JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Epidemiology of Alzheimer's disease and Dementia in India: A Systematic Literature Review

[1]Muhammad Nadeem Zafar

[1]Department of Clinical Psychiatry, PG Dip. Clinical Psychiatry

European Global School, Paris, France

Abstract: This study aims to estimate the epidemiology and prevalence of Alzheimer's disease and other dementias in India. To ascertain the prevalence of dementia in India, we conducted a comprehensive review of existing research, utilizing databases from various sources, including EBSCOhost, PubMed, PsycINFO, and Google Scholar. We employed R software (version 3.5.3) along with the "metaphor" package to perform a meta-analysis. Our meta-analysis incorporated data from 18 epidemiological studies. According to the findings of our meta-analysis, there are 20 individuals with dementia among every 1000 individuals in the population (95% confidence interval: 0.02-0.03). The prevalence was notably higher in the older age groups (75 years and above) compared to those under 75. However, prevalence rates did not significantly differ between males and females or between rural and urban populations. This study reveals that dementia, especially among the elderly population in India, is a significant public health concern. A comprehensive national survey supported by robust evidence is essential to accurately determine the prevalence of this condition in the nation.

Keywords: Epidemiology, dementia, Alzheimer's disease, India, meta-analysis, prevalence.

1. INTRODUCTION

As the world population ages at an unprecedented rate, Alzheimer's disease (AD) and other dementias are becoming a public health issue, especially in developing nations [1]. Emerging nations will house 14.2% of the world's 60%-plus population by 2020, roughly 70% of the elderly. In particular, India's life expectancy nearly doubled from 36.98 years in 1950-1960 to 69.27 years in 2015-2020. The 2011 census found 103.9 million elder Indians, up from 5.63 million in 1961 [1,2,3].

The senior population in India grew 35.5% between 2001 and 2011, compared to 23.9% between 1951 and 1961. Mortality rates, healthcare infrastructure, economic growth, and literacy rates all contributed to this demographic transition. Mental illness in the elderly affects their health and longevity [4]. Of all neuropsychiatric disorders, dementia causes the most impairment in the elderly. These major social shifts may affect dementia incidence in India. Several studies have examined dementia prevalence across the nation.

Dementia was 1.9% in South Asia in 2005 and expected to rise to 3.6 million by 2020 and 7.5 million by 2040. Epidemiological studies in India have shown dementia prevalence rates from 2 to 35 per 1000 [5]. There is no clear national assessment of dementia trends in India, despite the significant public health consequences and emotional and financial strain on carers [6,7].

2. METHODOLOGY

Up to June 2023, comprehensive searches were conducted on databases including EBSCOhost, PubMed, PsycINFO, and Google Scholar. The search strategy employed Boolean operators to combine keywords such as "India" and "dementia," encompassing Alzheimer's disease, vascular dementia, cognitive impairment, neurodegenerative disorder, and terms related to study design, including epidemiology, prevalence, observational study, cross-sectional study, cohort study, and disease frequency. Furthermore, supplementary publications were identified by manually examining the bibliographies, references, and cross-references of previously discovered research articles. Additionally, we conducted manual searches in Neurology India, as well as other Indian journals available online, including the Indian Journal of Psychiatry and the Indian Journal of Gerontology. Both authors independently conducted a comprehensive review of the full-text articles in accordance with pre-defined inclusion and exclusion criteria.

2.1 Inclusion and Exclusion Criteria

As of June 2023, we included all manuscripts published in the English language that provided quantitative data on either the number or frequency, while reporting data for both genders in the general population, encompassing rural, urban, or mixed backgrounds. Excluded from consideration were review papers, single-case studies, studies conducted in hospital settings, and research focused on specific racial or religious groups.

Out of a total of 719 articles initially identified, 623 were eliminated because their titles or abstracts did not align with the established inclusion and exclusion criteria. Subsequently, the full texts of the remaining 44 articles were meticulously examined. After thorough deliberation and assessment of their methodologies and conclusions, 18 studies were selected for inclusion in the meta-analysis.

2.2 Data Extraction

Articles were included based on the predefined inclusion criteria and subjected to a thorough review. A customized data extraction form was employed to extract pertinent information from each article, including the author's name, publication year, study location, sample size, diagnostic criteria, and the number of individuals screened for dementia.

2.3 Statistical Analysis

The statistical analysis was conducted using the R software (version 3.5.3), developed by the R Core Team at the University of Auckland, New Zealand. The analysis utilized a significance threshold of 5% (two-tailed tests) and involved the use of three R packages: "metafor," "meta," and "xlsx."

Data from the manuscript were imported from a Microsoft Excel spreadsheet into the R console with the "xlsx" library command. The "escalc" function was employed to compute the effect size, utilizing the "xi" and "ni" commands for event and sample size, respectively, within the "metafor" package. The analysis employed the Freeman-Tukey transformation, commonly referred to as the "Freeman-Tukey double arcsine transformation," via the escalc() and rma() routines.

The effect size using the random effects model was calculated using the rma() function. The overall summary proportion was determined with the "predict" function, and converted proportions from various studies were combined to ascertain the overall prevalence of dementia using the "metaprop" function. To revert the summary effect size back into proportion, the "transf()" function was utilized.

The metaprop() function directed the transformation process to translate the initial proportions into prevalence, with the "sm" input guiding the transformation technique. A forest plot was created using the "forest" tool. Finally, publication bias was estimated using a funnel plot, and Egger's unweighted regression test results were generated using the regtest() function to confirm the presence of publication bias.

3. REVIEW OF LITERATURE

3.1 Etiology

The loss of neurons in Alzheimer's disease is progressive. The hippocampus nucleus' entorhinal cortex usually causes it. Both early-onset and late-onset Alzheimer's are hereditary. Early-onset dementia is linked to trisomy 21 [8]. Age is the main risk factor for Alzheimer's disease. Other risk factors include traumatic brain injury, depression, cardiovascular and cerebrovascular disorders, older parental age, smoking, a family history of dementia, high homocysteine levels, and the APOE e4 allele. Educational achievement, oestrogen usage in women, anti-inflammatory medicine use, leisure activities like reading or performing music, a balanced diet, and regular aerobic exercise minimise Alzheimer's disease risk. Having a first-degree relative with Alzheimer's raises risk by 10% to 30%, while having two or more siblings triples risk [9,10].

3.2Epidemiology

Alzheimer's mostly affects the elderly. The global dementia population is anticipated to triple by 2050 from 24 million. Alzheimer's disease costs the US healthcare system $172 billion annually [11,12]. About 4.5 million Americans 65 and older were diagnosed with Alzheimer's in 2011. After 65, Alzheimer's disease doubles every five years [5]. Rarely more than 1% each year before 65, the frequency rises to 6% beyond 85. From 10% to 40% beyond 65, prevalence rates grow after 85 [2]. Women have a somewhat greater Alzheimer's disease risk, especially after 85 [13].

3.3Dementia

Dementia causes a broad deterioration in memory and other cognitive processes that hampers everyday tasks. A steady and sustained decline in cognitive function generally causes memory loss and a limited comprehension of one's inadequacies [14]. This conversation emphasises the role of a multidisciplinary team in dementia evaluation and management. The aetiology, risk factors, and difficulties in diagnosing and treating this range of cognitive impairments are also examined.

3.4Etiology

Many illnesses can induce neurocognitive problems, but Alzheimer's dementia (AD) accounts for 70%. Major Neurocognitive disorders have 13 etiological subcategories in the DSM-5. Alzheimer's, vascular, frontotemporal lobar degeneration, Lewy body, Parkinson's, HIV infection, Huntington's, prion, drug and alcohol abuse, traumatic brain injury, another medical condition, multiple aetiologies, and unspecified cases are subtypes. Patients often have many causes of serious neurocognitive disorders [15]. A patient may have vascular and Alzheimer's disease.

3.5Epidemiology

Most dementia cases—70%–80%—are caused by Alzheimer's disease. Hereditary or sporadic. Vascular dementia accounts for 15% of dementia cases and doubles every 5.3 years [16]. Smoking, diabetes, hypertension, and hypercholesterolemia increase vascular dementia risk. Lewy body dementia accounts for 5% of dementia cases, however misdiagnosis skews epidemiological statistics [17]. Parkinson's disease causes 10% of dementia cases, whereas frontotemporal dementia affects 25% of seniors.

3.6Psychiatric Disorders and Dementia

Early descriptions of primary dementias comprised cognitive, functional, and psychiatric symptoms. Alois Alzheimer, who discovered Alzheimer's disease, noted anxiety, hallucinations, delusions, agitation, and memory, orientation, and knowledge problems in patients. His colleagues Arnold Pick, Paul Sérieux, and Joseph Dejerine first defined midlife behaviour and language degradation as frontotemporal dementia. Although recognised early, basic dementias were subsequently called cognitive diseases [18]. Psychiatric issues, including mood, behaviour, perception, and mental content, have been shown to be frequent in dementia for 35 years.

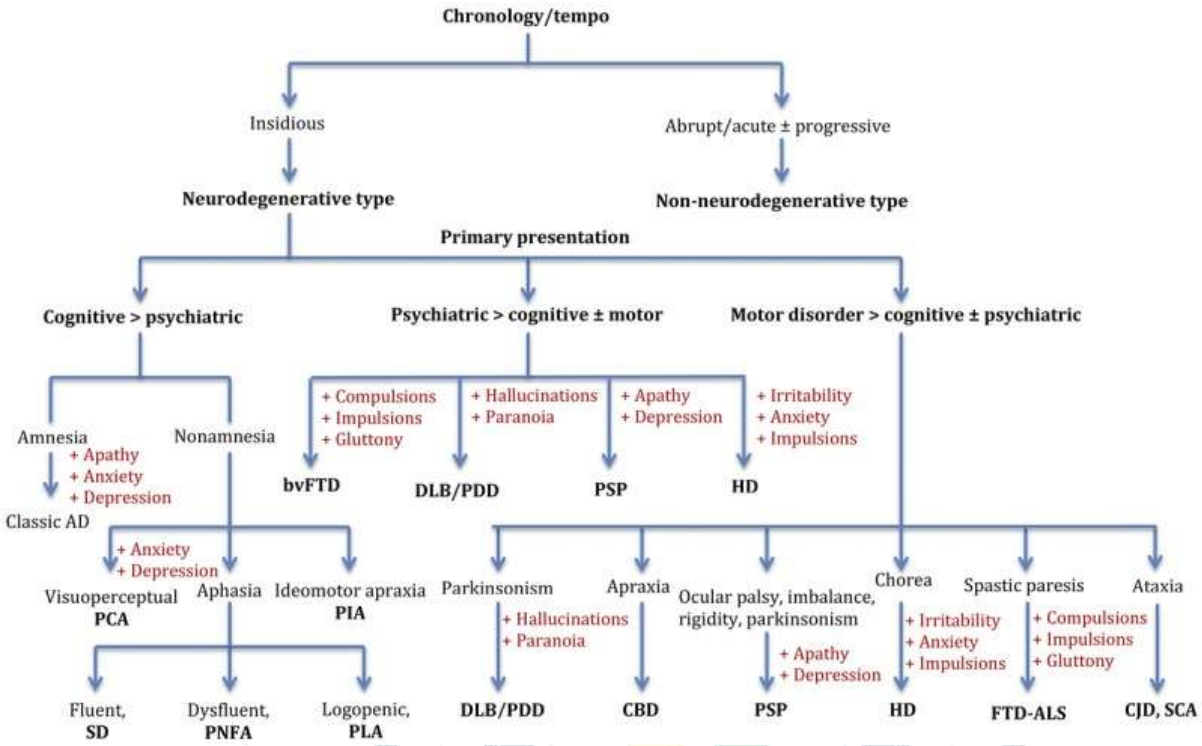

Figure 1: Algorithm for Identifying Neurodegenerative Types of Dementia

This figure illustrates an algorithm for the identification of different neurodegenerative types of dementia. It demonstrates how clusters of symptoms and the corresponding syndromes play a pivotal role in guiding the process of differential diagnosis for dementia. The diagram depicts how cognitive and motor syndromes define distinct pathways, and when combined with psychiatric states (indicated in red text), they can lead to the specific diagnosis of various dementia subtypes, such as the behavioural variant of frontotemporal dementia (bvFTD), frontotemporal dementia with amyotrophic lateral sclerosis (FTD-ALS), and dementia with Lewy bodies (DLB) [19].

This figure is reprinted with permission from Devineni B and Onyike CU, sourced from Psychiatr Clin North Am (2015) [DOI: (www.sciencedirect.com/science/article/pii/S0193953X15000271),

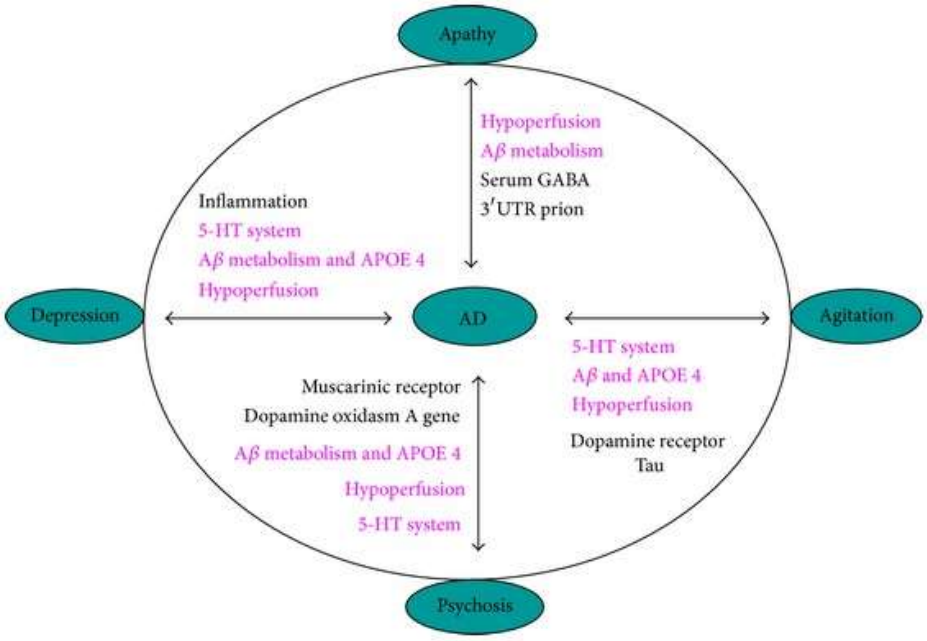

Figure 2: Impact of Neuropsychiatric Symptoms and Behavioural Anomalies in Alzheimer's disease (AD)

This figure highlights the profound impact of neuropsychiatric symptoms and behavioural anomalies in AD on the quality of life (QOL) of patients. These symptoms are believed to be predictive of eventual or more severe dementia, extensive neurodegeneration, loss of functional independence, institutionalization, and early mortality. As such, there is a general consensus that these neuropsychiatric symptoms and behavioural anomalies are indicative of poor outcomes.

3.7 Depression in Alzheimer Disease (AD)

Recent research suggests that 25%–74.9% of AD patients have depression. The incidence varies according to the use of different diagnostic techniques, such as the DSM, NPI-D, and Geriatric DepressionScale [19]. One research found 10.5% NPI-D (significant), 56.4% NPI-D (any), 30% Geriatric Depression Scale (GDS), and 16% antidepressant usage in the same population. The French Network on AD (REAL.FR) found 17.45% each year in several hundred AD patients without depression or medications over four years [20,21]. Clinical depressive symptoms are predicted in 40% of AD patients within 5 years.

3.8 Diagnostic Criteria for Alzheimer's Disease

The diagnostic criteria for Alzheimer's disease involve a series of tests and assessments for individuals suspected of having the condition. These tests include a neurological examination, MRI scans to assess neurons, blood tests, such as vitamin B12 levels, and a comprehensive review of the patient's medical and family histories [22]. Research has established a link between vitamin B12 deficiency and neurological issues, as well as an increased risk of AD. Elevated homocysteine levels, which can result from vitamin B12 deficiency, are a unique indicator and can lead to brain damage through oxidative stress, increased calcium influx, and apoptosis. Diagnosis of vitamin B12 insufficiency can be made by measuring serum vitamin B12 levels, along with tests for serum homocysteine levels and complete blood counts [23,24].

3.9 Treatment

As of the present moment, it is estimated that around 24 million people worldwide suffer from Alzheimer's disease (AD), and experts predict that by 2050, this number may quadruple. Despite being a significant public health concern, there are currently only two types of medications approved for the treatment of AD: cholinesterase enzyme inhibitors and N-methyl D-aspartate (NMDA) antagonists [25,26,27].

The decline in cholinergic transmission in the brain is a consequence of the destruction of acetylcholine-producing cells due to various physiological mechanisms in AD. Acetylcholinesterase inhibitors (AChEIs), which can be classified as irreversible, reversible, and pseudo-reversible, function by preventing cholinesterase enzymes (AChE and BChE) from degrading acetylcholine (ACh). This action increases the concentration of ACh in the synaptic cleft [28].

Conversely, excessive NMDA receptor (NMDAR) activity leads to an increased influx of calcium ions (Ca^{2+}), promoting synaptic dysfunction and cell death. NMDA antagonists restore the normal activity of NMDAR glutamate receptors by preventing overactivation, subsequently reducing Ca^{2+} influx. While these two drug classes have therapeutic effects in alleviating AD symptoms, they do not have the ability to reverse or halt the progression of the disease [29].

Unfortunately, there have been relatively few successful clinical trials in AD treatment in the past decade. To alter the pathogenesis of AD and develop effective treatments, various pathways have been proposed, including the aberrant metabolism of tau proteins, beta-amyloid accumulation, the inflammatory response, cholinergic dysfunction, and oxidative damage [30].

3.10 Symptomatic Treatment for Alzheimer's Disease

Cholinesterase Inhibitors: The cholinergic hypothesis posits that Alzheimer's Disease (AD) results from a reduction in acetylcholine (ACh) biosynthesis. One therapeutic approach to enhance cognitive and neural cell function involves increasing cholinergic levels by inhibiting acetylcholinesterase (AChE) [31,32,33].

Approved Drugs for Symptomatic Treatment of AD: Tacrine, Donepezil, Rivastigmine, Galantamine, Memantine

Disease-Modifying Compounds That Entered Clinical Trials: Semagacestat, Avagacestat, Tarenflurbil, Lanabecestat, Verubecestat, Atabecestat

The study's key findings revealed:

- The overall prevalence of dementia was 5.1%, with a noticeable increase in prevalence with advancing age and a decrease with lower educational levels.
- Among females, the prevalence of dementia was 7.2%, which was twice as high as that observed in males at 3.8% [34].
- Widows, widowers, and unmarried individuals exhibited a doubled prevalence of 9.3% in contrast to the 4.3% prevalence in the married population.
- Age, gender, marital status, education, occupation, the number of family members in the household, and liquor addiction were all significantly associated with dementia.
- The relative risk for the aforementioned variables was found to be greater than 1.

The objective of this study was to investigate the frequency and patterns of psychiatric morbidity, as well as the associations between physical illness and psychiatric morbidity, in an elderly urban population [35]. The research involved enrolling all consenting elderly individuals in a specific municipal ward division (total n=202), following a comprehensive survey of the entire adult population, which comprised 7,239 people [36,37]. A door-to-door survey approach was adopted, involving interviews and physical examinations of the participants. Various assessment tools, including the General Health Questionnaire-12, Mini Mental State Examination, CAGE Questionnaire, and Geriatric Depression Scale, were employed during the interviews, alongside a review of available documents. To verify the information, interviews with other family members were also conducted [38,39,40].

Key findings from the study included:

- Psychiatric illnesses were identified in 26.7% of the population, while physical illnesses were present in 69.8%.
- The most prevalent psychiatric diagnoses were depressive disorders, dementia, generalized anxiety disorder, alcohol dependence, and bipolar disorder.
- The leading physical illnesses included visual impairment, cardiovascular disease, rheumatic illnesses, pulmonary conditions, hearing impairment, genitourinary diseases, and neurological disorders.
- The presence of dementia was associated with factors such as advanced age, single/widowed/separated status, nuclear family setup, economic dependence, low education, and specific physical illnesses like cardiovascular disorders, rheumatic disorders, and neurological disorders.
- Depression was linked to female gender, single/widowed/separated status, residing in nuclear families, economic dependence, and co-existing physical illnesses, particularly cardiovascular disorders and visual impairment.

This study highlighted a higher prevalence of dementia and late-life depression in the studied population. The noteworthy associations with various sociodemographic factors and physical illnesses may have significant implications for healthcare planning.

4. CONCLUSION

In conclusion, this study presents the first reported AD incidence rates from southern India. These incidence rates appear to be notably higher than those reported in rural northern India, comparable to those reported in China, and slightly lower than those reported in Western countries. Dementia needs to be acknowledged as a significant mental health concern in nationwide surveys, and the diverse forms of dementia should be identified as a priority in geriatric care. Future research should focus on identifying potential risk factors, and healthcare organizations should work on developing preventive interventions to delay the onset of dementia. The results of this meta-analysis indicate that 20 per thousand individuals in India are affected by dementia. Given the methodological variations in different studies, it is imperative for The National Mental Health Survey of India to consider dementia as a key area of investigation.

REFERENCE

1. World Health Organization. (1998). Fact Sheet No. 135: Population Ageing – A Public Health Challenge. Geneva: World Health Organization.
2. United Nations, Department of Economic and Social Affairs, Population Division. (2019). World Population Prospects.
3. India Census. (2011). Population Census. New Delhi, India: Ministry of Home Affairs, Government of India.
4. Khan, F. (2011). Dementia in India: It's high time to address the need! Arch Ment Health, 12, 64.
5. Patel, V., & Prince, M. (2001). Ageing and mental health in a developing country: Who cares? Qualitative studies from Goa, India. Psychol Med, 31, 29-38.
6. Murray, C. J., Lopez, A. D., & World Health Organization. (1996). The Global Burden of Disease: A Comprehensive Assessment of Mortality and Disability from Diseases, Injuries, and Risk Factors in 1990 and Projected to 2020: Summary. Harvard: Harvard University Press.
7. Ferri, C. P., Prince, M., Brayne, C., Brodaty, H., Fratiglioni, L., Ganguli, M., et al. (2005). Global prevalence of dementia: A Delphi consensus study. Lancet, 366, 2112-2117.
8. Ganguli, M., Chandra, V., Kamboh, M. I., Johnston, J. M., Dodge, H. H., Thelma, B. K., et al. (2000). Apolipoprotein E polymorphism and Alzheimer disease: The Indo US Cross National Dementia Study. Arch Neurol, 57, 824-830.
9. Yoshitake, T., Kiyohara, Y., Kato, I., Ohmura, T., Iwamoto, H., Nakayama, K., et al. (1995). Incidence and risk factors of vascular dementia and Alzheimer's disease in a defined elderly Japanese population: The Hisayama study. Neurology, 45(6), 1161–1168.
10. Zhang, M., Katzman, R., Yu, E., Liu, W., Xiao, S. F., & Yan, H. (1998). A preliminary analysis of the incidence of dementia in Shanghai, China. Psychiatry Clin Neurosci, 52, S291–S294.
11. Nicolas, G., Acuña-Hidalgo, R., Keogh, M. J., Quenez, O., Steehouwer, M., Lelieveld, S., Rousseau, S., Richard, A. C., Oud, M. S., Marguet, F., Laquerrière, A., Morris, C. M., Attems, J., Smith, C., Ansorge, O., Al Sarraj, S., Frebourg, T., Campion, D., Hannequin, D., Wallon, D., Gilissen, C., Chinnery, P. F., Veltman, J. A., & Hoischen, A. (2018). Somatic variants in autosomal dominant genes are a rare cause of sporadic Alzheimer's disease. Alzheimers Dement, 14(12), 1632-1639.
12. Liljegren, M., Landqvist Waldö, M., Rydbeck, R., & Englund, E. (2018). Police Interactions Among Neuropathologically Confirmed Dementia Patients: Prevalence and Cause. Alzheimer Dis Assoc Disord, 32(4), 346-350.
13. Tong, B. C., Wu, A. J., Li, M., & Cheung, K. H. (2018). Calcium signaling in Alzheimer's disease and therapies. Biochim Biophys Acta Mol Cell Res, 1865(11 Pt B), 1745-1760.
14. Verma, M., Wills, Z., & Chu, C. T. (2018). Excitatory Dendritic Mitochondrial Calcium Toxicity: Implications for Parkinson's and Other Neurodegenerative Diseases. Front Neurosci, 12, 523.
15. Wallace, L., Theou, O., Rockwood, K., & Andrew, M. K. (2018). Relationship between frailty and Alzheimer's disease biomarkers: A scoping review. Alzheimers Dement (Amst), 10, 394-401.
16. Vik-Mo, A. O., Bencze, J., Ballard, C., Hortobágyi, T., & Aarsland, D. (2019). Advanced cerebral amyloid angiopathy and small vessel disease are associated with psychosis in Alzheimer's disease. J Neurol Neurosurg Psychiatry, 90(6), 728-730.
17. Reitz, C., & Mayeux, R. (2014). Alzheimer disease: epidemiology, diagnostic criteria, risk factors, and biomarkers. Biochem Pharmacol, 88(4), 640-645.
18. Schachter, A. S., & Davis, K. L. (2000). Alzheimer's disease. Dialogues Clin Neurosci, 2(2), 91-100.
19. O'Brien, J. T., & Thomas, A. (2015). Vascular dementia. Lancet, 386(10004), 1698-1706.
20. Kane, J. P. M., Surendranathan, A., Bentley, A., Barker, S. A. H., Taylor, J. P., Thomas, A. J., Allan, L. M., McNally, R. J., James, P. W., McKeith, I. G., Burn, D. J., & O'Brien, J. T. (2018). Clinical prevalence of Lewy body dementia. Alzheimers Res Ther, 10(1), 19.
21. Young, J. J., Lavakumar, M., Tampi, D., Balachandran, S., & Tampi, R. R. (2018). Frontotemporal dementia: latest evidence and clinical implications. Ther Adv Psychopharmacol, 8(1), 33-48.
22. Uttley, L., Carroll, C., Wong, R., Hilton, D. A., & Stevenson, M. (2020). Creutzfeldt-Jakob disease: a systematic review of global incidence, prevalence, infectivity, and incubation. Lancet Infect Dis, 20(1), e2-e10.
23. Custodio, N., Montesinos, R., Lira, D., Herrera-Pérez, E., Bardales, Y., & Valeriano-Lorenzo, L. (2017). Mixed dementia: A review of the evidence. Dement Neuropsychol, 11(4), 364-370.
24. McKeith, I. (2004). Dementia with Lewy bodies. Dialogues Clin Neurosci, 6(3), 333-341.
25. McColgan, P., & Tabrizi, S. J. (2018). Huntington's disease: a clinical review. Eur J Neurol, 25(1), 24-34.
26. Salardini, A. (2019). An Overview of Primary Dementias as Clinicopathological Entities. Semin Neurol, 39(2), 153-166.
27. Clifford, D. B., & Ances, B. M. (2013). HIV-associated neurocognitive disorder. Lancet Infect Dis, 13(11), 976-986.
28. Gutwinski, S., Schreiter, S., Priller, J., Henssler, J., Wiers, C. E., & Heinz, A. (2018). Drink and Think: Impact of Alcohol on Cognitive Functions and Dementia - Evidence of Dose-Related Effects. Pharmacopsychiatry, 51(4), 136-143.
29. Uwagbai, O., & Kalish, V. B. (2022). Vascular Dementia. StatPearls [Internet]. StatPearls Publishing; Treasure Island, FL.
30. Kalaria, R. N. (2016). Neuropathological diagnosis of vascular cognitive impairment and vascular dementia with implications for Alzheimer's disease. Acta Neuropathol, 131(5), 659-685.
31. Gomperts, S. N. (2016). Lewy Body Dementias: Dementia With Lewy Bodies and Parkinson Disease Dementia. Continuum (Minneap Minn), 22(2 Dementia), 435-463.
32. Masliah, E., Mallory, M., Deerinck, T., DeTeresa, R., Lamont, S., Miller, A., Terry, RD., Carragher, B., Ellisman, M. (1993). Re-evaluation of the structural organization of neuritic plaques in Alzheimer's disease. J Neuropathol Exp Neurol, 52(6), 619-632.
33. Amador-Ortiz, C., & Dickson, D.W. (2008). Neuropathology of hippocampal sclerosis. Handb Clin Neurol, 89, 569-572.
34. Mackenzie, I.R., & Neumann, M. (2016). Molecular neuropathology of frontotemporal dementia: insights into disease mechanisms from postmortem studies. J Neurochem, 138(Suppl 1), 54-70.
35. Gambetti, P., Kong, Q., Zou, W., Parchi, P., & Chen, SG. (2003). Sporadic and familial CJD: classification and characterisation. Br Med Bull, 66, 213-239.

36. Finger, E.C. (2016). Frontotemporal Dementias. Continuum (Minneap Minn), 22(2 Dementia), 464-489.
37. Manix, M., Kalakoti, P., Henry, M., Thakur, J., Menger, R., Guthikonda, B., Nanda, A. (2015). Creutzfeldt-Jakob disease: updated diagnostic criteria, treatment algorithm, and the utility of brain biopsy. Neurosurg Focus, 39(5), E2.
38. Strub, R.L. (2003). Vascular dementia. Ochsner J, 5(1), 40-43.
39. Deutschländer, A.B., Ross, O.A., Dickson, D.W., & Wszolek, Z.K. (2018). Atypical parkinsonian syndromes: a general neurologist's perspective. Eur J Neurol, 25(1), 41-58.
40. Alzheimer, A. (1911). Über eigenartige Krankheitsfälle des späteren Alters. Z Ges Neurol Psychiatr, 4(1), 356-385.