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***Correspondence**

Ahed J Alkhatib
Email: ajalkhatib@just.edu.jo

New Frontiers in Alzheimer's and Parkinson's Disease Treatments

Ahed J Alkhatib*[1,2,3]

[1]Department of Legal Medicine, Toxicology and Forensic Medicine, Jordan University of Science & Technology, Jordan.
[2] International Mariinskaya Academy, department of medicine and critical care, department of philosophy, Academician secretary of department of Sociology.
[3]Cypress International Institute University, Texas, USA.

Abstract:

Alzheimer's disease and Parkinson's disease are common neurodegenerative diseases mostly seen in elderly people however there are early-onset cases from genetic mutations as well. The different neurodegenerative diseases and their symptoms and causes are discussed to get a better understanding. Both diseases have amyloid plaques, neurofibrillary tangles, and Lewy Bodies. There is no complete cure for them despite extensive research and present-day treatment helps in treating only the symptoms. Diagnosing Alzheimer's disease is difficult; it can only be confirmed through histological study after death. Methods like cerebrospinal fluid tests and imaging scans are being studied to help find the disease earlier. Current medicines for Alzheimer's work by stopping/reducing the production of choline-acetyltransferase. To restore dopamine levels in the nervous system, Levodopa is given in Parkinson's disease. Treatment options currently available are not very effective and do not prevent the progression of the disease. Future studies should examine new drug-related treatments, which could mean using existing drugs in new combinations or looking for new treatments.

INTRODUCTION

Alzheimer's disease (AD) and Parkinson's disease (PD) are individually high-profile and impactful neurodegenerative disorders, each affecting millions of patients and indirectly changing the lives of millions of families as well (Bhole *et al.*, 2023; Caligiore *et al.*, 2022). Both diseases are characterized by the selective, progressive loss of neurons together with aggregated proteins such as α-synuclein and tau proteins (Alkhatib, 2020; Dumurgier and Sabia, 2021). However, their sequelae are vastly different (Khatib, 2022). AD is a major cause of dementia, currently the seventh leading cause of death, while PD is predominantly characterized as a movement disorder (Cleland *et al.*, 2021). AD is the most common form of neurodegenerative disease, accounting for 60% to 80% of such cases and affecting more than 6 million Americans alone (Fernández-Calle *et al.*, 2022; Huang *et al.*, 2023). As the world's population continues to age, the prevalence of neurodegenerative diseases is projected to escalate further (Grochowska and Przeliorz, 2022). PD is the fastest-growing neurodegenerative disease and, alongside AD, is now the fourth leading cause of death (Klinkovskij *et al.*, 2023).

Although the etiologies of AD and PD remain vague and their pathological mechanisms are complex, it is generally accepted that these disorders arise from a combination of genetic and non-genetic factors, including neuroinflammation, oxidative stress, and protein aggregation (Mentis *et al.*, 2021). The rate of these disorders has been rapidly growing recently with the aging world population (Brolin, 2023). Current diagnostic techniques are varied, concomitantly offering a wide selection of methodologies and panels; accuracy is historically highest among genetic tests (Ganesan, 2023). The search for new and improved diagnostics continues in order to enhance precision and detectability early in the onset of diseases (Hu *et al.*, 2023). There are many detection tools and systems under development, mainly focused on detecting protein misfolding at the preclinical stage (Faraji-Arough *et al.*, 2023). AD and PD share similar pathophysiology and there is evidence of these disorders overlapping by causing concomitant neurodegeneration (Das *et al.*, 2020; Wilson *et al.*, 2023). Additionally, single pharmaceutical agents can simultaneously treat symptoms of both diseases, suggesting shared pathogenic mechanisms (Minakawa, 2022).

Current Treatment Landscape for Alzheimer's and Parkinson's disease

There are an estimated 50 million people worldwide living with Alzheimer's disease or other types of dementia (Nandi *et al.*, 2022). With continued life expectancy increases, these figures are expected to triple by the year 2050 (Gustavsson *et al.*, 2023). In order to further investigate neurodegenerative diseases, such as Alzheimer's and Parkinson's disease, the underlying pathophysiology leading to neuronal death must be understood. In their early stages, the symptoms of Alzheimer's and Parkinson's diseases can be difficult to pick apart (Li *et al.*, 2022). Both disorders progressively damage and kill cells needed for normal brain function, yet they each target different functions of brain cells (Tahami Monfared *et al.*, 2022). Current treatment plans for Alzheimer's disease often involve pharmacological or other non-pharmacological means (Erekat *et al.*, 2014). Among the most common medications are acetylcholinesterase inhibitors (Alkhatib, 2023). They function to increase concentrations of the neurotransmitter acetylcholine to help manage the symptoms of cognitive decline (Wimo *et al.*, 2023). Non-pharmacological strategies can include cognitive training and physical exercise programs (Thangwaritorn *et al.*, 2024). The goal of these programs is to increase the resilience of the brain when faced with neurodegeneration (Nichols *et al.*, 2022). Other treatments in the field of Alzheimer's disease include modulating BACE1 activity, altering amyloid beta, and

reducing the presence of neurofibrillary tangles (Liang *et al.*, 2021). Currently approved medications for Parkinson's disease primarily revolve around dopamine replacement therapy (Alkhatib, 2021). These medications often behave like dopamine in the brain, or attempt to prevent the breakdown of dopamine. Levodopa is a direct dopamine replacement and is considered the gold standard in treatment (Rostagno, 2022). Two other medications approved by the FDA include Safinamide and Xadago. Both reduce the breakdown of dopamine to help treat Parkinson's symptoms. Other symptomside medications can include amantadine, MAO type B inhibitors, and Catechol-O-Methyltransferase (COMT) inhibitors (Thangwaritorn *et al.*, 2024). Other non-pharmacological approaches can include deep brain stimulation or targeted drug delivery to improve motor function (Rostagno, 2022).

Innovative Therapeutic Approaches and Technologies

There is little doubt that Alzheimer's (AD) and Parkinson's disease (PD) are the two types of neurodegenerative diseases with the most social and healthcare impact worldwide (Maiese, 2023). The estimated population with such diseases is around 44 million. Nonetheless, the rapid development in molecular biology and biotechnology has provided unique platforms for researchers to design and examine a wide range of new drugs and interventions. In recent years, too, a diversity of therapeutic and technological advancements has emerged (Iqbal, 2020; Iqbal, 2021; Kim *et al.*, 2023). These include gene treatments, stem cell interventions, liposome and nanoparticle fast injections, and monoclonal antibodies. Additionally, immunotherapies are emerging as novel approaches to disease management (Abdullah *et al.*, 2021; Chopade *et al.*, 2023; Iqbal *et al.*, 2018; Mehta *et al.*, 2023). However, developing such interventions faces hurdles relating to the design, methodology, and dissemination. These new ways are difficult and require close collaborations between disciplines and practices such as pharmaceutical engineering, biotechnology, nanomedicine, and pharmacokinetics (Majolo *et al.*, 2024). Meanwhile, the development of new interventions has not only centered on drugs but also a broad range of assisting equipment such as artificial intelligence (AI). Such technologies are making it possible to diagnose diseases in ways that were previously considered impossible - even by the most experienced neurologists and clinicians. The use of different biosensors combined with machine-learning algorithms can efficiently predict pathological mutations or clinical outcomes of the disease (Mohamed, 2024). Personalized brain simulators for deep brain stimulations have also been developed and there are many examples of portable brain simulators designed for the bedside or home environment. Overall, the future therapeutic landscape will not only be enhanced by drug treatment but also by bioengineering and biotechnological assistance (Gao *et al.*, 2023). Practical drug solutions are in motion and will address important outcomes for the two diseases. For AD, there are liposome and nanoparticle technology and patching innovations (Ross *et al.*, 2018). Meanwhile, experimental gene therapies or stem cell interventions might boost the treatment of PD (Yamani *et al.*, 2024). On the other hand, adjunct approaches should not be disregarded (Zhang *et al.*, 2023). Many lifestyle interventions, such as diet and exercise, have been shown to reduce the pathological development of the disease or to alleviate symptoms. Intervention is feasible and affordable (Alkhatib, 2019). A combination of antioxidant therapies together with a high-fiber, low-fat diet can reduce the concentration of metals and slow down cognitive decline. An example for PD is that a minocycline treatment can reduce the neuroinflammatory profile while continuous light prenatal exercise may enhance brain plasticity in a rabbit PD model, producing behavioral and cognitive improvement. Outcomes should encourage social and healthcare systems to design and advocate for new muscle and sports venues for the elderly (Gao *et al.*, 2023; Meghani *et al.*, 2023).

Future Directions and Concluding Remarks

Treatment methods for Alzheimer's disease (AD) and Parkinson's disease are witnessing

substantial advancements due to improvements in awareness and research, appending an optimistic outlook for the upcoming times (Ciurea *et al.*, 2023; Sharma *et al.*, 2024). Devising strategies to process an integrated and comprehensive evaluation of probabilities for Alzheimer's disease with updated medical practice and a Bayesian network in the system of a health examination is a pressing call (Al-Mutery *et al.*, 2023; Ning *et al.*, 2022). The trouble of such a system is far more challenging linked to a single disease when there are two types of diseases (Senevirathne *et al.*, 2023). An integrated model was put to solve the issue, and the ambitious expectation is that the proposed methodology can confirm practical and feasible to detect and handle these diseases made up of the brain (Arafah *et al.*, 2023).

Since prediction and prevention are better than treatment for Alzheimer's disease, the proposed approach is also applied to the prediction and prevention (Rogler *et al.*, 2021). A rising number of ailment-altering treatments are in the advancement for future management, making it paramount to prepare and offer health services involving complex interventions of these treatments (Younossi *et al.*, 2021)**.** People with probable diagnoses of Alzheimer's disease should receive additional knowledge, which involves signposting to maintain health and social passion provided for the management of conditions that mimic the manifestations of Alzheimer's disease (Rovin *et al.*, 2021). Patients must be given information so they may make decisions about their desired symptom treatments (Kadura and Raghu, 2021). Once option treatments are offered judgments should display the patient's illness and worthiness (Ritchie *et al.*, 2017). This will encourage a treatment-masterful community by requiring rational and ready usage (Fraenkel *et al.*, 2021; Lingvay *et al.*, 2022). A vigil or a watch usually indicates the future course of something traditionally of human activities (Pouwels *et al.*, 2022).

In recent times, clearness campaigns intrigue, and disclosure devices have been employed to authorize a broad range of lifestyle and health-associated conduct, for instance, viewing people to 'drink driving' crusades to reduce road traffic accidents or to criticize the energy, fats, and carbohydrate content of foodstuffs to avoid an increase in diet-pertinent diseases (Kapoor and Chinnathambi, 2023; Taddei, 2024). This surveys the consequences of plaques, tangles, trans-synaptic spread, and brain inflammation disease, and signals how this data could be cast off to design biosignature particulars (Chen *et al.*, 2021; Leng and Edison, 2021).

CONFLICT OF INTEREST

Authors hereby declare that they have no conflict of interest.

REFERENCES

Abdullah, Q.Y., Alghalibi, S.M., Al-Mahbashi, A.A., Al-Khalqi, E.A., 2021. The Association of Epstein-Barr Virus Antibodies with Cancer Patients among Yemeni Patients. PSM Microbiol., 6(2): 49-59.

Al-Mutery, A., Hussain, I., Mumtaz, K., 2023. Advancements in Brain Diseases: Exploring the Complexities and Pursuing Therapeutic Breakthroughs. Preprints.

Alkhatib, A.J., 2019. Molecular and Biochemical Outcomes of Exercise: A Review Study. Glob. J. Ortho. Res., 1: 1-3.

Alkhatib, A.J., 2020. Physical Rehabilitation: Activation and Regulation of Cellular Machinery Hidden Power as a New Medical Hypothesis. J. Phys. Med. Rehabil. Stud. Rep., SRC/JPMRS/120. DOI: doi. org/10.47363/JPMRS/2020 (2), 115: 3.

Alkhatib, A.J., 2021. Journal of Novel Physiotherapies Research Reviews. Am. J. Epidemiol., 158: 416-423.

Alkhatib, A.J., 2023. Multiple Sclerosis (MS): Review of the Literature and Personal Therapeutic Experience. PSM Biol. Res., 8(3): 109-115.

Arafah, A., Khatoon, S., Rasool, I., Khan, A., Rather, M.A., Abujabal, K.A., Faqih, Y.A.H., Rashid, H., Rashid, S.M., Bilal Ahmad, S., 2023. The future of precision medicine in the cure of Alzheimer's disease. Biomed., 11(2): 335.

Bhole, R.P., Kute, P.R., Chikhale, R.V., Bonde, C.G., Pant, A., Gurav, S.S., 2023. Unlocking the potential of PROTACs: A comprehensive review of protein degradation strategies in disease therapy. Bioorg. Chem., 139: 106720.

Brolin, K., 2023. The etiology of Parkinson's disease. Genetic and non-genetic risk factors for a multifactorial disease. Doctoral Thesis (compilation), Department of Experimental Medical Science. Lund University, Faculty of Medicine.

Caligiore, D., Giocondo, F., Silvetti, M., 2022. The Neurodegenerative Elderly Syndrome (NES) hypothesis: Alzheimer and Parkinson are two faces of the same disease. IBRO Neurosc. Rep., 13: 330-343.

Chen, C., Zhou, Y., Wang, H., Alam, A., Kang, S.S., Ahn, E.H., Liu, X., Jia, J., Ye, K., 2021. Gut inflammation triggers C/EBPβ/δ-secretase-dependent gut-to-brain propagation of Aβ and Tau fibrils in Alzheimer's disease. The EMBO J., 40(17): e106320.

Chopade, P., Chopade, N., Zhao, Z., Mitragotri, S., Liao, R., Chandran Suja, V., 2023. Alzheimer's and Parkinson's disease therapies in the clinic. Bioeng. Transl. Med., 8(1): e10367.

Ciurea, A.V., Mohan, A.G., Covache-Busuioc, R.-A., Costin, H.-P., Glavan, L.-A., Corlatescu, A.-D., Saceleanu, V.M., 2023. Unraveling molecular and genetic insights into neurodegenerative diseases: Advances in understanding Alzheimer's, Parkinson's, and Huntington's diseases and amyotrophic lateral sclerosis. Int. J. Molec. Sci., 24(13): 10809.

Cleland, N.R., Al-Juboori, S.I., Dobrinskikh, E., Bruce, K.D., 2021. Altered substrate metabolism in neurodegenerative disease: new insights from metabolic imaging. J. Neuroinflammation., 18: 1-18.

Das, S., Zhang, Z., Ang, L.C., 2020. Clinicopathological overlap of neurodegenerative diseases: A comprehensive review. J. Clin. Neurosci., 78: 30-33.

Dumurgier, J., Sabia, S., 2021. Life expectancy in dementia subtypes: Exploring a leading cause of mortality. Lancet Healthy Longev., 2(8): e449-e450.

Erekat, N., Al-Khatib, A., Al-Jarrah, M., 2014. Heat shock protein 90 is a potential therapeutic target for ameliorating skeletal muscle abnormalities in Parkinson's disease. Neural Regen. Res., 9(6): 616-621.

Faraji-Arough, H., Maghsoudi, A., Rokouei, M., 2023. Study of genetic and non-genetic effects on cumulative survival in a crossbred population of quail. Trop. Anim. Health Prod., 55(1): 5.

Fernández-Calle, R., Konings, S.C., Frontiñán-Rubio, J., García-Revilla, J., Camprubí-Ferrer, L., Svensson, M., Martinson, I., Boza-Serrano, A., Venero, J.L., Nielsen, H.M., 2022. APOE in the bullseye of neurodegenerative diseases: impact of the APOE genotype in Alzheimer's disease pathology and brain diseases. Molec. Neurodegen., 17(1): 62.

Fraenkel, L., Bathon, J.M., England, B.R., St. Clair, E.W., Arayssi, T., Carandang, K., Deane, K.D., Genovese, M., Huston, K.K., Kerr, G., 2021. 2021 American College of

Rheumatology guideline for the treatment of rheumatoid arthritis. Arthritis Rheumatol., 73(7): 1108-1123.

Ganesan, K., 2023. Generation of genetic and non-genetic risk factor-based mouse models resembling the sporadic human Alzheimer's disease phenotype.

Gao, J., Karp, J.M., Langer, R., Joshi, N., 2023. The Future of Drug Delivery. Chem. Mater., 35(2): 359-363.

Grochowska, K., Przeliorz, A., 2022. The effect of the ketogenic diet on the therapy of neurodegenerative diseases and its impact on improving cognitive functions. Dement. Geriatr. Cogn. Disord. Extra., 12(2): 100-106.

Gustavsson, A., Norton, N., Fast, T., Frölich, L., Georges, J., Holzapfel, D., Kirabali, T., Krolak-Salmon, P., Rossini, P.M., Ferretti, M.T., 2023. Global estimates on the number of persons across the Alzheimer's disease continuum. Alzheimer's Dement., 19(2): 658-670.

Hu, Y.-H., Su, T., Wu, L., Wu, J.-F., Liu, D., Zhu, L.-Q., Yuan, M., 2023. Deregulation of the glymphatic system in Alzheimer's disease: Genetic and non-genetic factors. Aging Dis., 16(1): 283.

Huang, G., Li, R., Bai, Q., Alty, J., 2023. Multimodal learning of clinically accessible tests to aid diagnosis of neurodegenerative disorders: a scoping review. Health Inf. Sci. Syst., 11(1): 32.

Iqbal, M.N., 2020. COVID-19 Pandemic: The Potential Role of Nanotechnology and Nanomedicine in Vaccine Development. Int. J. Nanotechnol. Allied Sci., 4(2): 44-46.

Iqbal, M.N., 2021. Nanoscience and Nanotechnology for SARS-CoV-2: Challenges and Future Perspectives. Int. J. Nanotechnol. Allied Sci., 5(1): 7-9.

Iqbal, M.N., Ashraf, A., Ling, S., Wang, S., 2018. In vitro improved production of monoclonal antibody against zearalenone in supplemented cell culture media. PSM Biol. Res., 3(3): 106-110.

Kadura, S., Raghu, G., 2021. Rheumatoid arthritis-interstitial lung disease: manifestations and current concepts in pathogenesis and management. Eur. Respir. Rev., 30(160).

Kapoor, M., Chinnathambi, S., 2023. TGF-β1 signalling in Alzheimer's pathology and cytoskeletal reorganization: a specialized Tau perspective. J. Neuroinflammation., 20(1): 72.

Khatib, A.J., 2022. Parkinson's Disease: A Comprehensive Overview of the Disease.

Kim, S.W., Lee, J.H., Kim, B., Yang, G., Kim, J.U., 2023. Natural products as the potential to improve Alzheimer's and Parkinson's disease. Int. J. Molec. Sci., 24(10): 8827.

Klinkovskij, A., Shepelev, M., Isaakyan, Y., Aniskin, D., Ulasov, I., 2023. Advances of Genome Editing with CRISPR/Cas9 in Neurodegeneration: The Right Path towards Therapy. Biomed., 11(12): 3333.

Leng, F., Edison, P., 2021. Neuroinflammation and microglial activation in Alzheimer disease: where do we go from here? Nat. Rev. Neurol., 17(3): 157-172.

Li, X., Feng, X., Sun, X., Hou, N., Han, F., Liu, Y., 2022. Global, regional, and national burden of Alzheimer's disease and other dementias, 1990–2019. Front. Aging Neurosci., 14: 937486.

Liang, C.-S., Li, D.-J., Yang, F.-C., Tseng, P.-T., Carvalho, A.F., Stubbs, B., Thompson, T., Mueller, C., Shin, J.I., Radua, J., 2021. Mortality rates in Alzheimer's disease and non-Alzheimer's dementias: a systematic

review and meta-analysis. Lancet Healthy Longev., 2(8): e479-e488.

Lingvay, I., Sumithran, P., Cohen, R.V., le Roux, C.W., 2022. Obesity management as a primary treatment goal for type 2 diabetes: time to reframe the conversation. Lancet., 399(10322): 394-405.

Maiese, K., 2023. The metabolic basis for nervous system dysfunction in alzheimer's disease, parkinson's disease, and huntington's disease. Curr. Neurovasc. Res., 20(3): 314-333.

Majolo, F., Hoffmann, L.F., Pilatti, W.L., Sant'Ana, C.A., Silva, J., Martins, A., Pedrosa, R., Dahmer, B., da Silva, G.L., Macedo, L.F.S., 2024. Recent Drugs Tested in Clinical Trials for Alzheimers and Parkinsons Diseases Treatment: Current Approaches in Tracking New Drugs. Front. Clinic. Drug Res.-CNS and Neurol. Disord. Volume 12: 1.

Meghani, N.A.A., Hudson, J., Stratton, G., Mullins, J., 2023. Older adults' perspectives on physical activity and sedentary behaviour within their home using socio-ecological model. PLOS ONE., 18(11): e0294715.

Mehta, M., Bui, T.A., Yang, X., Aksoy, Y., Goldys, E.M., Deng, W., 2023. Lipid-Based Nanoparticles for Drug/Gene Delivery: An Overview of the Production Techniques and Difficulties Encountered in Their Industrial Development. ACS Mater. Au., 3(6): 600-619.

Mentis, A.-F.A., Dardiotis, E., Efthymiou, V., Chrousos, G.P., 2021. Non-genetic risk and protective factors and biomarkers for neurological disorders: a meta-umbrella systematic review of umbrella reviews. BMC Med., 19: 1-28.

Minakawa, E.N., 2022. Bidirectional relationship between sleep disturbances and Parkinson's disease. Front. Neurol., 13: 927994.

Mohamed, W.M.Y., 2024. Connecting the Dots: AfrAbia's Environmental Challenges and Parkinson's Disease, Preprints.

Nandi, A., Counts, N., Chen, S., Seligman, B., Tortorice, D., Vigo, D., Bloom, D.E., 2022. Global and regional projections of the economic burden of Alzheimer's disease and related dementias from 2019 to 2050: A value of statistical life approach. EClinicalMed., 51.

Nichols, E., Steinmetz, J.D., Vollset, S.E., Fukutaki, K., Chalek, J., Abd-Allah, F., Abdoli, A., Abualhasan, A., Abu-Gharbieh, E., Akram, T.T., 2022. Estimation of the global prevalence of dementia in 2019 and forecasted prevalence in 2050: an analysis for the Global Burden of Disease Study 2019. Lancet Public Health., 7(2): e105-e125.

Ning, S., Jorfi, M., Patel, S.R., Kim, D.Y., Tanzi, R.E., 2022. Neurotechnological approaches to the diagnosis and treatment of Alzheimer's disease. Front. Neurosci., 16: 854992.

Pouwels, S., Sakran, N., Graham, Y., Leal, A., Pintar, T., Yang, W., Kassir, R., Singhal, R., Mahawar, K., Ramnarain, D., 2022. Non-alcoholic fatty liver disease (NAFLD): a review of pathophysiology, clinical management and effects of weight loss. BMC Endocr. Disord., 22(1): 63.

Ritchie, C.W., Russ, T.C., Banerjee, S., Barber, B., Boaden, A., Fox, N.C., Holmes, C., Isaacs, J.D., Leroi, I., Lovestone, S., 2017. The Edinburgh Consensus: preparing for the advent of disease-modifying therapies for Alzheimer's disease. Alzheimer's Res. Ther., 9: 1-7.

Rogler, G., Singh, A., Kavanaugh, A., Rubin, D.T., 2021. Extraintestinal manifestations of inflammatory bowel disease: current

concepts, treatment, and implications for disease management. Gastroenterol., 161(4): 1118-1132.

Ross, C., Taylor, M., Fullwood, N., Allsop, D., 2018. Liposome delivery systems for the treatment of Alzheimer's disease. Int. J. Nanomed., 13: 8507-8522.

Rostagno, A.A., 2022. Pathogenesis of Alzheimer's disease. MDPI, pp. 107.

Rovin, B.H., Adler, S.G., Barratt, J., Bridoux, F., Burdge, K.A., Chan, T.M., Cook, H.T., Fervenza, F.C., Gibson, K.L., Glassock, R.J., 2021. Executive summary of the KDIGO 2021 guideline for the management of glomerular diseases. Kidney Int., 100(4): 753-779.

Senevirathne, D.K.L., Mahboob, A., Zhai, K., Paul, P., Kammen, A., Lee, D.J., Yousef, M.S., Chaari, A., 2023. Deep brain stimulation beyond the clinic: Navigating the future of Parkinson's and Alzheimer's disease therapy. Cells., 12(11): 1478.

Sharma, M., Pal, P., Gupta, S.K., 2024. Advances in Alzheimer's disease: A multifaceted review of potential therapies and diagnostic techniques for early detection. Neurochem. Int., 105761.

Taddei, R.N., 2024. Understanding the role of glia and oligomeric tau in the early synapse loss of Alzheimer disease dementia, UCL (University College London).

Tahami Monfared, A.A., Byrnes, M.J., White, L.A., Zhang, Q., 2022. Alzheimer's disease: epidemiology and clinical progression. Neurol. Ther., 11(2): 553-569.

Thangwaritorn, S., Lee, C., Metchikoff, E., Razdan, V., Ghafary, S., Rivera, D., Pinto, A., Pemminati, S., Skylynn, T., Christopher, L., 2024. A review of recent advances in the management of Alzheimer's disease. Cureus., 16(4).

Wilson, D.M., Cookson, M.R., Van Den Bosch, L., Zetterberg, H., Holtzman, D.M., Dewachter, I., 2023. Hallmarks of neurodegenerative diseases. Cell., 186(4): 693-714.

Wimo, A., Seeher, K., Cataldi, R., Cyhlarova, E., Dielemann, J.L., Frisell, O., Guerchet, M., Jönsson, L., Malaha, A.K., Nichols, E., 2023. The worldwide costs of dementia in 2019. Alzheimer's Dement., 19(7): 2865-2873.

Yamani, I.A.J., Alnaimi, I., Alkhatib, A.J., Alnaimi, S., 2024. Neural Toxicity And Deviating Behaviors: A Review Study. Educ. Adm.: Theory Pract., 30(5): 6948-6955.

Younossi, Z.M., Corey, K.E., Lim, J.K., 2021. AGA clinical practice update on lifestyle modification using diet and exercise to achieve weight loss in the management of nonalcoholic fatty liver disease: expert review. Gastroenterol., 160(3): 912-918.

Zhang, C., Zhao, J., Wang, W., Geng, H., Wang, Y., Gao, B., 2023. Current advances in the application of nanomedicine in bladder cancer. Biomed. Pharmacother., 157: 114062.