De Santis,[12] Henrik Zetterberg,[12,13,14,15,16,17] Kaj Blennow,[12,18,19] Duilio Brugnoni,[5] Marc Suárez-Calvet,[6,7,8] Nicholas J. Ashton[12,20,21,22] and Alessandro Padovani[1,2,3,22]



In prep.

At-risk individuals among cognitively healthy elderlies





Study 3a– Imaging markers

In prep.

Molecular Psychiatry www.nature.com/mp

ARTICLE

Check for updates

Dopaminergic deficits along the spectrum of Alzheimer's disease

Andrea Pilotto[1,2,3,4,18], Alice Galli[1,2,18], Arianna Sala[5], Silvia Paola Caminiti[6], Luca Presotto[7], Claudio Liguori[8], Nicola Biagio Mercuri[8], Enrico Premi[9], Valentina Garibotto[10], Giovanni Frisoni[11], Agostino Chiaravalloti[12], Orazio Schillaci[12], Marcello D'Amelio[13,14], Barbara Paghera[15], Silvia Lucchini[15], Francesco Bertagna[15], Daniela Perani[16] and Alessandro Padovani[1,2,3,17]

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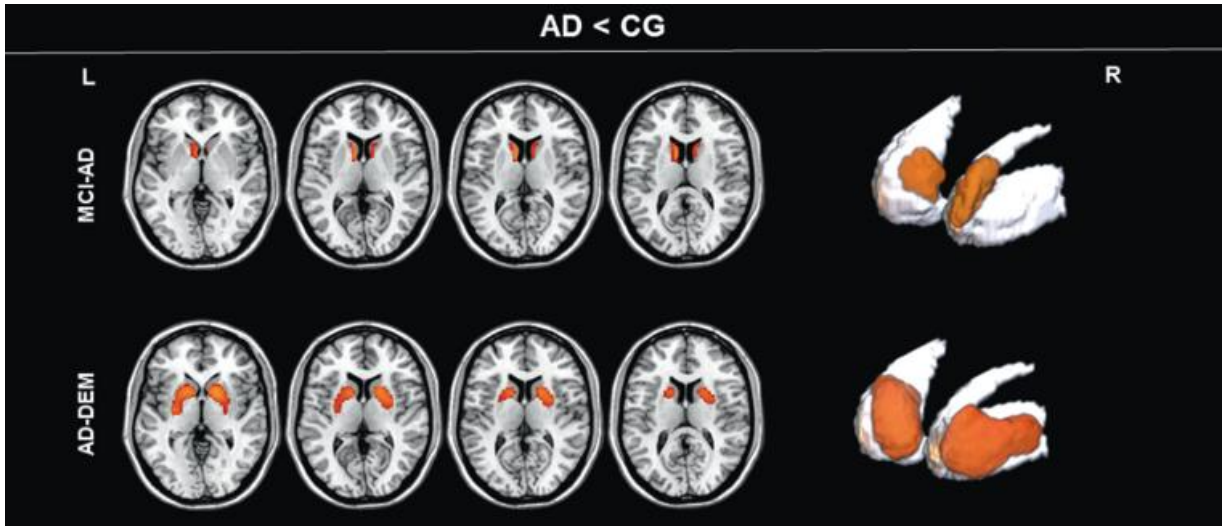
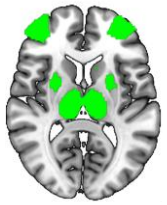
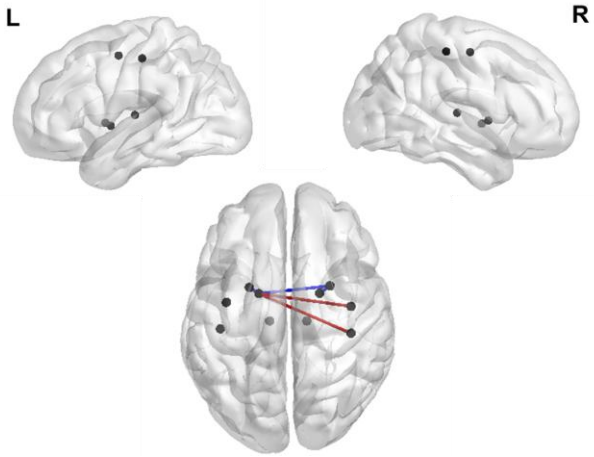
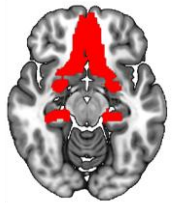


Dopaminergic deficits in AD vs. DLB

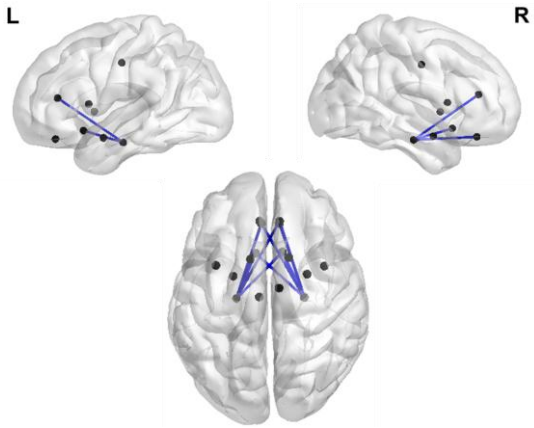


Dorsal Network





Ventral Network

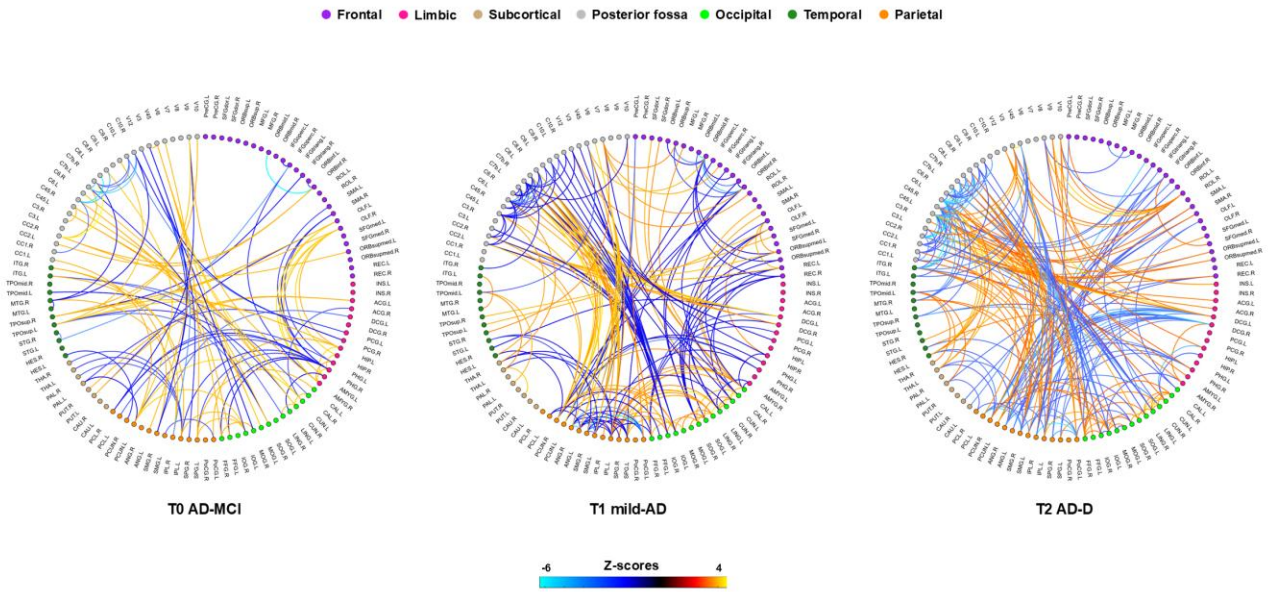


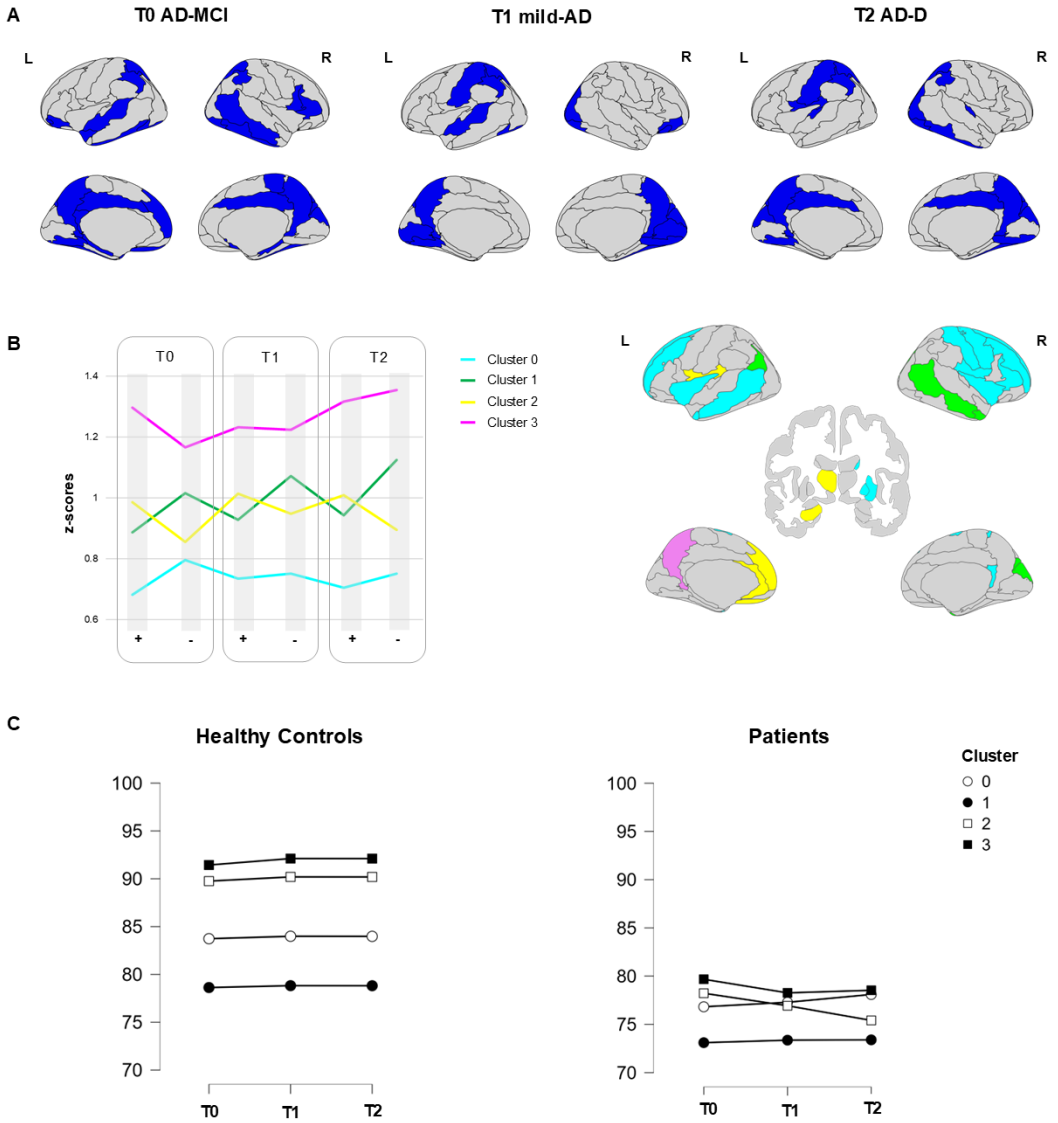
Study 3b– Imaging markers

Major revisions

Longitudinal metabolic rearrangement of brain connectivity along the Alzheimer's Disease progression

Alice Galli[1,2], MSc; Marianna Inglese[3], PhD; Luca Presotto[4], PhD; Rachele Malito[5], MSc; Xin Di[6], PhD; Nicola Toschi[3], PhD; Andrea Pilotto[1,2], MD; Alessandro Padovani[1,2], MD, PhD; Cristina Tassorelli[7,5], MD, PhD; Daniela Perani[8], MD; Arianna Sala[9], PhD; Silvia Paola Caminiti[7,*,#], PhD





Study 4– Vulnerability to neurodegeneration

Submitted

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DOI: 10.1002/alz.14556

Alzheimer's & Dementia®
THE JOURNAL OF THE ALZHEIMER'S ASSOCIATION

RESEARCH ARTICLE

The role of insulin resistance and *APOE* genotype on blood–brain barrier integrity in Alzheimer's disease

Alessandro Padovani[1,2,3,4,5] | Alice Galli[1,2,3,4] | Elena Bazzoli[6] | Chiara Tolassi[1,2,3] | Salvatore Caratozzolo[1,2] | Bianca Gumina[1,2] | Alberto Benussi[1,2] | Ilenia Libri[1,2] | Tiago Fleming Outeiro[7,8] | Andrea Pilotto[1,2,3,4,5]

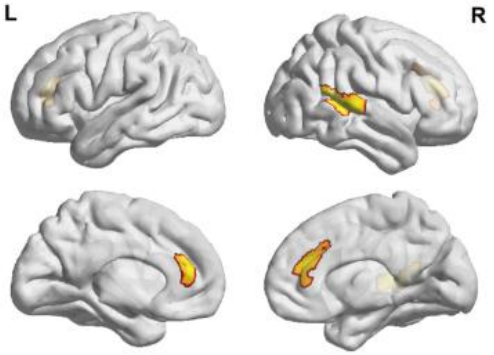
Diabetes impact on nigrostriatal vulnerability in Parkinson's Disease

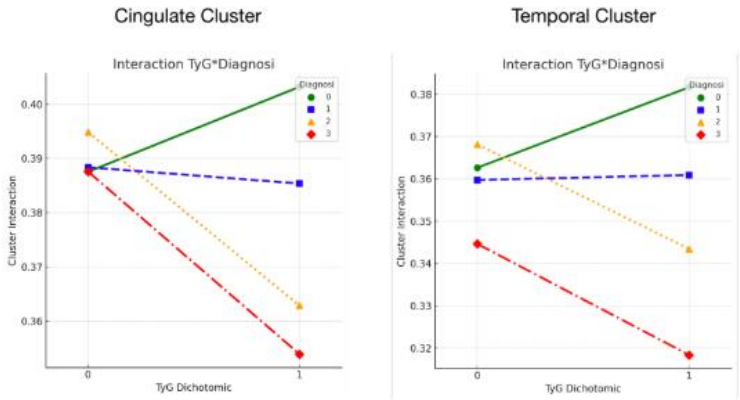
Alice Galli,[1,2] Cinzia Zatti,[1-3] Alessandro Lupini, [1,2] Silvia Paola Caminiti, [4] Andrea Rizzardi,[1,2] Silvia Lucchini, [5] Francesco Bertagna, [5] Barbara Paghera, [5] Tiago Fleming Outeiro, [6-8] Daniela Perani, [9] Alessandro Padovani[1,2,10†] and Andrea Pilotto[1-3†].

†These authors contributed equally to this work.

In prep.

Insulin resistance and brain atrophy in AD





What's next?

1 DATA HARMONIZATION AND PATIENTS RECRUITING

1. Description of **risk factors**
2. Impact of **neuropsychiatric symptoms** on neurodegenerative diseases
3. Use of digital assessment tools

2 SINGLE MULTIMODAL MARKERS EVALUATION

1. Single-markers construct validity
2. Data-driven approaches to stratify patients (e.g., cluster algorithms, machine learning)

3 AI-MODEL IMPLEMENTATION

1. Implementation of AI to deal with data complexity
2. Single-subject multimodal assessesment able to stratify patients