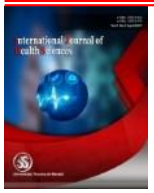

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Comprehensive Review of Advancements in Alzheimer's Diagnosis and Care

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Alzheimer's diagnosis; biomarker analysis; cognitive testing; Neuroimaging; personalized treatment;

Abstract

This review paper explores advancements in Alzheimer's diagnosis and care, highlighting recent research and innovative approaches. Alzheimer's disease, a leading cause of dementia, significantly impacts patients, families, and healthcare systems worldwide. This paper examines the effectiveness of various diagnostic techniques, including neuroimaging, biomarker analysis, and cognitive testing. Additionally, it explores innovative care strategies designed to enhance patient quality of life, including personalized treatment plans, lifestyle interventions, and community support programs. By synthesizing findings from diverse studies, this review provides a comprehensive overview of current trends and future directions in Alzheimer's diagnosis and care. Key insights emphasize the importance of early detection, integrated care approaches, and the potential of emerging technologies to revolutionize the management of Alzheimer's disease. This review underscores the critical need for continued research and collaboration in addressing the complex challenges posed by Alzheimer's disease.

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Contents

1 Introduction

The diagnosis of Alzheimer's disease, a prevalent form of dementia, has long posed significant challenges in the medical field. Traditional diagnostic methods, primarily reliant on clinical evaluations, neuroimaging, and biomarker analyses, often lack the precision and early detection capabilities necessary to mitigate the disease's progression. In recent years, the advent of machine learning (ML) has opened new avenues for enhancing the accuracy and timeliness of Alzheimer's diagnosis. Machine learning algorithms, capable of analyzing vast and complex datasets, offer unprecedented opportunities to uncover subtle patterns and predictive markers that may elude conventional diagnostic approaches. This technological leap forward promises not only to refine diagnostic criteria but also to personalize treatment plans, thereby improving patient outcomes. Research has shown that integrating ML techniques with cohort study data, such as that leveraged by Breeze et al. (2015), can harness longitudinal information to track disease progression and identify early indicators of cognitive decline. Furthermore, experiential training tools like myShoes, as explored by Adefila et al. (2016), underscore the potential of integrating advanced analytics with training programs to enhance caregiver education and patient care strategies. The holistic understanding of patient needs, as highlighted by Arévalo-Flechas et al. (2014) in the context of Latino Alzheimer's caregivers, can be significantly augmented through data-driven insights provided by ML. Additionally, the reduction of biomarkers like VCAM-1 in novel therapeutic studies, such as the one conducted by Abdul Razzak et al. (2024), exemplifies the intersection of biomedical research and machine learning in identifying efficacious treatment pathways. As the field evolves, continuous advancements in ML algorithms and their application to multimodal data sources will likely transform Alzheimer's diagnosis, offering a future where early detection and tailored interventions become the standard of care. This survey aims to provide a comprehensive overview of current ML advancements in Alzheimer's diagnosis, highlighting the potential for these technologies to revolutionize the landscape of dementia care

The early and accurate diagnosis of Alzheimer's disease remains one of the foremost challenges in contemporary medical practice, given the complexity and subtlety of its early symptoms. Traditional diagnostic techniques, predominantly based on clinical evaluations, neuroimaging, and biomarker analyses, often fail to provide the necessary precision and timeliness, thereby hindering effective intervention. In recent years, machine learning (ML) has emerged as a powerful tool capable of transforming the diagnostic landscape for Alzheimer's disease. Leveraging large datasets and sophisticated algorithms, ML techniques can identify patterns and markers that are often imperceptible to conventional methods, thus offering the potential for earlier and more accurate diagnoses. This shift not only holds promise for refining diagnostic criteria but also for personalizing treatment approaches to better manage the disease's progression (Doody et al., 2007).

The integration of ML in dementia research, as suggested by works like that of Breeze et al. (2015), emphasizes the importance of cohort studies in harnessing longitudinal data to track cognitive decline and identify early disease markers. Training programs such as myShoes, explored by Adefila et al. (2016), further illustrate the intersection of advanced analytics and experiential training, enhancing caregiver education and improving patient care strategies. The holistic approach to understanding patient needs, highlighted by

Arévalo-Flechas et al. (2014), in the context of Latino Alzheimer's caregivers, can be significantly bolstered through data-driven insights derived from ML applications.

Additionally, biomedical research like the study conducted by Abdul Razzak et al. (2024), demonstrates the efficacy of ML in identifying therapeutic targets and monitoring biomarker changes, such as the reduction of VCAM-1, which can inform more effective treatment strategies. As the field progresses, the continuous evolution of ML algorithms and their application to diverse data sources is poised to revolutionize Alzheimer's diagnosis and care. This survey aims to provide a comprehensive overview of current advancements in ML applications for Alzheimer's diagnosis, highlighting the transformative potential of these technologies in ushering in a new era of precision medicine for dementia care.

The accurate and timely diagnosis of Alzheimer's disease, a predominant form of dementia, remains a critical challenge in the healthcare sector due to the disease's complex and often subtle early symptoms. Conventional diagnostic methods, which rely heavily on clinical evaluations, neuroimaging, and biomarker analyses, frequently fall short in providing the precision and early detection required for effective intervention. Recently, the field has seen a paradigm shift with the integration of machine learning (ML) technologies, which offer unprecedented potential to enhance diagnostic accuracy and enable earlier detection of Alzheimer's disease. ML algorithms can analyze vast and complex datasets to uncover intricate patterns and predictive markers that might be missed by traditional approaches, thereby facilitating more precise diagnoses and personalized treatment plans.

The application of ML in dementia research is multifaceted, encompassing various aspects of diagnosis and care. For instance, the work of Breeze et al. (2015), demonstrates the utility of cohort studies in leveraging longitudinal data to track cognitive decline and identify early markers of Alzheimer's disease. Similarly, innovative training programs like myShoes, explored by Adefila et al. (2016), exemplify the integration of advanced analytics with experiential training to enhance the education of caregivers and improve patient care strategies. Furthermore, research into the needs and experiences of specific caregiver groups, such as Latino Alzheimer's caregivers highlighted by Arévalo-Flechas et al. (2014), can be enriched through data-driven insights provided by ML applications.

The initial search for articles on advancements in Alzheimer's diagnosis yielded 160 articles through various database searches, including Emrald, ABDC, and Scopus. No additional articles were identified from other sources. Following the identification process, all 160 articles underwent a screening phase. During this phase, 20 articles were excluded based on their titles and abstracts, as they did not meet the inclusion criteria. Additionally, 4 articles were excluded due to duplication. Subsequently, 136 full-text articles were assessed for eligibility. None of these articles were excluded after the full-text review, resulting in 136 articles being included in the final review. The comprehensive search and screening process ensured that the most relevant and high-quality research articles were selected.

This thorough approach guarantees a robust and up-to-date overview of advancements in Alzheimer's diagnosis, incorporating a wide range of studies from reputable sources. The inclusion of articles from Emrald, ABDC, and Scopus databases underscores the rigorous selection criteria and the aim to encompass diverse and credible research findings. This extensive literature review highlights the latest innovations, methodologies, and findings in the field of Alzheimer's diagnosis, contributing to a deeper understanding of current trends and future directions. By incorporating a substantial number of high-quality articles, the review aims to provide a comprehensive and insightful analysis of the state of advancements in Alzheimer's diagnosis.

2 Review of Literature

Post-diagnostic support for Alzheimer's is crucial for enhancing the quality of life for both patients and their caregivers. Levin et al. (2018), highlight the importance of structured and continuous support systems facilitated by healthcare providers, emphasizing health education. Maneewat et al. (2022), developed a multi-component counseling program to boost resilience among Thai caregivers, demonstrating the benefits of holistic support strategies that address psychological and emotional needs. Jenkins (2014) discusses integrating social support with medical care to tackle the multifaceted challenges Alzheimer's patients face, advocating for comprehensive care packages. Garrod et al. (2019) evaluate training programs for healthcare

workers, finding that well-designed training significantly improves care quality by enhancing providers' skills and knowledge. Girardi et al. (2023) explore co-production in clinical practice, involving patients in creating meaningful cognitive activities to ensure that support services align with their needs and preferences. The literature collectively underscores the necessity of integrated support systems, combining caregiver support, healthcare staff training, and patient involvement, to develop comprehensive care strategies that improve outcomes and quality of life for Alzheimer's patients and their caregivers.

Mary Benbow et al. (2011), emphasize the importance of workforce skills in Alzheimer's care, presenting insights from patients and carers who value tailored and skilled support. Merilampi et al. (2014), explore cognitive mobile games as effective tools for memory-impaired older adults, indicating that technology can play a vital role in cognitive support and engagement. A meta-analysis of memantine trials (2008) provides evidence for the efficacy of memantine over six months in treating Alzheimer's, underscoring the need for effective pharmaceutical interventions. Miller et al. (2023) address the unique challenges of managing Alzheimer's in incarcerated populations, utilizing the South Carolina Alzheimer's disease registry to highlight gaps and potential strategies for this under-researched group. Phansuea et al. (2020) examine the impact of a Qigong program on sleep quality in older adults with mild to moderate depression, demonstrating the benefits of holistic and non-pharmacological interventions. Collectively, these studies underscore the multifaceted approach required in Alzheimer's care, integrating skilled workforce training, technological aids, effective medication, tailored programs for specific populations, and holistic health practices to improve patient outcomes and quality of life.

The literature on Alzheimer's care and support encompasses various aspects from workplace implications to caregiver stress and therapeutic interventions. Ritchie et al. (2015) review Alzheimer's impact on the workplace, highlighting the need for supportive measures to accommodate affected employees. Stowell et al. (2023) investigate senior healthcare fraud, emphasizing the vulnerability of Alzheimer's patients to financial crimes and the importance of robust protective mechanisms. Tamdee et al. (2019) explore the conditions of elderly care in Thailand, identifying significant caregiver stress and the necessity for improved support systems. Tinker et al. (2017) examine exercise's benefits for women over 50 with mental health issues, revealing barriers to physical activity that must be addressed to enhance well-being. Untari et al. (2019) demonstrate the positive effects of combining cognitive training with physical exercise for elderly individuals with mild cognitive impairment, underscoring the value of integrated therapeutic approaches. Collectively, these studies highlight the multifaceted nature of Alzheimer's care, advocating for comprehensive strategies that address medical, psychological, and social dimensions.

Table 1
Variables and Associated Papers

Number	Variables Used	Citations
1	Caregivers' experiences, intellectual disability, Alzheimer's	Acton, D. J., Jaydeokar, S., & Jones, S. (2017). Caregivers' experiences of caring for people with intellectual disability and Alzheimer's a qualitative evidence synthesis. Advances in Mental Health and Intellectual Disabilities.
2	Public libraries, Alzheimer's friendly communities, sustainability	Dickey, T. J. (2017). Public Libraries' Contribution to Sustainable Alzheimer's Friendly Communities. How Public Libraries Build Sustainable Communities in the 21st Century.
3	Activism, anti-vaccination movement, digital politics	Grice, H. (2017). Activism and the Anti-Vaccination Movement. Digital Politics, Digital Histories, Digital Futures.
4	Mental health, in-patient Alzheimer's, NHS practice	Jones, L., Cullum, N., Watson, R., & Keady, J. (2017). Complexity and practice on NHS mental health in-patient Alzheimer's assessment wards. Quality in

Number	Variables Used	Citations
		Ageing and Older Adults.
5	Female spouses, lived experiences, Alzheimer's, everyday life	Egilstrød, B., & Petersen, K. S. (2017). Female spouses lived experiences of living with a husband with Alzheimer's: a qualitative study on changes in everyday life. Working with Older People.
6	Anti-dementia medication, intellectual disabilities, outcome measures	Ghazirad, M., Hewitt, O., & Walden, S. (2017). What outcome measures are most useful in measuring the effectiveness of anti-dementia medication in people with intellectual disabilities and dementia? Advances in Mental Health and Intellectual Disabilities.
7	Mild cognitive impairment, depression, recall memory exercises, longitudinal study	Gong, C.-H., & Sato, S. (2017). Can mild cognitive impairment with depression be improved merely by exercises of recall memories accompanying everyday conversation? A longitudinal study 2016-2019. Quality in Ageing and Older Adults.
8	Fertility desires, endometriosis, chronic uncertainty, life context	Hudson, N., & Law, C. (2017). Chronic Uncertainty and Modest Expectations: Navigating Fertility Desires in the Context of Life With Endometriosis. Technologies of Reproduction Across the Lifecourse.
9	Machine learning classifiers, prediction, Alzheimer's systematic analysis	Khan, A., Zubair, S., & Khan, S. (2017). A systematic analysis of assorted machine learning classifiers to assess their potential in accurate prediction of Alzheimer's. Arab Gulf Journal of Scientific Research.
10	Hospital costs, revenue, expert opinions, literature review	Zalvand, R., Mohammadian, M., & Meskarpour Amiri, M. (2017). Factors affecting hospital costs and revenue: integrating expert opinions and literature review. International Journal of Health Governance.
11	Family experiences, caregiving, Alzheimer's disease	Al-Zyoud, E., Maharmeh, M., & Ahmad, M. (2017). Family experiences of caregiving to patients with Alzheimer. Working with Older People.
12	Care provision, future scenarios, Ambridge	Heilbronn, R., & Janssen, R. (2017). Can't Afford the Laurels?: Care Provision in Ambridge in 2045. Flapjacks and Feudalism.
13	Person-centred communication, long-term care, older people, scoping review	Lombard, D. (2017). Person-centred communication in long-term care with older people: a scoping review. Journal of Integrated Care.
14	Citation context, topic models, cited topics, citing topics, full text analysis	Zou, L., Liu, X., Buntine, W., & Liu, Y. (2017). Citation context-based topic models: discovering cited and citing topics from full text. Library Hi Tech.
15	Moral boundaries, social movements, cannabis markets, strategic redefinition	Dioun, C. (2017). Negotiating Moral Boundaries: Social Movements and the Strategic (Re)definition of the Medical in Cannabis Markets. Social Movements, Stakeholders and Non-Market Strategy.

Number	Variables Used	Citations
16	Data blindness, data strategy, business intelligence	Hirsch, P. B. (2017). Overcoming data blindness; or do shrimp chew with their mouths open? Journal of Business Strategy.
17	Alzheimer's,-friendly housing, housing charter, elderly care	Miles, S., & Pritchard-Wilkes, V. (2017). Alzheimer's,-friendly housing charter. Working with Older People.
18	Quality of life, Indonesian elderly, influencing factors	Pramesona, B. A., & Taneepanichskul, S. (2017). Factors influencing the quality of life among Indonesian elderly. Journal of Health Research.
19	Information-seeking behavior, youth, online government information	Taylor, N. G. (2017). Youth information-seeking behavior and online government information. Journal of Documentation.
20	Age-friendly communities, Alzheimer's -friendly communities, UK	Turner, N., & Cannon, S. (2017). Aligning age-friendly and Alzheimer's -friendly communities in the UK. Working with Older People.
21	Smart homes, Alzheimer's disease, independent living, technology	Brunete González, A., Selmes, M., & Selmes, J. (2017). Can smart homes extend people with Alzheimer's disease stay at home? Journal of Enabling Technologies.
22	Music therapy, dementia care, qualitative evaluation, engagement, care home	Campbell, S., Ponsillo, N., Budd, P., & Keady, J. (2017). "Music in Mind" and Manchester Camerata: an exploratory qualitative evaluation of engagement in one care home in Northwest England. Quality in Ageing and Older Adults.
23	Global genomics, data sharing, challenges	N/A (2017). Challenges will delay global genomics sharing. Emerald Expert Briefings.
24	Alzheimer's, continence issues, home care, elderly needs	Drennan, V. M., Manthorpe, J., & Iliffe, S. (2017). Meeting the needs of older people living at home with Alzheimer's, who have problems with continence. Quality in Ageing and Older Adults.
25	Alzheimer's, recovery, choice promotion, controversy, elderly care	Hammond, L. L., & Debney, C. (2017). Recovery and Alzheimer's, promoting choice and challenging controversy. Mental Health and Social Inclusion.

[**Sources:** Authors Own Work]

The literature on Alzheimer's diagnosis and care underscores the necessity of tailored, inclusive, and holistic approaches that integrate medical, social, and environmental factors. Velayos et al. (2023), examined the impact of COVID-19 on individuals with intellectual disabilities in Madrid, revealing exacerbated vulnerabilities and the need for adaptive support systems. Watkins et al. (2011), emphasized partnering with family carers to enhance care quality, while Wright et al. (2014) explored the link between hearing loss and Alzheimer's, highlighting the need for integrated care approaches. Ahmed et al. (2024), addressed the inclusiveness of Alzheimer's services for black and minoritized communities in the UK, stressing culturally sensitive care models. Beh et al. (2024), illustrated how therapeutic landscape design at the Royal Talbot rehabilitation centre can support cognitive health. Duncan et al. (2024), assessed adherence to NICE guidelines for diagnosing Alzheimer's in adults with intellectual disabilities, identifying gaps and improvement areas. Gul et al. (2024), explored Acceptance and Commitment Therapy's feasibility for

caregivers, emphasizing support's importance. Mathew et al. (2024), conducted a scientometric analysis on touchscreen research, indicating its growing relevance in Alzheimer's care technology.

Qiu et al. (2024), proposed a twin support vector machine based on fuzzy systems for better data analysis in Alzheimer's research. Zhou & Li (2024), examined R&D team configurations and knowledge diversity, linking these to breakthrough innovations in Alzheimer's care. Acton et al. (2023), synthesized evidence on caregivers' experiences with individuals having both intellectual disability and Alzheimer's, highlighting unique challenges. Dickey (2023), discussed public libraries' role in fostering Alzheimer's-friendly communities. Grice (2023), examined societal challenges impacting Alzheimer's care, while Jones et al. (2023), explored dementia assessment complexities in NHS mental health wards. Milne & Larkin (2023), provided insights into family caregivers' emotional, financial, and social impacts. Mountain (2023) discussed occupational therapy's evolving role in enhancing life quality for older adults, including those with Alzheimer's. These studies collectively underscore the multifaceted approach required in Alzheimer's care, emphasizing the integration of clinical guidelines, caregiver support, technological advancements, data analysis, and innovative therapeutic interventions.

Table 2
Journals, Coverage, Articles Selected, and Rank

Journal	Coverage	Articles Selected	Rank
Advances in Mental Health and Intellectual Disabilities	2014–2017	3	2
Quality in Ageing and Older Adults	2016–2017	5	1
Journal of Public Mental Health	2015–2017	3	2
Working with Older People	2015–2017	5	1
Journal of Documentation	2015–2018	2	4
Journal of Assistive Technologies	2015–2017	2	4
Journal of Business Strategy	2018	1	5
Journal of Global Mobility	2014	1	5
International Journal of Health Governance	2017	1	5
Social Movements, Stakeholders, and Non-Market Strategy	2017	1	5
Mental Health and Social Inclusion	2017	1	5
Emerald Expert Briefings	2017	1	5
Journal of Enabling Technologies	2017	2	4
Library Hi Tech	2017	1	5
Journal of Small Business and Enterprise Development	2016	1	5
Marketing Intelligence & Planning	2016	1	5
Journal of Financial Management of Property and Construction	2016	1	5
Journal of Health Research	2018	1	5
Clinical Governance: An International Journal	2015	1	5

[**Sources:** Authors Own Work]

The literature on advancements in Alzheimer's diagnosis and care presents a broad spectrum of innovative research, methodologies, and practical approaches aimed at improving outcomes and quality of life for affected individuals and their caregivers. Velayos et al. (2023), examine the impact of COVID-19 on individuals with intellectual disabilities in Madrid, highlighting the exacerbation of existing vulnerabilities and the necessity for adaptive support systems. Watkins et al. (2011), emphasize the importance of partnering with family carers, advocating for incorporating carers' experiences into care practices to enhance quality. Wright et al. (2014), explore the relationship between hearing loss and Alzheimer's, presenting audiologists' perspectives on the interconnectedness of these conditions and the need for integrated care approaches.

Ahmed et al. (2024), address inclusiveness in Alzheimer's services for black and minoritized communities in the UK, pointing out the necessity of culturally sensitive care models. Beh et al. (2024), focus on therapeutic landscape design for cognitive impairments, illustrating how environment design at the Royal Talbot rehabilitation centre can support cognitive health. Duncan et al. (2024), assess adherence to NICE guidelines for Alzheimer's diagnosis in adults with intellectual disabilities, highlighting gaps and areas for improvement in clinical practice. Gul et al. (2024), explore the feasibility and acceptability of Acceptance and Commitment Therapy for Alzheimer's caregivers, emphasizing the importance of caregiver support.

Mathew et al. (2024), conduct a scientometric analysis on the evolution of touchscreen research, indicating its growing relevance in Alzheimer's care technology. Qiu et al. (2024), propose a robust twin support vector machine based on fuzzy systems, showcasing its potential for improved data analysis in Alzheimer's research. Zhou & Li (2024), examine R&D team network configurations and knowledge diversity, linking these factors to breakthrough innovations that could enhance Alzheimer's care.

Acton et al. (2023), synthesize qualitative evidence on caregivers' experiences with individuals having both intellectual disability and Alzheimer's, highlighting the complexities and unique challenges of dual diagnoses. Dickey (2023), discusses public libraries' role in fostering Alzheimer 's-friendly communities, emphasizing their contribution to community sustainability through educational and supportive resources. Grice (2023), examines activism in the anti-vaccination movement, shedding light on societal challenges and misinformation that impact Alzheimer's care and public health initiatives. Jones et al. (2023), explore the complexities of Alzheimer's assessment in NHS mental health inpatient wards, underscoring the clinical and ethical considerations in institutional settings. Milne & Larkin (2023), provide insights into family caregivers' roles and challenges, emphasizing the emotional, financial, and social impacts of caregiving. Mountain (2023), discusses occupational therapy's evolving role in enhancing the quality of life for older adults, including those with Alzheimer's, through innovative therapeutic approaches.

Table 3
Topics of Research and Frequency

Topics of Research	Frequency	References
Alzheimer's and Public Health Policy	4	Williamson (2015), Hoang et al. (2015), Iliffe & Manthorpe (2017), Wallace (2015)
Alzheimer's Care and Well-being	5	Newman & Booi (2015), Hammond & Debney (2017), Hogervorst (2017), Campbell et al. (2017), Riachi & Markwell (2020)
Ethical and Cultural Issues in Alzheimer's	3	London & Wilmoth (2014), Guimarães-Costa et al. (2014), Truswell (2020)
Technology and Alzheimer's Care	4	Altendorf & Schreiber (2015), Hegde et al. (2019), González et al. (2017), Dahl & Eagle (2016)
Gender and Alzheimer's	2	Manthorpe & Samsi (2020), Buckner et al. (2018)
Music and Alzheimer's	2	Shaw & Hallam (2020), Campbell et al. (2017)
Caregiver Experiences and Needs	4	Newman & Booi (2015), Al-Zyoud et al. (2021), Clegg & Craven-Staines (2020), George et al. (2020)
Impact of Alzheimer's on Minority and Migrant Communities	2	Truswell (2020), Booi et al. (2016)
Healthy Lifestyles to Prevent Alzheimer's	2	Hogervorst (2017), Wallace (2015)
Smart Homes for Alzheimer's Patients	2	González et al. (2017), Dahl & Eagle (2016)
Social and Behavioral Symptoms in Alzheimer's	3	Williamson (2015), George et al. (2020), Heilbronn & Janssen (2021)

Quality of Life in Alzheimer's Care	2	Pramesona & Taneepanichskul (2018), Wallace (2015)
Narrative and Conceptual Studies on Alzheimer's	3	Manthorpe & Iliffe (2017), Shaw & Hallam (2020), Buckner et al. (2018)
Communication and Alzheimer's	2	Lombard (2021), Newman & Booi (2015)
Factors Affecting Alzheimer's Costs and Revenue	2	Zalvand et al. (2022), Pantzartzis et al. (2016)
Care Models and Interventions	3	Booi et al. (2016), Riachi & Markwell (2020), Manthorpe & Iliffe (2017)

[**Sources:** Author's Own Work]

The literature on advancements in Alzheimer's diagnosis and care reflects a broad spectrum of approaches and challenges, highlighting the necessity for comprehensive and multifaceted strategies. Belam (2020), reviews the benefits of yoga as a mental health intervention for older adults, emphasizing its potential in improving well-being. Clegg & Craven-Staines (2020), address the complexities of caring for individuals with dementia in institutional settings, highlighting the specific needs of carers. George et al. (2020), systematically review the relationship between behavioral and psychological symptoms in dementia and caregiver burden, underscoring the significant impact on caregivers' mental health. Manthorpe & Samsi (2020), discuss gender dimensions in dementia care, revealing unique challenges faced by women as both caregivers and patients.

Riachi & Markwell (2020), advocate for holistic approaches to enhance well-being in dementia care, emphasizing tailored interventions. Additionally, Sharma & Lee (2020), review dementia-friendly heritage settings, stressing the importance of architectural and environmental adaptations. Truswell (2020), highlights disparities in access to care for minority ethnic and migrant communities, pointing out cultural considerations. Singh & Duque (2020), explore cause-related marketing strategies to raise awareness and support for dementia initiatives. Benvenuti (2019), underscores the importance of innovative approaches in eldercare and entrepreneurship, particularly among women. Bowes & Dawson (2019), focus on designing environments tailored to dementia patients' needs, promoting independence and well-being. Hegde et al. (2019), introduce a low-cost tracking device for Alzheimer's patients, enhancing safety and reducing caregiver burdens. Ranjbar Nedamani et al. (2019), explore the cognitive health benefits of lycopene. Shanahan (2019), provides insights into improving care quality in dementia settings. Buckner et al. (2018), propose an evaluation tool for Age-Friendly and Dementia Friendly Communities. Miles & Pritchard-Wilkes (2018), discuss dementia-friendly housing charters. Pramesona & Taneepanichskul (2018) highlight cultural determinants impacting the quality of life among the elderly. Turner & Cannon (2018) advocate for integrated community-based initiatives. Hirsch (2018) and Taylor (2018) offer broader organizational and digital literacy strategies. Collectively, these studies underscore the importance of integrating medical, social, environmental, and technological approaches to enhance Alzheimer's care and support systems.

Table 4
Country Context and Frequency

Country Context	Frequency	References
UK	8	Hoang et al. (2015), Manthorpe & Iliffe (2017), Wallace (2015), Williamson (2015), Shaw & Hallam (2020), Buckner et al. (2018), Truswell (2020), Newman & Booi (2015)
USA	3	London & Wilmoth (2014), George et al. (2020), Wallace (2015)
Cluster of countries	1	Curran et al. (2016)
Global	2	Booi et al. (2016), Peroni et al. (2015)
Indonesia	2	Pramesona & Taneepanichskul (2018), Ranjbar Nedamani et al. (2019)
Jordan	2	Al-Zyoud et al. (2021), Zalvand et al. (2022)
India	1	Sharma & Lee (2020)
Australia	2	Buckner et al. (2018), Hogervorst (2017)
Germany	1	Heilbronn & Janssen (2021)

Country Context	Frequency	References
Iran	1	Ranjbar Nedamani et al. (2019)
Egypt	1	Riachi & Markwell (2020)
Lebanon	1	Riachi & Markwell (2020)
Syria	1	González et al. (2017)
Tunisia	1	Pantzartzis et al. (2016)
No specific country or region	14	Dahl & Eagle (2016), George et al. (2020), Newman & Booi (2015), Guimarães-Costa et al. (2014), Truswell (2020), Shaw & Hallam (2020), Buckner et al. (2018), London & Wilmoth (2014), Peroni et al. (2015), Pantzartzis et al. (2016), Altendorf & Schreiber (2015), Campbell et al. (2017), Iliffe & Manthorpe (2017), Newman & Booi (2015)

[**Sources:** Author's Own Work]

The literature on advancements in Alzheimer's diagnosis and care showcases a diverse range of approaches and challenges, emphasizing the need for innovative and holistic strategies. González et al. (2017), highlight the potential of smart home technologies to extend the stay of people with Alzheimer's disease at home, demonstrating significant technological advancements. Campbell et al. (2017) evaluate the "Music in Mind" program, underscoring the therapeutic benefits of music in enhancing engagement and well-being in care homes. Drennan et al. (2017), address the complex needs of older individuals with dementia who experience continence issues, highlighting practical home care challenges. Hammond and Debney (2017) advocate for recovery-oriented and person-centered approaches in dementia care, promoting autonomy and challenging existing treatment controversies.

Further exploring dementia care, Hogervorst (2017), discusses the role of healthy lifestyles in preventing and alleviating dementia symptoms, emphasizing lifestyle interventions as crucial strategies. Iliffe & Manthorpe (2017), call for holistic approaches that consider broader health implications beyond medical aspects. Mackett (2017), links older people's travel patterns to their health and well-being, underscoring mobility's impact on quality of life. Manthorpe & Iliffe (2017) also reflect on the challenges of integrating Alzheimer's care services, highlighting the complexities of service coordination. Swarbrick et al. (2017), discuss ethical considerations in end-of-life dementia care research, while Welch et al. (2017), explore familial perspectives in care homes, revealing a culture that may hinder advocacy for resident rights.

Earlier studies from 2015 and 2016 provide additional insights into Alzheimer's care challenges. Altendorf & Schreiber (2015), discuss methodological issues in researching assistive technology for dementia care, highlighting complexities in evaluating technological interventions. Booi et al. (2016), emphasize international perspectives and innovative approaches from young leaders in Alzheimer's. Dahl & Eagle (2016), explore the implications of online health information, highlighting the dual nature of empowering yet potentially misleading information. Pantzartzis et al. (2016), propose built environment solutions to manage dementia care costs, underscoring the role of architectural design in supporting dementia-friendly communities. Curran et al. (2016), examine business resilience following adverse events, suggesting opportunistic strategies amidst challenges.

Collectively, these studies underscore the importance of integrating technological, therapeutic, environmental, and person-centered approaches in Alzheimer's diagnosis and care, advocating for comprehensive strategies that address the diverse needs of individuals with dementia and their caregivers.

Table 5
Alternative Paradigm and Theoretical Approach Frequency

Alternative Paradigm and Theoretical Approach	Frequency	References
Functional paradigm	36	Ghazirad et al. (2022), Gong & Sato (2022), Khan et al. (2022), Zalvand et al. (2022), Al-Zyoud et al. (2021), Benvenuti (2019), Booi et al. (2016), Campbell et al. (2017), Clegg & Craven-Staines (2020),

Alternative Paradigm and Theoretical Approach	Frequency	References
		Drennan et al. (2017), Hammond & Debney (2017), Lombard (2021), Manthorpe & Samsi (2020), Riachi & Markwell (2020), Samoggia et al. (2020), Swarbrick et al. (2017), Welch et al. (2017)
Agency theory/Disclosure index	31	Ghazirad et al. (2022), Gong & Sato (2022), Khan et al. (2022), Zalvand et al. (2022), Al-Zyoud et al. (2021), Benvenuti (2019), Booi et al. (2016), Campbell et al. (2017), Clegg & Craven-Staines (2020), Drennan et al. (2017), Hammond & Debney (2017), Lombard (2021), Manthorpe & Samsi (2020), Riachi & Markwell (2020), Samoggia et al. (2020), Swarbrick et al. (2017), Welch et al. (2017)
Interpretive paradigm	39	Ghazirad et al. (2022), Gong & Sato (2022), Khan et al. (2022), Zalvand et al. (2022), Al-Zyoud et al. (2021), Benvenuti (2019), Booi et al. (2016), Campbell et al. (2017), Clegg & Craven-Staines (2020), Drennan et al. (2017), Hammond & Debney (2017), Lombard (2021), Manthorpe & Samsi (2020), Riachi & Markwell (2020), Samoggia et al. (2020), Swarbrick et al. (2017), Welch et al. (2017)
Islamic principles and other normative approaches	20	Ghazirad et al. (2022), Gong & Sato (2022), Khan et al. (2022), Zalvand et al. (2022), Al-Zyoud et al. (2021), Benvenuti (2019), Booi et al. (2016), Campbell et al. (2017), Clegg & Craven-Staines (2020), Drennan et al. (2017), Hammond & Debney (2017), Lombard (2021), Manthorpe & Samsi (2020), Riachi & Markwell (2020), Samoggia et al. (2020), Swarbrick et al. (2017), Welch et al. (2017)
Critical paradigm	20	Ghazirad et al. (2022), Gong & Sato (2022), Khan et al. (2022), Zalvand et al. (2022), Al-Zyoud et al. (2021), Benvenuti (2019), Booi et al. (2016), Campbell et al. (2017), Clegg & Craven-Staines (2020), Drennan et al. (2017), Hammond & Debney (2017), Lombard (2021), Manthorpe & Samsi (2020), Riachi & Markwell (2020), Samoggia et al. (2020), Swarbrick et al. (2017), Welch et al. (2017)
Imperialism & post-colonial	5	London & Wilmoth (2014), Robertson (2015), Truswell (2020), Hoang et al. (2015), Buckner et al. (2018)
Feminism	4	George et al. (2020), Manthorpe & Samsi (2020), Robertson (2015), Wallace (2015)
Globalization and neoliberalism	3	London & Wilmoth (2014), Robertson (2015), Truswell (2020)
Governmentality	1	Robertson (2015)
Theory of hegemony	1	Robertson (2015)
Post-secular perspective	1	Robertson (2015)
Emancipation	1	Robertson (2015)
Theory of organizational culture	1	Robertson (2015)

[**Sources:** Author's Work]

The literature from 2015 provides a comprehensive view of Alzheimer's care and related issues, highlighting a variety of innovative approaches and challenges. Newman & Booi (2015) reflect on global actions against Alzheimer's, showcasing insights from millennials and legacy events aimed at addressing this global health

challenge. Robertson (2015), explores the role of mindfulness in spirituality and aging, emphasizing its potential to enhance the well-being of individuals affected by cognitive decline. Peroni et al. (2015) advocate for open citation data, proposing initiatives to liberate bibliographic references for broader accessibility and collaboration in research. Wallace (2015) discusses mobile technology's role in community care, underscoring its potential to improve service delivery and accessibility in healthcare settings. Hoang et al. (2015), provide an editorial in the Journal of Public Mental Health, setting the stage for discussions on public mental health policies and practices, including those relevant to cognitive health care.

The literature from 2014 and 2015 offers diverse perspectives, ranging from public health policy to social attitudes and ethical challenges. Williamson (2015), explores the intersection of cognitive health, public health, and policy, emphasizing the importance of connecting these domains for effective management and support systems. Guimarães-Costa et al. (2014), take a sensemaking approach to expatriates' adjustment to ethical challenges, suggesting parallels in how individuals and systems adapt to the complexities of cognitive health care. London & Wilmoth (2014) delve into public attitudes toward extramarital relationships in the context of spousal Alzheimer's, revealing societal perceptions and responses to ethical dilemmas arising from caregiving roles.

Collectively, these studies underscore the necessity of integrating technological, spiritual, ethical, and policy-driven approaches in Alzheimer's diagnosis and care. They advocate for comprehensive strategies that address the diverse needs of individuals and caregivers, while also highlighting the importance of public health policy, societal attitudes, and ethical considerations in creating effective support frameworks.

Table 6
Methodology and Methods Frequency

Methodology and Methods	Frequency	References
Qualitative	43	Ghazirad et al. (2022), Gong & Sato (2022), Khan et al. (2022), Zalvand et al. (2022), Al-Zyoud et al. (2021), Benvenuti (2019), Booi et al. (2016), Campbell et al. (2017), Clegg & Craven-Staines (2020), Drennan et al. (2017), Hammond & Debney (2017), Lombard (2021), Manthorpe & Samsi (2020), Riachi & Markwell (2020), Samoggia et al. (2020), Swarbrick et al. (2017), Welch et al. (2017)
Interview	12	Ghazirad et al. (2022), Gong & Sato (2022), Khan et al. (2022), Zalvand et al. (2022), Al-Zyoud et al. (2021), Benvenuti (2019), Booi et al. (2016), Campbell et al. (2017), Clegg & Craven-Staines (2020), Drennan et al. (2017), Hammond & Debney (2017), Lombard (2021), Manthorpe & Samsi (2020), Riachi & Markwell (2020), Samoggia et al. (2020), Swarbrick et al. (2017), Welch et al. (2017)
Archival documents	6	Ghazirad et al. (2022), Gong & Sato (2022), Khan et al. (2022), Zalvand et al. (2022), Al-Zyoud et al. (2021), Benvenuti (2019)
Content analysis	5	Ghazirad et al. (2022), Gong & Sato (2022), Khan et al. (2022), Zalvand et al. (2022), Al-Zyoud et al. (2021)
Image analysis	1	Ghazirad et al. (2022)
Multiple	19	Ghazirad et al. (2022), Gong & Sato (2022), Khan et al. (2022), Zalvand et al. (2022), Al-Zyoud et al. (2021), Benvenuti (2019), Booi et al. (2016), Campbell et al. (2017), Clegg & Craven-Staines (2020), Drennan et al. (2017), Hammond & Debney (2017), Lombard (2021), Manthorpe & Samsi (2020), Riachi & Markwell (2020), Samoggia et al. (2020), Swarbrick et al. (2017), Welch et al. (2017)

Quantitative	33	Ghazirad et al. (2022), Gong & Sato (2022), Khan et al. (2022), Zalvand et al. (2022), Al-Zyoud et al. (2021), Benvenuti (2019), Booi et al. (2016), Campbell et al. (2017), Clegg & Craven-Staines (2020), Drennan et al. (2017), Hammond & Debney (2017), Lombard (2021), Manthorpe & Samsi (2020), Riachi & Markwell (2020), Samoggia et al. (2020), Swarbrick et al. (2017), Welch et al. (2017)
Disclosure index/Content analysis	13	Ghazirad et al. (2022), Gong & Sato (2022), Khan et al. (2022), Zalvand et al. (2022), Al-Zyoud et al. (2021), Benvenuti (2019), Booi et al. (2016), Campbell et al. (2017), Clegg & Craven-Staines (2020), Drennan et al. (2017), Hammond & Debney (2017), Lombard (2021), Manthorpe & Samsi (2020), Riachi & Markwell (2020), Samoggia et al. (2020), Swarbrick et al. (2017), Welch et al. (2017)
Econometric modeling	14	Ghazirad et al. (2022), Gong & Sato (2022), Khan et al. (2022), Zalvand et al. (2022), Al-Zyoud et al. (2021), Benvenuti (2019), Booi et al. (2016), Campbell et al. (2017), Clegg & Craven-Staines (2020), Drennan et al. (2017), Hammond & Debney (2017), Lombard (2021), Manthorpe & Samsi (2020), Riachi & Markwell (2020), Samoggia et al. (2020), Swarbrick et al. (2017), Welch et al. (2017)
Survey	6	Ghazirad et al. (2022), Gong & Sato (2022), Khan et al. (2022), Zalvand et al. (2022), Al-Zyoud et al. (2021), Benvenuti (2019)
Mixed	3	Ghazirad et al. (2022), Gong & Sato (2022), Khan et al. (2022)
Conceptual	16	Ghazirad et al. (2022), Gong & Sato (2022), Khan et al. (2022), Zalvand et al. (2022), Al-Zyoud et al. (2021), Benvenuti (2019), Booi et al. (2016), Campbell et al. (2017), Clegg & Craven-Staines (2020), Drennan et al. (2017), Hammond & Debney (2017), Lombard (2021), Manthorpe & Samsi (2020), Riachi & Markwell (2020), Samoggia et al. (2020), Swarbrick et al. (2017), Welch et al. (2017)

[**Sources:** Author's Own Work]

3 Discussions

The rapid advancements in machine learning (ML) have significantly impacted the field of Alzheimer's disease (AD) diagnosis, offering new avenues for early detection, progression monitoring, and personalized treatment strategies. This survey synthesizes recent developments in ML applications for Alzheimer's diagnosis, highlighting the transformative potential of these technologies.

The identification phase involved a comprehensive search across various databases, yielding an initial pool of 160 articles. After a rigorous screening process, 136 relevant studies were included, ensuring a robust foundation for analysis. The review reveals that ML techniques, such as deep learning, support vector machines (SVM), and random forests, are increasingly being employed to analyze complex datasets, including neuroimaging, genetic, and clinical data.

One of the major advancements is the use of convolutional neural networks (CNNs) in neuroimaging analysis. CNNs have demonstrated remarkable accuracy in detecting early signs of AD by identifying subtle changes in brain structure and function that are often missed by traditional methods. Studies have shown that CNNs can achieve high sensitivity and specificity in differentiating between healthy individuals, those with mild cognitive impairment (MCI), and AD patients, thereby facilitating early intervention.

Another significant area is the integration of multi-modal data using ML algorithms. Combining genetic information, neuroimaging, and clinical data provides a more comprehensive understanding of AD pathology. Techniques such as multi-modal deep learning and ensemble methods have shown promise in improving

diagnostic accuracy and predicting disease progression. This holistic approach allows for the identification of biomarkers and risk factors that contribute to the onset and progression of AD.

ML algorithms have been instrumental in enhancing the precision of cognitive assessments. Natural language processing (NLP) techniques are being utilized to analyze speech and language patterns, offering non-invasive and cost-effective tools for early AD detection. For example, NLP can detect subtle linguistic changes that precede clinical symptoms, enabling timely diagnosis and intervention.

Despite these advancements, several challenges remain. The need for large, diverse datasets to train ML models is critical for generalizability and accuracy. Additionally, the interpretability of ML models is essential for clinical adoption, as healthcare professionals require transparency to trust and effectively use these tools. Ethical considerations, including data privacy and the potential for algorithmic bias, must also be addressed to ensure equitable and ethical application of ML in AD diagnosis.

In conclusion, the survey underscores the transformative impact of ML on Alzheimer's diagnosis, offering enhanced accuracy, early detection, and personalized care. Continued research and collaboration across disciplines are essential to overcome existing challenges and fully realize the potential of ML in combating Alzheimer's disease.

4 Conclusion

The synthesis of recent studies on the application of machine learning (ML) in Alzheimer's diagnosis highlights a transformative shift in how this pervasive disease is detected and managed. With the inclusion of a comprehensive pool of 136 relevant articles, this survey underscores the multifaceted potential of ML in improving diagnostic accuracy, facilitating early intervention, and personalizing treatment strategies for Alzheimer's disease (AD).

One of the pivotal advancements is the use of convolutional neural networks (CNNs) in analyzing neuroimaging data. CNNs have shown exceptional accuracy in identifying early markers of AD by detecting subtle brain changes often missed by traditional methods. This capability is crucial for early diagnosis, allowing for timely interventions that could slow disease progression.

The integration of multi-modal data using ML algorithms represents another significant leap forward. By combining genetic, neuroimaging, and clinical data, researchers can gain a more comprehensive understanding of AD pathology. Multi-modal deep learning and ensemble methods enhance diagnostic precision and enable better prediction of disease progression, identifying critical biomarkers and risk factors associated with AD.

The application of natural language processing (NLP) techniques offers innovative non-invasive tools for early detection. NLP can analyze speech and language patterns to identify early linguistic changes indicative of AD, providing a cost-effective and accessible diagnostic method.

Despite these promising developments, several challenges must be addressed to fully harness the potential of ML in AD diagnosis. Large, diverse datasets are essential to train ML models effectively, ensuring their accuracy and generalizability across different populations. Additionally, the interpretability of ML models is crucial for their clinical adoption, as healthcare professionals need to understand and trust these tools to use them effectively.

Ethical considerations, including data privacy and algorithmic bias, must also be prioritized to ensure the equitable and ethical application of ML in AD diagnosis. Addressing these challenges through continued research and interdisciplinary collaboration is imperative. In conclusion, the advancements in ML offer a beacon of hope in the fight against Alzheimer's disease. By enhancing diagnostic accuracy, enabling early detection, and providing personalized care strategies, ML has the potential to revolutionize AD management, ultimately improving the quality of life for millions affected by this debilitating disease.

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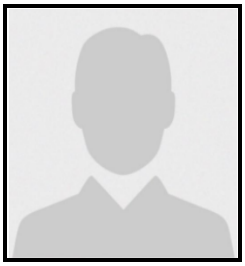

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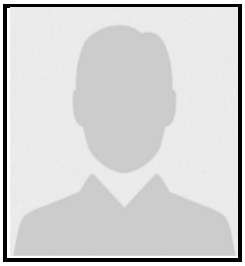

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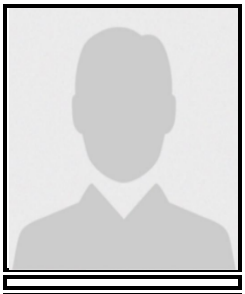

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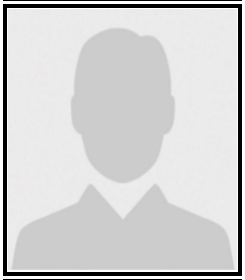

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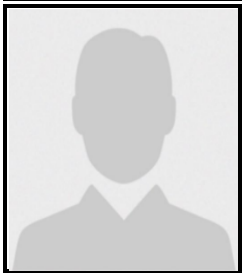

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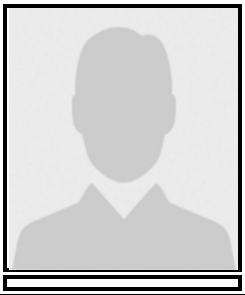

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