Uncovering accessibility gaps. Geospatial and diagnostic practices analysis of the Centres for Cognitive Disorders and Dementias (CCDD) in Apulia and Basilicata, Italy

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Abstract

Background. This study analysed accessibility, patient and healthcare professionals' characteristics, neuropsychological practices, and patient care gaps at Centres for Cognitive Disorders and Dementias (CCDD) in Apulia and Basilicata, Italy.
Methods. Geographic information systems (GIS) analysis and online survey were employed. CCDDs clinicians completed a self-report questionnaire covering "Characteristics of the CCDD" and "Neuropsychological assessment", from July 2021 to January 2023. Geographical coordinates were used to identify peripheral areas, based on the Italian strategy for Inner Areas.
Results. Thirty-three CCDDs were identified. Geospatial analysis revealed ultra-peripheral municipalities and inadequate public transport to CCDDs in several areas. Most patients were women aged 70-89. Neurologists played a key role in diagnosis and test administration. Diagnostic criteria and neuropsychological tools varied: international criteria were rarely applied, recommended tests were underutilised, and some cognitive domains undervalued.
Conclusion. These findings highlight the need for effective healthcare interventions for cognitive disorders and the potential for teleneuropsychology to bridge care gaps.

INTRODUCTION

Exploring differences in access to healthcare services is one of the priorities in public health [1], particularly about dementia, a prevalent condition affecting millions of people worldwide. Dementia is a degenerative condition related to ageing and is the most common cause of cognitive and behavioural decline, affecting 55 million people globally, with around 10 million new cases annually (https://www.who.int/publications/i/item/9789241513487). The proportion of older adults is increasing in Italy and many other countries [2], leading to a greater impact of cognitive decline on the population. In Southern Italy, severe difficulties in essential functions (i.e., perceptual, motor and memory skills) are higher compared to the Central and Northern regions (32.1% *vs* 25.5% and 22.9%, respectively). There is also a lower proportion of older adults in the South visiting specialist doctors or undergoing specialist ex-

ams compared to the national average (63.2% *vs* 66.1%, and 43.2% *vs* 49.3%, respectively) (https://www.istat.it/it/files/2021/07/Report-anziani-2019.pdf). Women tend to use outpatient health services more frequently, especially between the ages of 65 and 74 (https://www.istat.it/it/files/2021/07/Report-anziani-2019.pdf). The regions of Basilicata (562,869 inhabitants; mean age is 45.7) and Apulia (4,029,000; mean age 44.6 years), in Southern Italy, have unevenly distributed populations, with a higher prevalence of chronic diseases in Basilicata compared to national averages (https://www.istat.it/it/files/2021/07/Report-anziani-2019.pdf). Both regions have a significant number of patients suffering from dementia (10,000 *vs* 55,000 patients in Basilicata and Apulia, respectively), with dementia and neurologic diseases being the leading cause of death in Basilicata (https://regione.basilicata.it/giunta/site/Giunta/detail.jsp?otype=1012&id=3077556 and https://www.sanita.puglia.it/documents/36031/53941903/PDTA+Alzheimer.pdf/930c654f-b1e2-4949-b00c-0273bb2ea0ed). The analysis of the essential levels of assistance/care reveals critical performance in prevention, community health services, and hospital assistance within the two regions [3].

In response to healthcare needs, the Italian Government approved the National Dementia Plan in 2015 [4] The Plan aimed to establish Centres for Cognitive Disorders and Dementias (CCDD) dedicated to evaluating, diagnosing, and treating cognitive disorders and dementias. These centres, which can be public, territorial, outpatient, hospital, university, or research institutes, have the authority to formulate official diagnoses and define legally recognized Therapeutic Pharmacological Plans. The CCDDs' essential characteristics include multidisciplinary and multi-professionalism to cater to each patient's care needs effectively [4]. In Italy, the 2023 census by the Italian National Institute of Health (Istituto Superiore di Sanità, ISS) [5] reports a total of 587 CCDDs, with 268, 105, and 214 located in Northern Italy, Central Italy, and Southern Italy and the Islands, respectively. The regions of Apulia and Basilicata had 31 and 3 CCDDs, respectively [5]. It is common to encounter disparities in healthcare access, especially in rural or remote areas and among vulnerable populations. Nevertheless, the accessibility of CCDDs has not been taken into consideration in previous research.

Accessibility to healthcare services represents a crucial concern that impacts the well-being of communities and individuals [6] and supports policy decisions regarding the allocation of resources for care provision [7], that better meet the needs of the community [8]. A valuable tool in addressing accessibility challenges in the healthcare sector is the geospatial analysis [9]. It involves the use of geographic information systems (GIS) and spatial data to understand the distribution of healthcare facilities, their proximity to populations, and the barriers that might hinder people from accessing services. Several studies [8] have investigated the spatial characteristics of healthcare facilities, including their location, distribution, and proximity to various modes of transportation, particularly for facilities catering to older adults. According to a recent study by Kim

et al. [6], the combination of qualitative and geospatial methods is a new and promising way to gain a comprehensive understanding of health issues. However, as reported above, to our knowledge, no Italian study has yet explored the accessibility of essential healthcare services such as CCDDs.

A second point relates to the internal organisation of CCDDs in terms of their location in hospitals or universities, waiting times, patient flow, healthcare professionals involved, and the diagnostic protocols used (including factors such as reference diagnostic criteria and types of neuropsychological tests). In the first survey by the Italian National Institute of Health [5], the CCDDs' location, staff composition, and services varied significantly across the three macro-geographical areas of Italy. Notably, CCDDs located in the Southern part of the country were less commonly found in hospitals or universities, had fewer patients and monthly referrals, shorter wait times for initial visits, and a lower proportion of psychologists administering psychodiagnostics tests compared to CCDDs in the other two areas. They also tended to be less integrated into coordinated care pathways (Therapeutic, Diagnostic and Care Pathways, DTCP) [5]. Despite being critical to the team, psychologists and neuropsychologists have the lowest percentage of permanent employment in CCDDs [10]. A recent survey [11] examining the current work situation of self-identified neuropsychologists in Italy reports that the majority of participants (71.7%) worked in the field of the diagnosis of dementia. However, the survey does not offer data on the distribution of respondents on a regional basis, nor on how many of them work in the CCDDs.

As far as the diagnostic protocols are concerned, the study by Di Pucchio *et al*. [12] specifically addressed the neuropsychological tests used in Italian CCDDs. The results showed that more than half of the included CCDDs based their screening procedures mainly on the administration of rough cognitive (e.g., Mini-Mental State Examination) and functional (e.g., Activities of Daily Living and Instrumental Activities of Daily Living) scales or a small set of tests. However, the study does not investigate adherence to known diagnostic criteria or protocols, while much has been done internationally to standardise the protocols. The international criteria for diagnosing dementia and neurocognitive disorders are well-established, serving as an important reference for standardising clinical practice [13, 14]. European Consensus efforts have also aimed to harmonise diagnostic protocols. Festari *et al*. [15] provided data on neuroimaging and biomarker usage in diagnosing Mild Cognitive Impairment (MCI) and mild dementia, revealing varying usage levels among European clinicians. According to that study, 93% of European clinicians use Magnetic Resonance Imaging (MRIs), while 92% and 68% use Cerebrospinal Fluid (CSF) biomarkers and Fluorodeoxyglucose-Positron Emission Tomography (FDG-PETs), respectively. It is less common to use cardiovascular MIBG-scintigraphy (38%), polysomnography (60%), amyloid-PET (54%), and electroencephalography (EEG) (33%). Most clinicians (77%) did not use the new tau-PET tracers' methodology. A consensus

framework developed by the Joint Program for Neurodegenerative Diseases (JPND) and the Italian Ministry of Health [16] addressed harmonising neuropsychological assessments for neurodegenerative dementias in Europe. The study emphasised the need for standardised testing methodologies and the limited availability of psychometric information on these tests. In fact, it was found the use of heterogeneous and non-standardized neuropsychological tests in European countries, along with variations in administration and scoring methods, which leads to incomparable results. After a thorough analysis, the authors reached a consensus on general recommendations for neuropsychological assessment procedures and tools. In this line, a methodology for producing normative data and cut-off values, facilitating early detection and cross-country comparisons in test validation, was also proposed [17].

Overall, in light of the data reported so far and the issues that have emerged, the main objective of our study is threefold. Firstly, it aims to investigate the accessibility of CCDDs (Centres for Cognitive Disorders and Dementias) in the regions of Apulia and Basilicata. Secondly, it seeks to update information regarding the organisation and activities of these centres (e.g., by characterising their staff, equipment, patients, and types of diagnoses). Lastly, the study aims to survey the neuropsychological procedures employed in clinical practice to diagnose dementia.

METHODS
CCDD involvement

As a starting point, we used the CCDDs list provided by the ISS survey conducted in 2014-2015 [5]. To our knowledge, this was the most updated publicly available list of CCDDs. Following further research on the territory and comparing the official website list of each Italian Regions, the chief medical officer and Directors of Medical Services of these CCDDs were contacted by phone. We ended up with the identification of a total of thirty-three CCDDs (30 in Apulia and 3 in Basilicata; see *Figure S1 available online as Supplementary Materials*) and contacted them with a letter of intent explaining the project in detail. The Ethical Committee of Salento University and the Local Health Authority of Lecce (Italy) approved the study (Protocol n. 174371/2020). Participants were volunteers and did not receive any compensation. They provided Informed Consent to complete the questionnaire. All data were collected between July 2021 and January 2023. No personal information about the age or gender of the clinicians was required.

Procedure
GIS analysis

The addresses and geographical coordinates of all CCDDs present in Puglia and Basilicata were used for the geospatial analysis of the location and spatial distribution of CCDDs. The Basilicata region comprises 131 municipalities, divided into two provinces, Matera (n=31) and Potenza (n=100), and the health regional system is organised into six health districts (i.e., Potenza, Val d'Agri, Senise, Lauria, Melfi, and Venosa).

The Apulia region comprises 257 municipalities divided into six provinces and as many health districts (i.e., the Metropolitan City of Bari: 41; Barletta-Andria-Trani, BAT: 10; Brindisi: 20; Foggia: 61; Lecce: 96; Taranto: 29). First, each municipality was assigned to a single CCDD according to the following criteria: whether a CCDD is present in a health district, then it is the reference for all municipalities in that district; whether more than one CCDD is present in a health district, then the municipalities in the same district are assigned to the geographically closest CCDD (km). In the absence of CCDDs in a health district, each municipality in that district is assigned to the geographically closest CCDD (km) of another district in the same province. In our sample, there was at least one CCDD per province. Using the Google Maps application, it was possible to derive three variables for each municipality: distance in kilometres from the reference CCDD (Distance), time travel in minutes to the reference CCDD by own car (TimeCar), and by public transport (TimePublic). Information about public transport availability was derived from Google Maps, which used online sources such as the Italian railway public service (e.g., Trenitalia) and regional public bus service (e.g., Sita Sud srl). Referring to the strategy for Inner Areas in Italy developed by the Italian Agency for Territorial Cohesion [18], municipalities were classified in terms of distance from the "service delivery centres".

Online CCDD survey

Clinicians were required to complete a self-report survey employed by the Qualtrics platform (https://www.qualtrics.com) using a link shared via mail. The survey was divided into two consecutive sections. The first section, "Characteristics of the CCDD", required information that defines the characteristics of the CCDD: name, location of the service (e.g., hospital, university, territorial), years of operation, number and indicative socio-demographic information about the patients, composition of the medical staff, type of diagnoses, diagnostic procedures (e.g., use of biomarkers, neuroimaging, etc.). The second part, "Neuropsychological assessment", asked whether a standardised or tailored neuropsychological protocol is used, what specific measures are included in the protocol (selected from a list of 9 composite batteries, 29 neuropsychological tests, and 14 clinical scales), scoring procedures (e.g., raw scores, normative correction, etc.), normative data used, diagnostic criteria used, and knowledge about the national guidelines on the Diagnostic, Therapeutic and Care Pathways (DTCP) for dementia. The questionnaire consisted of closed-ended matrices answered on a 5-point scale Likert scale, ranging from 0 (very rarely) to 5 (very often) and checkbox questions (i.e., multiple-choice-type questions), allowing participants to choose multiple options (e.g., tests used in neuropsychological assessment). Open-ended questions were added to the checkbox options in case the participant did not find their answer in the checkbox list.

Mobile phones, computers, and tablets could all be used to complete the survey. Compiling took up to a total of about 15/20 minutes. Clinicians could decide

whether to complete both sections consecutively or save the first part and complete the second later. Participants had ten days to complete the second part of the survey.

Data analysis

We used t-tests and analyses of variance to explore the differences between areas in terms of Distance, time travel by own car (TimeCar), and by public transport (TimePublic). Geographical maps were then produced to visually represent the distribution of population, the allocation of municipalities to CCDDs, and the accessibility of CCDDs according to travel time by private car and by public transport. Jamovi version 2.3 (https://www.jamovi.org) and Quantum GIS version 3.22.13 LTR (http://www.qgis.org) were used for statistical analyses and geographical maps creation, respectively.

To analyse the survey data, we first performed descriptive statistics on the data collected from the online survey. For multiple-choice questions, we calculated the frequencies of responses in each category – sometimes, respondents were allowed to choose more than one answer. These cases were clearly marked in the results section. Plots were generated using the ggplot2 package in R Studio (http://www.rstudio.com/.25). In all the analyses, statistical significance was set at $p<0.05$.

RESULTS
CCDDs accessibility

Geospatial analysis revealed notable differences between the two regions. The distribution of the population is represented in *Figure S2 available online as Supplementary Materials*, classifying municipalities into seven categories based on number of inhabitants: under 1,000; between 1,000 and 5,000; between 5,000 and 15,000; between 15,000 and 60,000; between 60,000 and 100,000; between 100,000 and 250,000; and over 250,000.

The average distance (km) of the municipalities from the reference CCDDs is significantly higher in Basilicata than in Apulia ($Distance_{Apulia}=21.3\pm17.9$; $Distance_{Basilicata}=63.6\pm41.1$; $t_{386}=-14.07$, $p<0.001$), as it is the travel time (min) by car ($TimeCar_{Apulia}=23.8\pm16.6$; $TimeCar_{Basilicata}=59.7\pm32.4$; $t_{386}=-14.44$, $p<0.001$). Public transport is present in all municipalities of the Apulia Region ($TimePublic_{Apulia}=60.6\pm42.0$). Conversely, public connections to the CCDDs of reference are available in only 26 out of 131 municipalities in Basilicata, with an average travel time of 251.2 ± 234.8 ($TimePublic_{Basilicata}=251.2\pm234.8$). The discrepancy in journey times between public transportation and private cars/vehicles ($TimePublic=78.1\pm97.6$; $TimeCar=25.8\pm19.7$; $t_{282}=-10.1$, $p<0.001$) is significant.

Municipalities were classified into "service delivery centres" if a CCDD was located in the municipality, "enclosure area", with time travel less than 20 minutes; "intermediate area", between 20 and 40 minutes; "peripheral area", between 40 and 75 minutes; and "ultra-peripheral area", if the time travel exceeds 75 minutes. The analysis of the accessibility of CCDDs according to travel time by private car revealed ultra-peripheral areas in Basilicata and the province of Foggia (Apulia)

(see *Figure 1*). In fact, the provinces where the municipalities are furthest away from the CCDDs considering the distance in km and the travel time (min) by own means are Potenza ($Distance_{Potenza}=65.1\pm45.1$; $TimeCar_{Potenza}=61.7\pm34.2$), Matera ($Distance_{Matera}=58.5\pm24.4$; $TimeCar_{Matera}=53.2\pm21.4$) and Foggia ($Distance_{Foggia}=39.6\pm20.7$; $TimeCar_{Foggia}=40.0\pm20.5$).

When considering travel time by public transport (if available), the spread of peripheral and ultra-peripheral areas extends across all provinces, sparing only the "service delivery centres" and a few neighbouring municipalities (see *Figure 1*). Excluding from the comparisons Potenza and Matera, in which public transport service is practically absent, the provinces of Apulia Region with the longest travel times are Foggia ($TimePublic_{Foggia}=95.9\pm45.2$) and Taranto ($TimePublic_{Taranto}=73.3\pm44.1$).

In terms of individual CCDDs, Potenza (n=81), Maglie (n=37) in the Province of Lecce, and Foggia (n=33) are the CCDDs that more municipalities refer to, in decreasing order of frequency. Those that are the farthest away in terms of kilometres and most difficult to reach by private means are Potenza ($Distance_{Potenza\_CCDD}=74.7\pm44.4$; $TimeCar_{Potenza\_CCDD}=69.0\pm34.1$), Matera ($Distance_{Matera\_CCDD}=58.5\pm24.4$; $TimeCar_{Matera\_CCDD}=53.2\pm21.4$) and San Giovanni Rotondo in the Province of Foggia ($Distance_{SanGiovanniRotondo\_CCDD}=42.8\pm29.8$; $TimeCar_{SanGiovanniRotondo\_CCDD}=49.6\pm29.3$). In terms of population coverage, the CCDDs that serve the most inhabitants are Taranto (n=432,829), Foggia (n=299,240), and Potenza (n=260,977). Meanwhile, those that cover a smaller portion of the population are Triggiano (n=81,197) and Mola di Bari (n=68,903), both in the Province of Bari, and Copertino (n=36,922) in the Province of Lecce.

Survey section one: CCDD characteristics

Twenty CCDDs (60.6%) participated in the research, three from Basilicata (100.0%) and 17 from Apulia (56.7%). Twelve neurologists, three geriatricians, one psychiatrist, and four psychologists or neuropsychologists (i.e., psychologists with expertise in neuropsychology) compiled the first section of the survey. The second section of the survey was compiled by seventeen (51.5%) CCDDs (i.e., two from Basilicata and 15 from Apulia) and involved neurologists, geriatricians, psychologists or neuropsychologists, and psychiatrists. Non-responding CCDDs included nine hospitals, three territorial facilities, and one university/research service. We define CCDD services as non-responders if they meet any of the following criteria: (i) being contacted by phone but unable to participate; (ii) having inactive phone numbers or numbers attributed to other hospital wards; (iii) accepting to receive the survey link but not completing it. Regarding the geographical distribution of respondents, all CCDDs in Basilicata and the province of Taranto completed the survey, while non-respondents were unevenly distributed among the other provinces (non-respondents: Bari 62.5%, Foggia 50.0%, Lecce 44.0%, Brindisi, and BAT 33.0%).

Regarding the responding CCDDs, they have been active for an average of 14.79 years (SD=9, range=2-32),
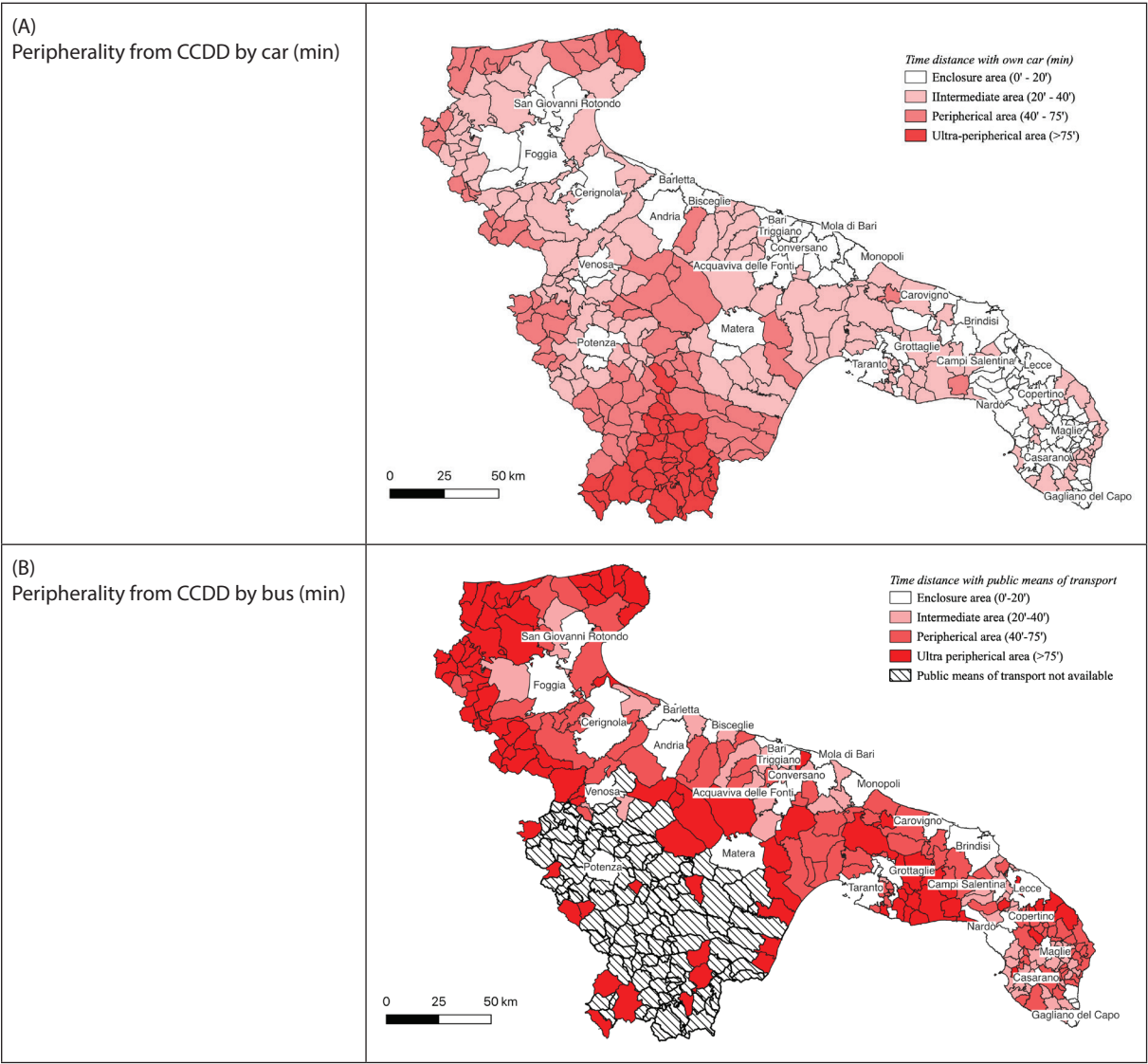
Figure 1

Peripherality. The map (A) depicts the peripherality of each municipality relative to its assigned CCDD, measured in terms of travel time by car. The map (B) depicts the peripherality of each municipality relative to its assigned CCDD, measured in terms of travel time by public means of transport. Referring to the strategy for Inner Areas in Italy developed by the Italian Agency for Territorial Cohesion (Barca *et al.*, 2014 [18]), municipalities were classified into "service delivery centres" if a CCDD is located in the municipality (labels), "enclosure area", with time travel less than 20 minutes (white); "intermediate area", between 20 and 40 minutes (pink); "peripheral area", between 40 and 75 minutes (dark pink); and "ultra-peripheral area", if the time travel exceeds 75 minutes (red). The analysis (A) shows the presence of two ultra-peripheral areas in Basilicata and the province of Foggia. The analysis (B) shows the presence of many ultra-peripheral areas and the absence of Public Transport services that connect municipalities to CCDDs in Basilicata.

and the service is usually provided in hospitals (14 hospital services, one university, and five territorial services). Clinicians have worked in the Centres for an average of 15.21 years (SD=11.94, range=2-40). Additionally, in addition to their medical specialty, most clinicians who completed the survey were Medical Executives (7 out of 20). Concerning referral, neurologists (8/20) often refer patients to the service. People were most likely to find general information about CCDDs on the online reservation platform of the public health service – CUP (14/20), the CCDD website (6/20) and the website of Apulia and Basilicata Region (3/20). According to respondents' estimates, an average of 605 citizens per

year require access to the service (SD=373.50, range 50-1,500), most of which are women (58.14%) compared to 42.72% males. Respondents also rated the frequency of access requests by patients' age range (i.e., 40-49, 50-59, 60-69, 70-79, 80-89, >90) and years of education (i.e., 0-5, 6-8, 9-13, >13). Ten out of 20 centres are often contacted by people aged 70 to 89, and 12/20 are very often contacted by people older than 90. Sixteen out of 20 centres indicated patients' education range between 6 and 8 years of school (which correspond to partially or fully attending middle school). High-educated citizens consult the services less frequently. Non-Italian citizens rarely require access to the

service. Regarding the diagnoses issued by the CCDDs (see *Figure 2*), patients are very often diagnosed with Alzheimer's dementia (12/20) and often with Vascular dementia (12/20). Parkinson's disease and mild cognitive impairment are diagnosed sometimes (10/20 and 8/20, respectively). Lewy Body dementia has the lowest frequency of diagnosis (7/20). Concerning instrumental exams to support the diagnosis, structural and functional neuroimaging are employed, respectively very often (12/20) and often (9/20) (see *Figure S3 available online as Supplementary Materials*).

### Survey section two: neuropsychological assessment characteristics

Clinicians use standard protocols (5/17), which can be modified, if necessary (9/17), or *ad-hoc* protocols (4/17), in neuropsychological evaluation. Regarding the composite neuropsychological battery, Mini-Mental State Examination (MMSE) is the most widely used tool (see *Table 1*), while the most used cognitive tests are Clock Drawing Tests, Verbal Fluency Tests, Frontal Assessment Battery (FAB), Babcock short-story, and Rey Auditory Verbal Learning Tests (RAVLTs) (see *Table 2*). The Geriatric Depression Scale (GDS) (16/17), Neuropsychiatric Inventory (NPI) (9/17) and Hamilton Depression Rating Scale (HDRS) (7/17) are the most used scales to assess emotional and behavioural diseases. Clinicians usually choose the Instrumental Activities of Daily Living Scale (IADL) (15/17) and the Index of Independence in Activities of Daily Living (ADL) (15/17). To correct patients' scores obtained in neuropsychological testing, clinicians employ normative data from the Italian population. Corrected scores are based on Italian Normative Data published in the literature (10/17), in the test manual (10/17), and International Normative Data (2/17). The score is reported as Corrected Scores (16/17), Equivalent Scores (5/17), and

also Raw Scores (5/17). The standardised diagnostic criteria most used is the DSM-5 (9/17), only five CCDDs consult consensus conferences. Three CCDDs declare to use the DSM-IV-TR. Sixteen out of 17 clinicians (i.e., psychology, geriatrician and neurologist) know the existence of the national guidelines on Diagnostic, Therapeutic and Care Pathways (DTCP) for dementia.

DISCUSSION

This study aimed to map the CCDDs in two Italian regions: Apulia and Basilicata. The study focused on the accessibility of CCDDs, clinical practices adopted by the services, patients' characteristics, the type of diagnoses, and professional figures working in the services. Moreover, the study analysed the neuropsychological assessment used by the CCDD services. The survey involved universities, hospitals and territorial healthcare services (ASL) indicated as CCDD. It is important to highlight that this is the first study to use a mixed methods approach, consisting of geospatial analysis and surveys to provide an updated map of available CCDDs, their accessibility and clinical practices.

Firstly, we examine the accessibility of CCDDs in these two regions and provide visual maps of geospatial access indicators. These indicators consider the distance from each municipality to the reference CCDD based on the type of transport (i.e., private *vs* public). The GIS approach enabled the study of the distribution of CCDDs in the territory and the analysis of their accessibility profile. The differences between Apulia and Basilicata are emblematic of Italy's diverse territorial fabric. In Basilicata, the first data that emerges is the lack of public transport service in many municipalities due to the predominantly mountainous terrain and poor road network. This fact highlights that many citizens are forced to use their own means of transport to reach a CCDD, which takes more than an hour. Given
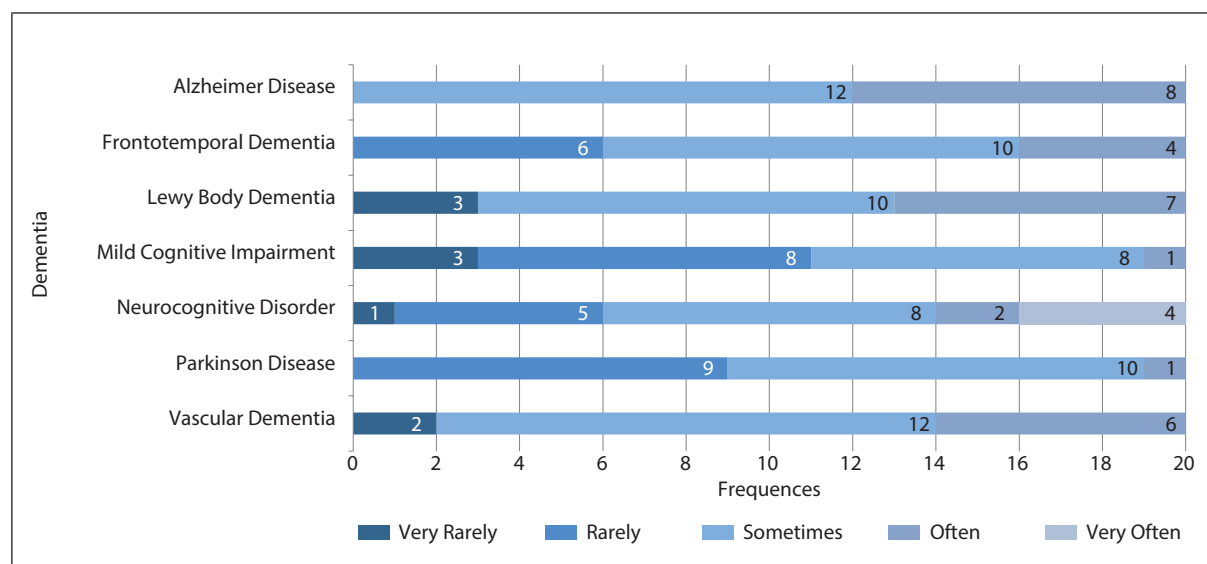
Figure 2
Type of diagnosis. The graph reports the distribution of responses (on a closed-ended matrix question answered on a 5-point scale Likert scale), regarding types of diagnoses issued.

Table 1
Global functioning battery. The Table shows the frequency of responses and the number of CCDD that completed the survey. Participants selected more than one answer

Neuropsychological Battery	Frequency	Number of CCDDs
Mini Mental State Examination (MMSE)	17	17
Clinical Dementia Rating (CDR)	10	17
Montreal Cognitive Assessment (MoCA)	5	17
Addenbrooke's Cognitive Examination Revised (ACE-R)	5	17
Alzheimer's Disease Assessment Scale (ADAS)	3	17
Severe Impairment Battery (SIB)	3	17
Milan Overall Dementia Assessment (MODA)	3	17
Wechsler Adult Intelligence Scale (WAIS)	3	17
Brief Neuropsychological Exam (ENB)	1	17
Frontal Assessment Battery (FAB)	13	17

CCDDs: Centres for Cognitive Disorders and Dementias.

Table 2
Neuropsychological tests. The Table reports the frequency of use of individual neuropsychological tests used to evaluate cognitive abilities, as well as the number of CCDDs that completed the survey. Participants selected more than one answer

Neuropsychological test	Frequency	Number of CCDDs
Clock Drowing Test	16	17
Short Stories	13	17
Verbal Fluency	12	17
Rey Auditory Verbal Learning Test (RAVLT)	12	17
Visual Search-Attentional Matrix	11	17
Rey-Osterrieth Complex Figure (ROCF)	11	17
Digit Span	9	17
Raven's Progressive Matrices	9	17

CCDDs: Centres for Cognitive Disorders and Dementias.

the characteristics of patients attending a CCDD, who are older adults and often unable to drive, this increases the dependency on caregivers and significantly adds to the burden of care [19].

The presence of only three CCDDs in Basilicata, primarily concentrated near the border with Apulia, indicates an uneven distribution of services across the region. Although the service better covers the most populated areas, policymakers should consider opening new CCDDs or branches of existing ones in the southern part of the province of Potenza. In Apulia, however, the distribution and number of CCDDs are adequate. However, the main problem with access to services in this region is communication. The absence of an official list has made it extremely difficult to identify CCDDs in the region, with a high probability that some CCDDs have been omitted. Concerning public accessibility, this highlights a significant challenge in easily sending and receiving information about the location of an essential service for people with dementia and their families. The geospatial analysis highlighted ultra-peripheral areas in the provinces of Potenza and Foggia. Excessive distance from a CCDD could jeopardise easy access to di-

agnostic assessment and the possibility of participating in psychosocial interventions, which require a certain consistency over time to be effective. As suggested in American studies for rural areas, remote services (telemedicine) could be a reasonable solution to reduce the gap in the distribution of services [20].

A recent study conducted by Tarlow *et al.* [21] proposes an effective approach to bolstering the accessibility of local health services in rural regions. The study explored the implementation of a "hub and spoke" telehealth model, which considered various factors such as geography, socioeconomic conditions, transportation, and healthcare-related challenges faced by clients. The authors also examined policies aimed at reducing disparities and bridging the digital divide. Additionally, local community leaders were involved in identifying access points based on available resources, with an administrative hub located in the city or town with the largest population. Considering the southern Italian towns' geographical characteristics, a central hub could be established to facilitate telemedicine services with a nurse who can provide in-person assistance to patients and caregivers, particularly those who may not be sig-

nificantly aided by technology due to advanced age. This service could also enable early access to treatment in the early stages of the disease, when patients may delay seeking medical attention due to the distance from healthcare facilities or a lack of accompanying support.

Some important evidence emerges about the characteristics of the population. Our results show that 58.14% of females require access to the service compared to 42.72% of males. Among the 20 centres, ten are often contacted by people aged 70 to 89, and 12 are often contacted by people older than 90. Sixteen out of 20 facilities indicated that patients' education ranged from 6 to 8 years (corresponding to partially or fully attending middle school). The frequency scores indicate that patients are very often diagnosed with Alzheimer's dementia (12/20) and often with Vascular dementia (12/20). Mild Cognitive Impairment and Parkinson's disease are sometimes diagnosed (10/20 and 8/20, respectively); Lewy Body dementia is the least common (7/20). Our results are consistent with prevalence reported in previous studies [22]. A comparison of our results with the Italian study confirms the high prevalence of Alzheimer's disease in Basilicata and Apulia.

As concerns the instrumental exams to support the diagnosis, structural and functional neuroimaging are employed, respectively, very often (12/20) and often (9/10) in Basilicata and Apulia, despite the suggested methods. In fact, as indicated by the European consensus to diagnose MCI and mild dementia [15], 93% of European clinicians use MRIs, while 92% and 68% use CSF biomarkers and FDG-PETs, respectively. Seventy-seven per cent of clinicians have not used tau-PET tracers [23, 24]. Moreover, Gustavsson *et al*. [25] proposed that estimating the prevalence of amyloid-positive populations could provide relevant Alzheimer's disease (AD) prevalence estimates. Based on this, it is evident that instrumental exams in Basilicata and Apulia are rarely used to support diagnostic diagnoses, as suggested in Consensus Conferences and academic memory clinics across Europe. It is essential to underline that using the appropriate and suggested tools may prevent misdiagnoses, improve patient outcomes, guide caregivers to provide better care, and could be fundamental for the effective prescription of the upcoming disease-modifying therapies for Alzheimer's disease.

The majority of CCDDs in the target regions participated in and completed the survey. Only in the province of Bari was the proportion of respondents lower than that of non-respondents. In these two regions, CCDDs are mainly located in hospitals and, to a lesser extent, in territorial services. Only one CCDD is located in a university. No significant differences were found between respondents and non-respondents in terms of setting location. Another important finding of our study is the diversity of diagnostic criteria and tools used in clinical practice, despite the well-established international criteria [14]. The diagnostic criteria most used is the DSM-5 (9/17), and only five CCDD consult consensus conferences. Three CCDDs declare to use DSM-IV-TR, which could be considered unusual criteria to diagnose dementia.

According to an analysis of the neuropsychological tests conducted in 501 Italian CCDDs [12], the most commonly used tests for cognitive disorders and dementia are MMSE (i.e., used in all CCDDs involved), Clock Drawing Test, Semantic and phonemic Fluency, Rey Auditory Verbal Learning Tests (RAVLTs), Babcock Short-Story, and Trail Making Test. Our research confirms these results, identifying MMSE as the test used in all the 17 CCDDs as first-level screening. Also, we identified other neuropsychological tests used in the CCDDs, such as the Frontal Assessment Battery (FAB), Rey-Osterrieth Complex Figure (ROCF) and Spinnler and Tognoni's Figure Copying Tasks for visuospatial and constructional ability, as well as Raven's Progressive Matrices considered as second level assessment in clinical practice. The survey demonstrates an important aspect: four out of 17 CCDDs perform only a first-level neuropsychological evaluation, administering only MMSE, CDR, Clock Drawing Test and some behavioural batteries as GDS, and three of them are hospital services. The importance of adequate neuropsychological assessment cannot be overstated, as it is crucial for accurately identifying the type of dementia even at an early stage, avoiding misdiagnosis, and providing the opportunity for early intervention. However, considering the recommendations of some international consensus conferences [16, 17], it is worth noting that some recommended tests (e.g., Free and Cue Selective Reminding Test (FCSRT) and Set Test; for the FCSRT, see also recent meta-analysis by Macchitella *et al*. [26]), and cognitive domains and skills (e.g., social cognition) were underused or undervalued. Research has consistently demonstrated that timely and precise diagnosis and care, including pharmacological, behavioural, and psychological interventions, can significantly slow the progression of dementia and enhance the quality of life of patients and caregivers [27]. Additionally, the adoption of uniform diagnostic criteria and instruments would facilitate patient assessment across CCDDs and ensure consistent care for patients, even when attending different healthcare services [15, 16]. Neuropsychological assessments in CCDDs are typically performed by neurologists, neuropsychologists, or psychologists with expertise in neuropsychology. It is essential to have a diverse range of competencies to correctly identify and care for patients affected by cognitive disorders or dementia. All of the CCDDs that participated in our survey employ multidisciplinary teams; it is crucial to involve experts in neuropsychology who are specifically trained to conduct comprehensive assessments of individuals' cognitive functioning. Some guidelines for the diagnosis of dementia recommend that a thorough neuropsychological evaluation should be conducted by neuropsychologists or by "*someone trained in neuropsychology*" [28]. Notably, in Italy as well as at the international level, specific and advanced training in neuropsychology is only provided in psychology degree programs and postgraduate courses in neuropsychology, and psychologists with this specific and advanced training are considered neuropsychologists. Despite this, to date, Italian law does not set any limits on practising neuropsychology; therefore, any psychologist, physician, pedagogist, or rehabilitation therapist may use some

diagnostic tools (such as tests) that are not classified as for psychologists' use only or offer neuropsychological rehabilitation, even if they have never attended education or training in clinical neuropsychology [10].

We found no obvious differences in the organisation and procedures used by territorial, hospital and university CCDDs. All CCDDs perform a first-level neuropsychological assessment; however, the second-level neuropsychological assessment in the Basilicata and Puglia CCDDs lacks common criteria and procedures. As a result, evaluations obtained in different CCDDs, or the same CCDD at different time points cannot be directly compared, making it difficult to track patients' health over time. Instead, consistent evaluation criteria are essential to collaboration among medical practitioners. From a different point of view, neuropsychological evaluations are often referenced by other healthcare professionals such as neurologists and geriatricians and clear, consistent criteria would facilitate their understanding and efficient use of information. Improving the coordination of medical interventions is an important goal set by the Ministerial Decree n. 70 of 04/02/2015 [29], which presents qualitative, structural, technological, and quantitative standards relating to hospital assistance. In order to achieve such standards, each region needs to develop a DTCP setting common guidelines for hospital services as well as a system to monitor the effectiveness and efficiency of the chosen treatments. Almost all the clinicians who completed the survey affirmed to be acknowledged with the existence of national guidelines about DTCP for dementia, although there are no DTCPs in Apulia and Basilicata. The detailed geographical data collected during this study will be a precious instrument to tailor Apulia and Basilicata's DTCP to the specific distribution of population and services on the territory, for instance, considering tele-neuropsychology and telemedicine to reach the most isolated communities.

CONCLUSION

In conclusion, using a mixed-method approach, the present study provides a comprehensive map of the services addressing cognitive disorders and dementia in these two southern Italian regions, highlighting strengths and criticalities, given the recent effort to provide a unitary theoretical, legislative and operational framework. These findings underscore the necessity to harmonise access to CCDDs in the two regions studied and the procedures for assessing cognitive, behavioural and functional symptoms. Due to the geographical challenges of the territory and the difficulties in travel and public transportation, offering telemedicine and teleneuropsychology services would be ideal. The admin-

istration of online neuropsychological tests has been investigated in several studies over the last few years, with promising results and applications [30, 31].

Our survey suggests a fundamental issue for future research, and our results also emphasise the importance of adhering to the National Dementia Plan to gain a better understanding of the epidemiology of dementia and to establish an integrated care pathway from diagnosis to treatment of these disabling pathologies by developing DTCP in the two regions. Additionally, incorporating cognitive stimulation into CCDD is advisable to prevent cognitive decline and improve disease outcomes. Clinical trials have demonstrated the effectiveness of Cognitive Training and Cognitive Rehabilitation programs for patients with MCI and dementia. Combining cognitive interventions with psychosocial support might yield more comprehensive benefits for the population [32]. Cognitive Reserve studies underscore the promotion of wellness by emphasising the advantages of maintaining physical, cognitive, and socially active lifestyles for public health [33]. To proactively address dementia risk factors and assist affected patients, the Health Care System must consider and incorporate all these aspects into the prevention, support, and treatment perspective.

REFERENCES

1. Graves BA. Integrative literature review: a review of literature related to geographical information systems, healthcare access, and health outcomes. Perspect Health Inf Manag. 2008;5:11.
2. Rousson V, Paccaud F. A set of indicators for decompos-
ing the secular increase of life expectancy. Population Health Metrics. 2010;8(1):1-9. doi: 10.1186/1478-7954-8-18
3. Betti M, De Tommaso CV, Maino F. Health inequalities in Italy. Comparing regions among prevention, commu-

nity health services and hospital assistance. Soc Dev Issues. 2023;45(1):61-76.

4. Presidenza del Consiglio dei Ministri Conferenza Unificata. Provvedimento 30 ottobre 2014. Accordo, ai sensi dell'articolo 9, comma 2, lett. c) del decreto legislativo 28 agosto 1997, n. 281, tra il Governo, le regioni e le province autonome di Trento e di Bolzano, le province, i comuni e le comunità montane sul documento recante: "Piano nazionale demenze - Strategie per la promozione ed il miglioramento della qualità e dell'appropriatezza degli interventi assistenziali nel settore delle demenze". Gazzetta Ufficiale - Serie Generale n. 9, 13 gennaio 2015.

5. Bacigalupo I, Giaquinto F, Salvi E, Carnevale G, Vaccaro R, Matascioli F, Remoli G, Vanacore N, Lorenzini P. Permanent Table of the National Dementia Plan Study Group and the CCDDs Study Group. Neurol Sci. 2024;45(2):525-38. doi: 10.1007/s10072-023-06958-8

6. Kim J, Kim DH, Lee J, Cheon Y, Yoo S. A scoping review of qualitative geographic information systems in studies addressing health issues. Soc Sci Med. 2022;314:115472. doi: 10.1016/j.socscimed.2022.115472

7. Pierse T, Keogh F, O'Shea E, Cullinan J. Geographic availability and accessibility of day care services for people with dementia in Ireland. BMC Health Serv Res. 2020;20(1):476. doi: 10.1186/s12913-020-05341-z

8. Nykiforuk CI, Flaman LM. Geographic information systems (GIS) for health promotion and public health: a review. Health Promot Pract. 2011;12(1):63-73. doi: 10.1177/1524839909334624

9. Cromley EK. GIS and disease. Annu Rev Public Health. 2003;24:7-24. doi: 10.1146/annurev.publhealth.24.012902.141019

10. Salvadori E, Pantoni L. Società Italiana di NeuroGeriatria (SINEG). The role of the neuropsychologist in memory clinics. Neurol Sci. 2020;41(6):1483-8. doi: 10.1007/s10072-020-04253-4

11. Onida A, Di Vita A, Bianchini F, Rivera D, Morlett-Paredes A, Guariglia C, Arango-Lasprilla JC. Neuropsychology as a profession in Italy. Appl Neuropsychol Adult. 2019;26(6):543-557. doi: 10.1080/23279095.2018.1466782

12. Di Pucchio A, Vanacore N, Marzolini F, Lacorte E, Di Fiandra T; I-DemObs Group; Gasparini M. Use of neuropsychological tests for the diagnosis of dementia: a survey of Italian memory clinics. BMJ Open. 2018;8:e017847. doi:10.1136/bmjopen-2017-017847

13. American Psychiatric Association, American Psychiatric Association DSM-5 Task Force. Diagnostic and statistical manual of mental disorders: DSM-5. 5th ed. Arlington, VA: American Psychiatric Publishing; 2013.

14. McKhann GM, Knopman DS, Chertkow H, Hyman BT, Jack Jr CR, Kawas CH, et al. The diagnosis of dementia due to Alzheimer's disease: Recommendations from the National Institute on Aging-Alzheimer's Association workgroups on diagnostic guidelines for Alzheimer's disease. Alzheimers Dement. 2011;7(3):263-9. doi: 10.1016/j.jalz.2011.03.005

15. Festari C, Massa F, Cotta Ramusino M, Gandolfo F, Nicolosi V, Orini S, et al. European consensus for the diagnosis of MCI and mild dementia: preparatory phase. Alzheimers Dement. 2023;19(5):1729-41. doi: 10.1002/alz.12798

16. Costa A, Bak T, Caffarra P, Caltagirone C, Ceccaldi M, Collette F, et al. The need for harmonization and innovation of neuropsychological assessment in neurodegenerative dementias in Europe: consensus document of the Joint Program for Neurodegenerative Diseases Working Group. Alzheimers Res Ther. 2017;9(1):27. doi: 10.1186/s13195-017-0254-x

17. Boccardi M, Monsch AU, Ferrari C, Altomare D, Berres M, Bos I, et al. Harmonizing neuropsychological assessment for mild neurocognitive disorders in Europe. Alzheimers Dement. 2022;18(1):29-42. doi: 10.1002/alz.12365

18. Barca F, Casavola P, Lucatelli S. Strategia nazionale per le aree interne: definizione, obiettivi, strumenti e governance. Roma: Ministero dello Sviluppo Economico, Dipartimento per lo Sviluppo e la Coesione Economica, Unità di Valutazione degli Investimenti Pubblici; 2014.

19. Merriman N, Mackey L, Fernandez EG, Curran F, Caulfield B, Power D, et al. 190 connected health sustaining home stay in dementia (chess): factors associated with the burden experienced by caregivers of people with dementia. Age Ageing. 2022;51(3):afac218.163. doi: 10.1093/ageing/afac218.163

20. Sekhon H, Sekhon K, Launay C, Afililo M, Innocente N, Vahia I, et al. Telemedicine and the rural dementia population: a systematic review. Maturitas. 2021;143:105-14. doi: 10.1016/j.maturitas.2020.09.001

21. Tarlow KR, McCord CE, Du Y, Hammett J, Wills, T. Rural mental health service utilization in a Texas telepsychology clinic. J Clin Psychol. 2020;76(6):1004-14. doi: 10.1002/jclp.22903

22. Filippi M, Cecchetti G, Cagnin A. et al. Redefinition of dementia care in Italy in the era of amyloid-lowering agents for the treatment of Alzheimer's disease: an expert opinion and practical guideline. J Neurol. 2023;270:3159-70. doi: 10.1007/s00415-023-11642-0

23. Sancesario GM, Toniolo S, Chiasserini D, Di Santo SG, Zegeer J, Bernardi G, et al. The clinical use of cerebrospinal fluid biomarkers for Alzheimer's disease diagnosis: the Italian selfie. J Alzheimers Dis. 2017;55(4):1659-66. doi: 10.3233/JAD-160975

24. Nobili F, Arbizu J, Bouwman F, Drzezga A, Agosta F, Nestor P, et al. EANM-EAN recommendations for the use of brain 18 F-Fluorodeoxyglucose Positron Emission Tomography (FDG-PET) in neurodegenerative cognitive impairment and dementia: Delphi consensus. Eur J Neurol. 2018;25(10):1201-17. doi: 10.1111/ene.13728

25. Gustavsson A, Norton N, Fast T, Frölich L, Georges J, Holzapfel D, et al. Global estimates on the number of persons across the Alzheimer's disease continuum. Alzheimers Dement. 2023;19(2):658-70. doi: 10.1002/alz.12694

26. Macchitella L, Tosi G, Giaquinto F, Iaia M, Rizzi E, Chiarello Y, et al. Genuine memory deficits as assessed by the Free and Cued Selective Reminding Test (FCSRT) in the behavioural variant of frontotemporal dementia. A systematic review and meta-analysis study. Neuropsychol Rev. 2024;34(3):823-37. doi: 10.1007/s11065-023-09613-3

27. Porsteinsson AP, Isaacson RS, Knox S, Sabbagh MN, Rubino I. Diagnosis of early Alzheimer's disease: clinical practice in 2021. J Prev Alzheimers Dis. 2021;8(3):371-86. doi: 10.14283/jpad.2021.23

28. Waldemar G, Dubois B, Emre M, Georges J, McKeith IG, Rossor M, et al. Recommendations for the diagnosis and management of Alzheimer's disease and other disorders associated with dementia: EFNS guideline. Eur J Neurol. 2007;14(1):e1-26. doi: 10.1111/j.1468-1331.2006.01605.x

29. Ministero della Salute. Decreto ministeriale 2 aprile 2015, n. 70. Regolamento recante definizione degli standard qualitativi, strutturali, tecnologici e quantitativi relativi all'assistenza ospedaliera. Gazzetta Ufficiale – Serie Generale n. 127, 4 giugno 2015.

30. Rizzi E, Vezzoli M, Pegoraro S, Facchin A, Strina V, Daini R. Teleneuropsychology: normative data for the

assessment of memory in online settings. Neurol Sci. 2023;44(2):529-38. doi: 10.1007/s10072-022-06426-9

31. Sperling SA, Acheson SK, Fox-Fuller J, Colvin MK, Harder L, Cullum CM, et al. Tele-neuropsychology: from science to policy to practice. Arch Clin Neuropsychol. 2024;39(2):227-48. doi: 10.1093/arclin/acad066

32. Giaquinto F, Iaia M, Rizzi E, Macchitella L, Romano DL, Tosi G, Angelelli P. Cognitive training for Alzheimer's disease and other forms of dementia: insights from a systematic review and Bayesian meta-analysis. J Alzheimers Dis. 2025;105(4):1252-74. doi: 10.1177/13872877251334795

33. Giaquinto F, Tosi G, Abbatantuono C, Pepe I, Iaia M, Macchitella L, et al. The indirect effect of cognitive reserve on the relationship between age and cognition in pathological ageing: a cross-sectional retrospective study in an unselected and consecutively enrolled sample. J Neuropsychol. 2023;17(3):477-90. doi: 10.1111/jnp.12323

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