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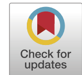
Data Article

Dataset on neuropsychological profile and microbiota composition in cognitively unimpaired elderly and Alzheimer's patients



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A R T I C L E I N F O

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A B S T R A C T

This article presents data collected from a total of 50 older adults (25 healthy controls and 25 diagnosed with Alzheimer's disease). Among the assessments performed in this sample was a comprehensive neurocognitive screening: including working memory, cognitive flexibility, perception, attention, motor coordination, inhibitory control, verbal fluency and visuo-spatial skills. The data presented also include analysis of the participants' gut microbiota using the shot gun approach in faecal samples. Finally, evaluations of the emotional state, level of functioning and adherence to the Mediterranean lifestyle of all participants are also available. Despite the limited sample size due to challenges in patient recruitment, present data could be useful in the identification of microbial signatures potentially predictive of cognitive decline or AD progression and also for helping to the design of clinical trials targeting the microbiome to assess

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effects on cognitive function. Furthermore, it is well known that the gut microbiota exhibits significant variability associated with lifestyle habits, diet, and geographic location, underscoring the critical influence of environmental and cultural factors in shaping its composition. These data are of utmost importance when considering regional and lifestyle-related diversity in microbiome research, as they can help researchers explore personalized therapeutic approaches and enhance participant stratification in future clinical trials.

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Specifications Table

Subject	Health Sciences, Medical Sciences & Pharmacology
Specific subject area	Relationship between microbiota and dementias.
Type of data	Data format: Raw Tables (.xlsx format)
Data collection	Data were collected through assessment interviews and stool sample collection in 25 Alzheimer's patients and 25 healthy controls. The participants are referred from different health centres in the province of Tarragona (Catalonia, Spain). The interviews included the assessment of cognitive functioning, emotional state, level of functionality, as well as the level of adherence to the Mediterranean diet and lifestyle. All neuropsychological tests and questionnaires were administered in the same order to avoid unexpected sources of variability. Gut microbiota was analysed using a shotgun metagenomic approach.
Data source location	Country: Spain, Region: Catalonia
Data accessibility	Repository name: Mendeley Data Data identification number: 10.17632/jpxfdj8wfr.1 Direct URL to data: https://data.mendeley.com/datasets/jpxfdj8wfr/1
Related research article	Mateo, D., Carrión, N., Cabrera, C., Heredia, L., Marquès, M., Forcadell-Ferreres, E., Pino, M., Zaragoza, J., Moral, A., Cavallé, L., González-de-Echávarri, J. M., Vicens, P., Domingo, J. L., and Torrente, M. (2024). Gut Microbiota Alterations in Alzheimer's Disease: Relation with Cognitive Impairment and Mediterranean Lifestyle. Microorganisms, 12(10), 2046. https://doi.org/10.3390/microorganisms12102046.

1. Value of the Data

- These data provide empirical evidence linking gut microbiota composition with cognitive performance in both healthy individuals and Alzheimer's disease (AD) patients.
- These data can facilitate the identification of microbial signatures potentially predictive of cognitive decline or AD progression.
- Present dataset can help the design of clinical trials targeting the microbiome to assess effects on cognitive function.
- Finally, since the composition of the microbiome is highly influenced by lifestyle, this dataset allows for analyses within the Mediterranean lifestyle.

2. Background

The data presented in this article complement a previously published study that explored gut microbiota (GMB) composition and cognitive function in Alzheimer's disease (AD) patients,

within the context of a Mediterranean lifestyle (ML). The study employed a case–control design and shotgun metagenomics [1]. As is well known, AD is a neurodegenerative disorder characterized by progressive cognitive decline, amyloid-β plaques, and tau neurofibrillary tangles [2]. Recent evidence suggests that GMB plays a role in AD pathogenesis through the microbiota–gut–brain axis [3]. Specifically, dysbiosis may increase gut and blood–brain barrier permeability, thereby triggering oxidative stress, neuroinflammation, and Aβ aggregation [4]. Many of the risk factors associated with disease prevention are also linked to the microbiota [5]. One such factor is adherence to ML, which includes the Mediterranean diet, sociability, and rest. Recent studies have shown that ML influences GMB and is associated with reduced AD biomarkers [6]. Therefore, exploring the relationship between microbiota, cognitive function, and lifestyle could help identify early signs of AD and allow for preventive interventions.

3. Data Description

The files associated with this data-in-brief article include:

(1) The raw data on cognitive functioning, emotional state, functional level, and adherence to the ML are provided in an Excel file (Data.xlsx). This file includes six variables related to sociodemographic characteristics and the experimental design: Subject, Sample ID, Group, Sex, Age, Education, Smoking status, Alcohol consumption, and BMI. A codebook is included in a separate sheet within the same file. In addition, this file contains the results obtained in the different tests and questionnaires. Table 1 shows the tests and associated variables included in this file.

Table 1
Tests and related variables included in the dataset.

Test	Variable
Mediterranean Lifestyle Index Interview (MEDLIFE)	Consumption
	Habits
	Physical and Social activity
Barcelona Test II	Personal orientation
	Spatial orientation
	Temporary orientation
	Digit Span forward
	Digit Span backward
	Semantic fluency task
	Formal lexical task
	Construction praxis
	Instrumental activities of daily living
	Basic activities of daily living
	Neuropsychiatric symptomatology
	Complementary neuropsychiatric symptomatology
Free and cued selective reminding test	Free recall first assay
	Total free recall
	Total recall
	Total delayed free recall
	Total delayed free and cued
Mini Mental Examination State	Total score
Trail making test	Part A
	Part B
Memory impairment screen	Total score
Clock drawing test	Total score
Frontal assessment battery	Total score
Cognitive reserve scale	Total score
Abbreviated Boston naming test versión C	Total score
Goldberg	Anxiety scale
	Depression scale

(2) The raw abundance data obtained in each sample for the different taxonomic levels in an excel file (Abundances.xlsx). This file also contains the instructions for associating each sample with the results of the tests and questionnaires in a separate excel sheet.
(3) Excel file containing the numerical coding for each taxonomic level. This file is essential for interpreting the results of the abundance analysis (Taxonomy.xlsx).

The dataset comprises the assessments of 50 participants. Twenty-five healthy controls and twenty-five AD patients.

4. Experimental Design, Materials and Methods

4.1. Experimental design and participants

The study consisted of a comparative design with two analysis groups (healthy controls -HC- and Alzheimer patients -AD-). Participants were recruited from different health centers in the province of Tarragona. Specifically, Verge de la Cinta Hospital, Xarxa Santa Tecla Hospital, Joan XXIII Hospital, and Lerín Neurocognitive Institute. The inclusion criteria were as follows:
For HC group:

1. Aged between 60 and 85 years old.

For AD group:

1. AD diagnosed by neurology service following NIA-AA criteria.
2. Aged between 60 and 85 years old.
3. Global deterioration scale-functional assessment staging (GDS-FAST) of 4-5.

The exclusion criteria for all groups were:

1. Diagnoses or comorbidity with other neurological diseases.
2. Use of antibiotics or corticosteroids in the previous 6 months before providing the stool sample.
3. Illnesses of the gastrointestinal tract.
4. Consumption of large doses of commercial probiotics (greater than or equal to 10^8 CFU per organisms per day).
5. Illiteracy.

The Protocol was approved by the ethical committee of Pere Virgili Institute for Health Research (IISPV, Ref. CEIM: 183/2020) and all participants gave their voluntary participation consent.

4.2. Faecal sample collection and microbiome analysis

Faecal samples were self-collected at home using the Stool Nucleic Acid Collection and Preservation System kit (Norgen Biotek Corporation, Thorold, ON, Canada) three days prior to the assessment interview. Participants stored the kits either at room temperature or refrigerated and brought them to the interview appointment. Aliquots (~500 mg) of each sample were transferred to Eppendorf tubes, frozen, and stored at −80 °C. DNA was extracted using the Fast Stool DNA Mini Kit (Qiagen, Germany), following a prior lysis step involving 200 ± 30 mg of sample in 100–200 μL of nuclease-free water at 95 °C, as per the manufacturer's protocol. DNA concentration and purity were assessed using a Qubit 4.0 fluorometer and the Qubit dsDNA HS Assay Kit (Thermo Fisher Scientific, Waltham, MA, USA). One aliquot per participant was analysed at the Centre for Omic Sciences (COS, Reus, Spain). The gut microbiome was characterized using a shotgun metagenomic sequencing strategy. DNA extraction was performed with the DNA

Prep with Tagmentation kit (Illumina, San Diego, CA, USA; catalog no. 20018705), following the manufacturer's guidelines. Library fragment sizes were evaluated with the Agilent TapeStation system and the High Sensitivity DNA kit (Agilent Technologies, Santa Clara, CA, USA). Libraries with concentrations under 750 pM or fragment lengths outside the 400–600 bp range were excluded from further analysis. Accepted libraries were normalized to 750 pM and sequenced on the Illumina NextSeq 2000 platform, generating paired-end reads of 150 bp (2 × 150 bp). Samples yielding fewer than 7.5 million reads were excluded. Taxonomic profiling of metagenomic reads was performed using Kraken2 [7], mapping the reads against multiple reference databases; unclassified reads were removed from the dataset.

4.3. Neurocognitve assessments

Free and cued selective reminding test (FCSRT): The Free and Cued Selective Reminding Test (FCSRT) is a commonly utilized assessment tool designed to differentiate the various processes involved in new memory formation. It was be developed by Buschke and validated in Spanish population by Peña-Casanova et al. [8]. This test aims to evaluate whether memory deficits impact the consolidation phase by implementing a learning paradigm that encourages deep semantic processing of words. Initially, participants are tasked with categorizing words into predefined semantic groups. Subsequently, these category cues are employed to aid the recall of items that were not retrieved through free recall. This approach allows to discern whether memory impairment arises from issues with consolidation or other influences, such as inattention during the word presentation or difficulties in retrieving previously consolidated information via free recall. The assessment consists of five distinct phases: (1) reading and identifying words, (2) an interference task (counting backward by threes for 20 s to prevent subvocal repetition), (3) free recall, (4) cued recall and (5) a delayed free and cued recall after 30 min. Phases (2) to (5) are repeated three times throughout the learning process.

Trail making test (TMT): The TMT, developed by Reitan, is one of the most widely utilized neuropsychological assessments and consists of two subtests: TMT-A and TMT-B. In TMT-A, participants are instructed to draw a line connecting the numbers 1 to 25, which are randomly arranged on a sheet, in the correct ascending order as quickly as possible [9]. In TMT-B, participants must alternate between numbers and letters while following the alphabetical sequence. The score is measured in seconds taken to complete the task, with longer times indicating poorer attentional capacity. TMT-B is related also with cognitive flexibility and working memory performance.

Orientation, Digit Span (DS), Categorical Evocation Fluency (CEF) and Construction Praxis (CP) from Barcelona test II (BTII): Participants' orientation was evaluated across three domains: personal, spatial, and temporal orientation. This subtest of the BTII assessed not only orientation but also a range of cognitive functions, including short- and long-term memory, perception, attention, environmental awareness, and the ability to cognitively integrate it. The total score ranges from 0 to 120, distributed as follows: personal orientation (0–25), spatial orientation (0–25), and temporal orientation (0–70). The DS is divided into two parts (forward digit and backward digit). Participants are asked to repeat a series of digits in forward order and in reverse order. This subtest measures immediate attention span, immediate memory, vigilance and active processing capacity. The maximum score for the two parts is 9 and 8 respectively. CEF is divided into two parts semantic fluency task (participants were asked to generate words belonging to the category of 'animals' for one minute) and formal lexical task (participants were asked to generate words that initiate with 'p' letter for one minute.). The subtest measure language skills, semantic memory, semantic verbal fluency, phonemic verbal fluency, working memory, and inhibitory control. Finally, in the CP subtest, participants are asked to copy figures. This subtest measures executive functions such as planning and execution, visual-spatial and motor coordination, motor action skills and visual-perceptive recognition. For more complex figures, it also involves constructive problem-solving abilities. The total score of this test is 30 (0–3 for each teen draw). The BTII has been validated in Spanish population by Peña-Casanova [10].

Mini Mental State Examination (MMSE): The Mini-Mental State Examination (MMSE) is one of the most widely used cognitive screening tools for detecting cognitive impairment and dementia. It is a brief, structured instrument that assesses several domains of cognitive function, including orientation, memory, attention, language, and visuospatial skills. The maximum score is 30, with lower scores indicating greater cognitive impairment. The screening test was developed by Folstein. In the Spanish population, a validation of the MMSE was conducted by Blesa et al. [11], focusing on older adults. The study demonstrated high inter-rater reliability (intraclass correlation coefficient = 0.93), as well as strong concurrent validity (r = 0.75).

Memory Impairment Screen (MIS): The Memory Impairment Screen (MIS) is a brief cognitive screening tool designed by Buschke to assess memory function. It has been validated in Spanish population by Böhm et al., [12]. The test employs a four-word memory test utilizing a specific encoding technique, with a scoring range of 0 to 8. The test includes immediate recall, a distraction task, and delayed recall phases. In this study the examiner also provided categorical association for these words. The score is calculated as (free recall x 2) + facilitated recall + 1 (if they were 76 years).

Clock Drawing Test (CDT): The CDT is a widely utilized neuropsychological screening tool designed to assess various cognitive domains, including visuospatial abilities, executive functions, attention, and semantic memory. Individuals are instructed to draw a clock face, place all the numbers, and set the hands to a specific time (11:10). This task requires the integration of multiple cognitive processes, making it effective for detecting cognitive impairments, particularly in dementia [13].

Frontal Assessment Battery (FAB): The FAB is a screening tool that assesses various aspects of executive function developed by Dubois et al., [14]. It consists of six subtests addressed to different functions of the frontal lobes: 1) similarities – abstract, reasoning conceptualization, 2) lexical fluency – mental flexibility, 3) motor series – programming and motor planning, 4) conflicting instructions – resistance to interference, 5) go-no go test – inhibitory control and 6) prehension behaviour – ability to inhibit a response to sensory stimulation. Each subtest is rated from 0 to 3 and total score ranges from 0 to 18. Higher scores indicate better performance.

Cognitive Reserve Scale (CRS): The CRS is a structured instrument developed to quantify cognitive reserve based on lifetime engagement in cognitively stimulating activities. Participants are asked about various domains, including education, occupational complexity, leisure activities, and social engagement, which are considered proxies for cognitive reserve. The maximum score is 25 and it has been validated in Spanish population by León et al. [15].

Abbreviated Boston Naming Test version C (Boston-C): The Boston-C is an abbreviated validated form of the Boston Naming Test, a neuropsychological assessment tool designed to evaluate confrontational word retrieval abilities. It comprises 15 black-and-white line drawings of objects, arranged in order of increasing difficulty. The participants are asked to name the objects and, if the participant is unable to provide the correct name, phonemic cues may be offered to facilitate retrieval. The maximum score is 15, one point for each answer without phonemic cue. This test has been validated in Spanish population by Casals-Coll et al. [16].

4.4. Emotional and functional assessments

Goldberg – Anxiety and Depression Scale (GADS): The GADS is a brief self-administered screening tool developed to detect symptoms of anxiety and depression in primary care and community settings. It comprises two subscales—anxiety and depression—each containing nine binary (yes/no) items, resulting in a total of 18 items. The first four questions of each subscale serve as a screening criterion to determine if the rest of the questions should be attempted. Specifically, if fewer than two of the first four questions are answered affirmatively, the remaining questions of the anxiety subscale should not be answered. In the case of the depression subscale, answering at least one of the first four questions affirmatively is sufficient to proceed with the rest of the questions. This scale measures symptomatology related to anxiety and depression. The total score is 18, one for each question [17].

Neuropsychiatric symptomatology (NS) and Activities of Daily Living (ADL) from Barcelona test II: These scales are applied to the family members in relation to the patients. In the NS, family members are asked about patients' neuropsychiatric symptoms (21 items). It measures the presence and severity symptoms such as depression, anxiety, apathy, disinhibition, among many others. There was also a complementary questionnaire (7 items) addressing specific neuropsychiatric symptoms, including anosognosia and optic ataxia, etc. The total score was 63 (0–3 for each question), and 21 for the complementary questionnaire (0 - 3 each question). In the ADL assessment, family members are asked to provide information about any difficulties or inability to perform these activities in the patients. The scale encompasses three categories: basic activities, instrumental activities, and advanced activities. This scale measures the participants' functional abilities and their level of dependency in daily activities. The total score is 100 (60 for advanced and instrumental activities + 40 for basic activities). These subtests are part of the BTII validated by Peña-Casanova [10].

Life Events Questionnaire (LEQ): The LEQ, developed by Soldevila et al [18], is a Spanish-language instrument designed to assess the impact of significant life events on individuals' psychological well-being. It evaluates the presence and perceived severity of various life events, such as bereavement, job loss, or serious illness, over a specified period. The LEQ is used in research to explore the relationship between life stressors and mental health outcomes, including anxiety and depression.

4.5. Mediterranean Lifestyle (ML) assessment

Mediterranean Lifestyle Index Interview (MEDLIFE): The questionnaire was created to assess adherence to a healthy ML. It was developed following the recommendations of the Mediterranean Diet Foundation's International Scientific Committee in 2010. MEDLIFE is divided into three indices: consumption, habit, and activity. This questionnaire incorporates, in addition to dietary aspects, traditional healthy lifestyle and cultural elements, such as physical and social activities as well as time to rest. The total score is 28 (15 consumption index + 7 habit index + 6 activity index). This scale was developed and validated in Spanish population by Sotos-Prieto et al. [19]. Notably, a more comprehensive consensus definition of the traditional ML was published in 2024 [20]. This definition broadens the concept of ML to include dimensions such as family and community values, spirituality and religious practices and a sense of life purpose -elements which are not fully addressed by the MEDLIFE instrument used in this study.

Limitations

The main limitation of the data described in this article is the sample size. In addition, although the MEDLIFE index used in this study is a validated tool to assess adherence to the ML, it does not fully capture certain dimensions included in recent consensus definitions -such as spirituality, life purpose and community values. These aspects may be relevant for a more holistic evaluation of the traditional ML and could be considered in future adaptations of the index.

Ethics Statement

The current investigation has complied with the Declaration of Helsinki, and it was approved by the Ethics Research Committee (CEIm) of the Pere Virgili Institute for Health Research (IISPV, Ref. CEIM: 183/2020). This study is also included on the ClinicalTrials.gov website (ID: NCT05943925). Informed consent was obtained from all individual participants included in the study.

Credit Author Statement

Luis Heredia: Writing – original draft, Writing – review and editing, Data curation. **David Mateo:** Investigation, Data curation. **Nerea Carrión:** Investigation, Data curation. **Margarita Torrente:** Methodology, Investigation, Supervision, Writing – review and editing.

Data Availability

Dataset on the neuropsychological assessment and microbiota analysis of elderly people with Alzheimer's disease and without cognitive impairment (Original data) (Mendeley Data).

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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