Alzheimer's Disease: Understanding the Cognitive Decline and Future Projections

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Abstract—**Alzheimer's disease (AD) is the most common cause of dementia, regarded as a chronic neurodegenerative disease that features behavioural problems, memory impairment, and a progressive decrease in cognitive abilities. The growing prevalence of AD poses dire challenges as the world's population continues to age, imposing a burden on individuals and families, health care centers, and the economy. This article analyses the Alzheimer's disease etiology, its risk factors, diagnosis, treatment options, prevention strategies, as well as its societal implications. There is no evidence to suggest a cure AD at this point in time, treatments available aim to control the disease's symptoms instead of halting or reversing its progression. There is promise for further investigation in AD treatment for tau tangles, amyloid plaques, and neuroinflammation. Diagnosis and treatment of Alzheimer's disease at an early stage improves outcomes. Furthermore, a balanced diet, cognitive stimulation, and regular physical activities constitute lifestyle changes that can help mitigate the risk of developing Alzheimer's disease. The economic burden with a sharp increase of Alzheimer's patients continues to climb alongside the strain the disease has on informal family caregivers and the health care system.**

This assessment focuses on the Alzheimer's problem using modified risk factors to further examine the issue on a population level.

Index Terms—**Dementia, Neurological, Amyloid Plaques, Neuro-inflammation, Memory loss**

I. INTRODUCTION

Alzheimer's disease (AD) specifically pertains to an illness that disrupts an individual's ability to think, behave, and recall memories. This illness is progressive in nature and there is no possible way to reverse its effects. As the most common form of dementia, AD accounts for 60–80% of dementia cases around the world. While it is possible for individuals in their 30s to develop early-onset Alzheimer's, most cases occur in individuals over 65 (1).

One of the hallmark features of Alzheimer's disease is the formation of neurofibrillary plaques and amyloid plaques, which slow the normal functioning and activities of the brain. As the disease worsens, cognitive skills such as memory, language, judgment, and even personality undergo significant changes. A common cause of death is pneumonia or bronchitis (2). To evaluate and diagnose AD, an essential clinical AD's features need to be identified and other common causes of cognitive decline in the elderly need to be ruled out. It is also suggested to test for vitamin B12 insufficiency and thyroid dysfunction as syphilis does not occur commonly enough to justify routine screening (under normal clinical circumstances). Neuroimaging should be done to establish additional cerebral pathology and assess potential vascular contributions to the dementia syndrome. Practical imaging with single-photon emission computed tomography or positron emission tomography is particularly helpful in cases with ambiguous clinical features (1,3). From the perspective of public health, the disease is particularly serious due to its widespread effects on individuals, families, and the healthcare system. Although Alzheimer's disease is currently deemed incurable, its treatment focuses on symptom reduction and disease progression halting. There is a consensus on the impact of age, family history, and lifestyle on dementia, however, the exact cause of Alzheimer's disease remains elusive. Early diagnosis, adequate therapy and caregiving for the people caring for others, is essential for improving the quality of life of individuals affected by this notorious ailment (2,3).
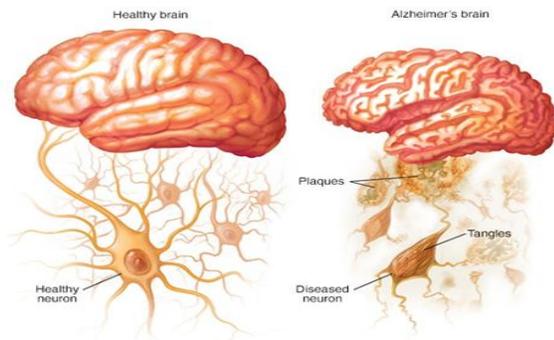
Fig 1 Comparison of Normal & Alzheimer Disease Brain

- Incidence, Prevalence, and Economic Impact of Alzheimer's Disease

a) Incidence of Alzheimer's Disease

The number of new cases of Alzheimer's disease that are diagnosed during a specific period is called the incidence. Alzheimer's Disease: Prevalence skyrockets with aging. This disorder is quite rare around 65 years, but becomes more common after 85 years of age. The incidence is relatively higher among women than men. Due to a longer lifespan, women are more prone to Alzheimer's disease. As well, certain genetic factors such as the APOE four allele increase the risk of developing the disease, which influences the rate of development in diverse populations on the prevalence of Alzheimer's Disease: the prevalence rate is the total number of a given population of individuals with a specific disease at a given time. Over the years, the prevalence of Alzheimer's disease has risen to overtake other diseases as the most common form of dementia, in sync with the rising trend in population aging (3, 5).

Global prevalence: Alzheimer's disease will account for approximately 55 million dementia cases globally in 2025, which translates to 60-80% of the cases. This translates to a rough estimate of 33 to 44 million individuals suffering from Alzheimer's. The socio-economic impacts of Alzheimer's disease: The disease's medical treatment, caregiving, and productivity losses pose a significant burden on the society and the healthcare systems. With growing elderly populations coupled with the rising prevalence of the disease, Alzheimer's is expected to have a growing economic burden. Worldwide financial impacts: The WHO and ADI have put forth estimates, claiming that the financial burden attributed to

dementia, Alzheimer's inclusive, would exceed 1 trillion dollars in 2020 and reach 2 trillion dollars by 2030.

The situation is rare in people around the age of 65, but it keeps growing as people get older, and especially after the age of 85. The occurrence is higher in females than in males; therefore, since women generally live longer, they are more likely to develop Alzheimer's. Besides, a number of genetic factors (such as the APOE four allele) not only increase the risk for this disease but also impact the rate of different groups' development (4).

b) Prevalence of Alzheimer's Disease

Prevalence refers to the total number of individuals with Alzheimer's disease at a specific time. Alzheimer's disease is the leading cause of dementia worldwide, and its incidence is gradually increasing as the aging of the global population continues (3,5).

Worldwide prevalence: Out of the 55 million people estimated to suffer from dementia globally in 2025, Alzheimer's disease is the major cause of 60–80% of the cases. That means the number of people affected by Alzheimer's disease is between 33 and 44 million all over the world (5).

c) The effects of Alzheimer's disease on the economy

The costs of medical care, caregiving, and lost productivity due to Alzheimer's disease, along with the associated, impose a substantial financial burden on both society and the healthcare system. As the population within the whole community ages and the disease is getting more frequent, the economic impact of Alzheimer's will also be larger. Global economic cost: According to the World Health Organization (WHO) and Alzheimer's Disease International (ADI), the cost of dementia, which includes Alzheimer's, will exceed $1 trillion annually in 2020 and will be twice as much in 2030 (5,6).

While the demographics of societies around the world are changing significantly, the financial burden of Alzheimer's disease is projected to grow dramatically over time. The costs of medical care and support are going to become more and more that is the number of Alzheimer's disease patients, particularly in wealthy countries. The impact will be much greater in such places as Japan and some parts of Europe where the population is aging rapidly.
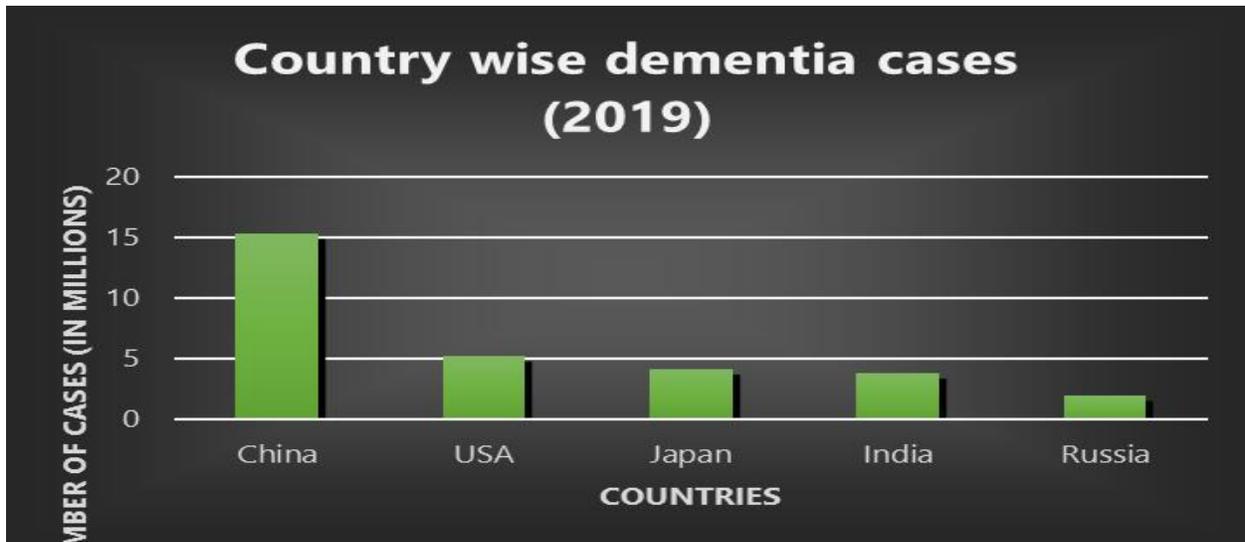
Graph 1 Number of Dementia Cases in Worldwide 2019)
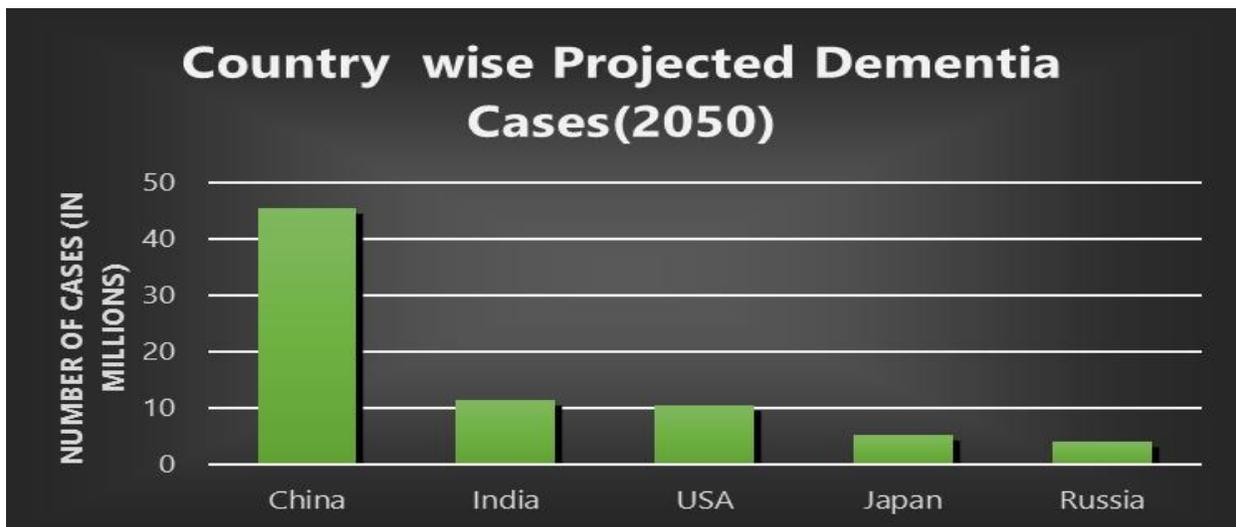
(Graph 2 Number of Projected Dementia Cases in 2050)

II. SYMPTOMS

Alzheimer's disease symptoms might vary; however, they usually appear in stages:

- Early Stage (Mild):
Loss of memory, trouble understanding issues, difficulty doing familiar tasks, and confusion regarding time and location.

- Middle Stage (Moderate):
Mood swings, increased memory loss, linguistic difficulties, spatial awareness issues, and the need for help with everyday tasks.

- Late Stage (Severe):
Complete reliance on caretakers, loss of communication skills, and physical decline, including trouble walking and swallowing.

1.1 Causes & Risk Factor
It is believed that a mix of lifestyle, environmental, and hereditary variables contribute to Alzheimer's disease. The accumulation of aberrant deposits of protein in the brain is one of the main biological characteristics:

- Clusters of protein fragments known as amyloid plaques form between nerve cells.

- Crooked lengths of another protein in them, tau, called neurofibrillary tangles, develop inside nerve cells and impair their ability to function.

Even though the exact places from where proteins accumulate in the body are still unidentified, the importance of family history and genetic variations as factors cannot be overlooked. The weighted pointer for Alzheimer's at a later stage is the APOE gene, while early-onset Alzheimer's may be triggered by a few genetic abnormalities. Moreover, lifestyle choices i.e. nutrition, exercise, and social interaction, together with cardiovascular and head traumas, have a significant impact on the risk (7).

III. DIAGNOSIS

Alzheimer's disease cannot be definitely diagnosed by a single test, and therefore the procedure is complicated and involves several stages. Laboratory tests, brain imaging, physical and neurological examinations, cognitive and neuropsychological testing, as well as taking medical history, are all part of the diagnosis. The benefits of first identification of the problem are in providing proper care (7,8).

To confirm a diagnosis of Alzheimer's disease a comprehensive evaluation including laboratory testing, brain imaging, physical and neurological examinations, cognitive testing, and medical history is conducted. Though there isn't a single test for Alzheimer's, early detection and the accuracy of the disease have significantly been improved by imaging and biomarker technologies (6,9).

Early diagnosis makes better care planning possible, access to therapies if available, and giving support to the disease-affected persons as well as their families. cognitive evaluations, testing to rule out further possible causes of dementia, and brain imaging (such as MRI and PET scans). Memory, on the other figuring out solutions, and other brain processes are frequently evaluated through cognitive testing. The use of blood tests to detect biomarkers linked to Alzheimer's disease, including tau tangles or amyloid plaques, is growing (8,10).

IV. PREVENTION & RISK REDUCTION

Various studies pointed out that certain changes in life habits and the use of specific strategies could decrease the frequency of Alzheimer's disease or delay its onset, notwithstanding that the existence of no guaranteed way to circumvent it (13). Understanding and implementing preventative strategies is crucial given the rising incidence of cognitive impairment and the negative impact it has on people, families, and society. Initial action can be crucial, but modifiable variables can add to the risk, even if genetics plays a big part (11, 12).

Alzheimer's cannot be completely avoided, although there are lifestyle choices that can lower the risk:

- Cognitive engagement:

Mentally stimulating activities and lifelong learning may lower the risk

- Exercise:

Exercise has shown to improve brain function and decrease the risk of Alzheimer's disease.

- Healthy diet:

A healthy, balanced diet, such as the Mediterranean diet, that is low in processed foods and high in antioxidants and omega-3 fatty acids might help protect brain function.

- Social links:

There is a link between reduced risk of cognitive impairment and having strong social relationships.

- Managing cardiovascular health:

Risk of Alzheimer's can be lowered by controlling diabetes, high blood pressure, and cholesterol.

- Avoiding Smoking and Excessive Alcohol Consumption:
Smoking reduces the level of blood flowing to the brain and accelerates the development of atherosclerosis, or narrowing of the arteries. Although some cognitive benefits have been linked with moderate alcohol consumption, especially red wine, heavy alcohol consumption is detrimental to the brain. Long-term excessive alcohol consumption can lead to cognitive deterioration and brain atrophy (14,15).

V. CHALLENGES

Alzheimer's disease poses numerous intricate problems that affect individuals, families, relatives, healthcare systems, and industries globally. Its physical and mental burden of the disease, the added caring burden, the absence of efficient treatment options, early diagnostic problems, and financial stress are some of these challenges (15,16). Additional research, better diagnostics, more effective therapies, more support for carers, and comprehensive public health approaches are urgently required to tackle these problems and reduce the adverse social impact of Alzheimer's disease (14,16).

Moreover, do individuals with Alzheimer's disease (AD) encounter numerous challenges, but families, doctors, and society in general do too (8,15). These are challenges that may affect many areas of life and are complex and multifaceted. Some of the main difficulties related to Alzheimer's disease are listed below:

(Fig 2 Challenges of Alzheimer Disease)

a)   Diagnosis and Early Detection:
Alzheimer's disease is often found after significant cognitive damage has already occurred (16). Alzheimer's disease has mild early manifestations which may be mistaken with other diseases or natural aging. This diagnostic delay may be hindered by the possibility of early treatments that could slow the progression of the disease (15,17).

b)   Treatment and Cure:
Alzheimer's disease currently has no known cure. The current therapies simply alleviate symptoms, momentarily delaying the disease's advancement without stopping the disease's progression or correcting cognitive impairment (14,17).

c)   Healthcare System and Economic Strain:
Alzheimer's patients often require specialized care, e.g., in-home assistance, nursing facilities, and memory centers. Nevertheless, the services may be limited, especially in developing or rural communities, and are costly. Being unable to find nor pay for appropriate services for the ones they love is a concern for most families (17,18).

d)   Education and Public Awareness:
Physicians, families, and the general public are poorly educated regarding Alzheimer's disease. More intensive training in managing dementia, detection of early symptoms, and psychological and behavioural symptoms management is needed (16,18).

e)   Research and Clinical Trials:
Since Alzheimer's disease is stigmatized, the participants need to meet specific criteria, and since patients as well as their relatives are loaded with these burdens, recruitment to clinical trials may prove challenging. Finding a cure has been hindered by the relatively slow recruitment of clinical trials and the high costs incurred (11, 19).

f)   Public Health Impact:
The population of Alzheimer's disease is expected to grow significantly as the population of the world ages, particularly among older populations such as individuals residing in North America, Europe, and some parts of Asia. The public policy, the healthcare system, and the world in general will all be deeply affected (20).

g)   Ethical and Legal Issues:
Alzheimer's is a fatal disease, and families might find it difficult to make end-of-life care decisions. Families might find it emotionally and legally burdensome to handle the patient's dying days, determine if a switch to hospice care should be made, and address complex medical and legal challenges (19,21)
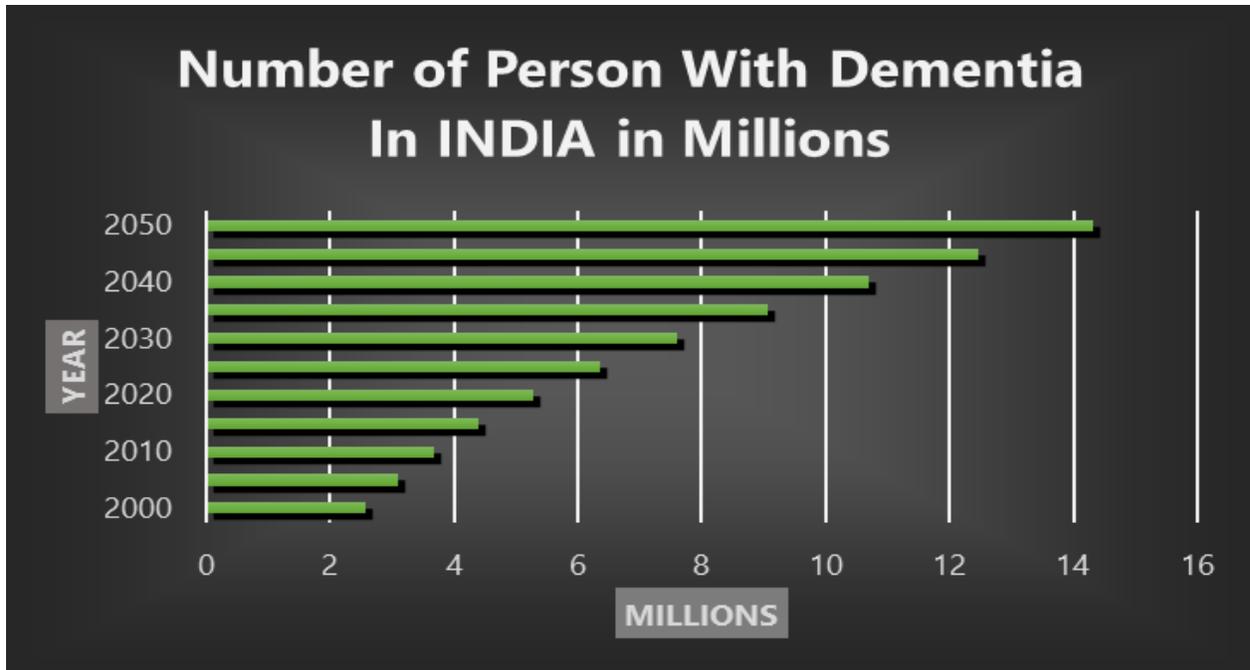
(Graph 3 Number of Dementia Person in India)

VI.FUTURE PROJECTIONS

As the elderly population grows, Alzheimer's disease is going to impart a growing economic burden in the coming decades. The healthcare and care costs will keep on going up as the percentage of individuals with Alzheimer's disease increases, particularly in developed countries. In countries such as Japan and parts of Europe where populations are aging rapidly, the burden will be much more apparent (22,23). Alzheimer's disease will become increasingly prevalent in the coming years, and its impact on individuals, families, hospitals, and economies across the globe will be substantial (24,25). Global healthcare infrastructure will struggle to cope with the needs of a rapidly ageing population, even as research developments offer promise of better diagnostic tools, treatments, and prevention. Intersectoral collaboration, increased research funding, improved simulations of care, and public health measures to reduce risk and support those with dementia and their families will all be needed to address these challenges. There is hope that Alzheimer's disease could one day be prevented or effectively treated through ongoing innovation (26,17).

VII. CONCLUSION

As the aging of the world's population increases, so does the risk and prevalence of the neurologic disorder Alzheimer's, creating a serious health and social issue (28). Hospitalization, nursing home care, and informal caring are the primary contributors to the huge financial impact (27,29). A multimodal approach is required to meet the increasing challenge of Alzheimer's disease, i.e., increased investment in finding effective treatments and ultimately a cure, improved care, early diagnosis, and prevention. Alzheimer's disease poses an extensive array of challenges that not only hit the individual with the diagnosis but also their families, caregivers, healthcare services, and economies. Alzheimer's disease is increasingly prevalent, and its significant economic burden underscores the imperative need for further research as well as the development of effective treatment and prevention strategies (28,30). While there is still much work to be done, advances in individualized medicine, early detection, and potential disease-modifying therapies hold promise for the future (31).

Alzheimer's disease is a serious global health issue that requires collaboration among the areas of public

policy, medicine, and research. One hopes that eventually we will find effective treatments or even a cure due to ongoing advances in the causes of the disease and the use of early interventions. At the same time, early detection, improved caregiver support, and prevention through healthy lifestyle decisions remain significant cornerstones in managing the impact of Alzheimer's among individuals and society (32, 33).

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