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# The Impact of Alzheimer's Disease - The Silent Killer

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# The Impact of Alzheimer's Disease - The Silent Killer

## **Abstract**

With a rise in life expectancy and the lack of a specific known cause, Alzheimer's disease is preying on our senior citizens worldwide at an alarming rate. This paper will explain what Alzheimer's disease is medically, treatments we have at our disposal, preventative measures, and education on the rising economic burden.

## **Cover Page Footnote**

Diane Kappan, Psychology, served as the faculty mentor for this Honors contract.

Alzheimer's disease is a progressive medical disorder that affects nerve cells in areas of the brain responsible for memory, cognition, language, and motor activity. Neurons, or nerve cells, in the brain transmit signals to and from multiple areas of the brain and central nervous system, with a chemical called acetylcholine. Binding of acetylcholine from one neuron to another is the very basis of brain activity, and the neurons responsible for producing acetylcholine are affected by Alzheimer's disease. As Alzheimer's disease progresses acetylcholine production is reduced and neurons slowly lose function and begin to die after which neurons and neurotransmitters can no longer be reproduced or repaired (Alzheimer's Association, 2016; National Institute on Aging, 2016; Webster's Medical Dictionary, 2016).

The area in the brain responsible for memory retention is the hippocampus, and it is commonly the first area to be affected by Alzheimer's disease. In a healthy brain the hippocampus becomes active during memory formation and retrieval. In a brain affected by Alzheimer's disease, forming new and retrieving old memories becomes increasingly more difficult due to the loss of acetylcholine-producing neurons in the hippocampus. As hippocampal neurons continue to decay, communication between nerve cells is permanently lost. Most commonly memory loss is one of the first observable symptoms of Alzheimer's disease (Alzheimer's Association, 2016; National Institute on Aging, 2016; Webster's Medical Dictionary, 2016).

Multiple areas in the brain are responsible for cognition, including the frontal cortex, occipital lobes, and hippocampus. Cognitive abilities require communication and transfer of information from all of these brain regions. Nerve cell damage in any of these areas hinders thinking abilities and problem-solving skills (Alzheimer's Association, 2016; National Institute on Aging, 2016; Webster's Medical Dictionary, 2016).

Motor activity is generated in the motor cortex, which is located in the frontal lobe. As neurons decay and die in the motor cortex, movement becomes increasingly difficult and proceeds to a total loss of mobility (National Institute on Aging, 2016).

The Alzheimer's foundation of America (AFA) identifies three stages of Alzheimer's disease as mild, moderate, and severe. These stages reflect the movement of the disease from the central areas of the brain outward. As the disease progresses the symptoms become more severe (Alzheimer's Foundation of America, 2016).

In the mild stage of Alzheimer's disease, the hippocampus appears to be the area affected the most. Patients experience short-term memory loss, most often have trouble remembering what they were doing, saying, or where they were going. Patients often find themselves more confused and find themselves struggling to remember the steps needed to complete a previously normal task. Complaints of memory loss are often the first indication that a person is suffering from Alzheimer's disease. Patients begin to have increased trouble speaking and understanding what other people are saying, this could perhaps be because of the inability to remember words and word meanings. Patients begin to need outside assistance. Family and friends will also begin to notice unexpected behaviors and personality changes (Alzheimer's Association, 2016).

In the moderate stage of Alzheimer's disease, patients begin to lose long-term memory as well as permanent loss of short term memories. The ability to learn new tasks is extremely limited. In this stage the areas responsible for memories of specific information such as facial recognition rapidly begins to decline, with intermittent bouts of lucidity. The spread of the disease from the central brain regions outward is now noticeable as patients begin to lose the ability to differentiate between and recognize family members. Processing sensory information

or normal reasoning is also inhibited by the degeneration of neurons. Patients now need complete supervision and assistance with tasks such as washing and feeding themselves, indicating that the disease has now spread to the motor areas. In some cases, patients in this stage experience hallucinations, delusions, paranoia, and impulsivity indicating that sensory areas of the brain are degenerating as well (Alzheimer's Association, 2016; Alzheimer's Foundation of America, 2016).

The severe stage of Alzheimer's disease proceeds towards death. The extensive amount of degeneration of the brain's neurons (see Fig. 1) leads to profound loss of abilities. Patients can no longer communicate and are completely dependent on outside care. The loss of motor neurons is so profound that the patient can no longer swallow or breathe on their own. The body completely shuts down as the brain shrinks and dies (National Institute on Aging, 2016).

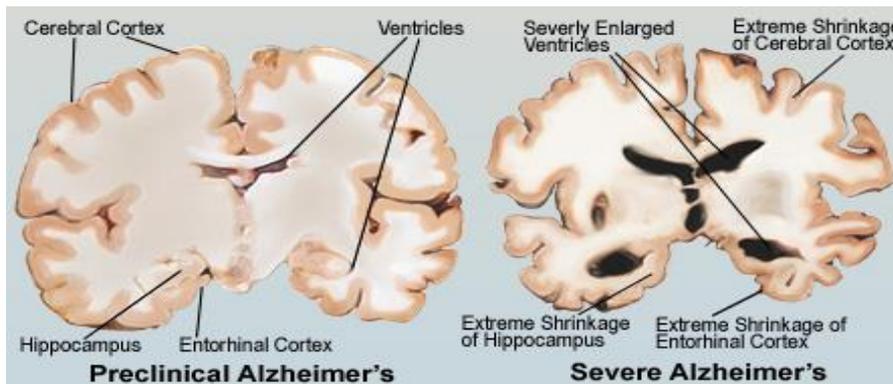


Figure 1 Shown here are two representation images of a healthy brain and a brain afflicted with severe Alzheimer's disease. The National Institute on Aging (2016) shows the extreme atrophy that happens in the hippocampus and cerebral cortex. With Alzheimer's disease the brain shrinks and eventually dies.

### What people do not know about Alzheimer's disease.

Considerable survey research has been conducted asking people what they know about Alzheimer's disease, including what people know about the disease and its symptoms. The

survey asked whether people think that Alzheimer's disease is curable, treatable, reversible or fatal, and also inquired about whether there was an accurate test to determine whether someone has the disease (Harvard School of Public Health, 2011; National Institute on Aging, 2016; Alzheimer's Foundation of America, 2016).

According to one study, the population surveyed did not seem to understand that Alzheimer's disease is a serious disease. The Harvard School of Public Health (2011) completed a phone study asking people from five countries, one of which was the United States, to rank their fear of diseases, from the the most to least fearful. The list included cancer, heart disease, stroke, Alzheimer's disease, diabetes, depression, and influenza. The results showed that in four of the five countries, cancer was the most feared disease by all participants. In those four countries, Alzheimer's disease was rated the second most fearful disease by only 25% of the participants. Ironically, all of the diseases are curable or manageable with treatment, except Alzheimer's disease, which suggests that most people have insufficient information about Alzheimer's disease.

The Harvard School of Public Health (2011) survey included 2678 respondents, most reported low fear of Alzheimer's disease. In addition, fewer than half recognized that Alzheimer's is a fatal disease, when in fact Alzheimer's is the seventh leading cause of death in high income countries. Alzheimer's disease is the only cause of death among the top ten causes of death in the United States that cannot be clinically prevented or effectively treated. Multiple studies show that Alzheimer's disease might eventually become one of the most prominent causes of death because of improper diagnosis, improper data collection, and lack of proper health insurance (National Institute on Aging, 2016).

In addition to lack of fear of Alzheimer's disease and knowledge of fatality of Alzheimer's disease, respondents of the HPSH (2011) study reported that they believe there is now an effective medical or pharmaceutical treatment to slow the progression of Alzheimer's disease. The study also shows that most people believe there is medication that will make the symptom of Alzheimer's disease less severe.

However, according to the Alzheimer's Association (2016) there are two FDA approved medications-- cholinesterase inhibitors and memantine. The pharmaceutical treatments approved by the Food and Drug Administration in the United States only temporarily help symptoms, they are not effective treatments or cures (see Fig. 2). For example, 47% of respondent from the United States think there is an effective treatment to alleviate symptoms.

The current FDA approved treatments include cholinesterase inhibitors which temporarily help to prevent the breakdown of acetylcholine, delaying symptoms for as much as six to twelve months. This medication is generally prescribed in the mild to early moderate stage of AD. Aricept, Razadyne, and Exelon are the most common cholinesterase inhibitors prescribed (Alzheimer's Association, 2016).

Memantine regulates the activity of glutamate, a neurotransmitter involved in learning and memory retention. Memantine delays the progression of symptoms for some people temporarily. Many experts consider its benefits similar to those of cholinesterase inhibitors. Nemenda is most commonly prescribed and is only approved for moderate to severe Alzheimer's disease (Alzheimer's Association, 2016).

The Harvard School of Public Health (2011) also reported that nearly half of respondents believed that there was an effective test to determine if a patient is suffering from Alzheimer's

disease, for example, in the United States, 59% of respondents reported that they thought there is a reliable and accurate test for Alzheimer’s disease (see Fig. 2).

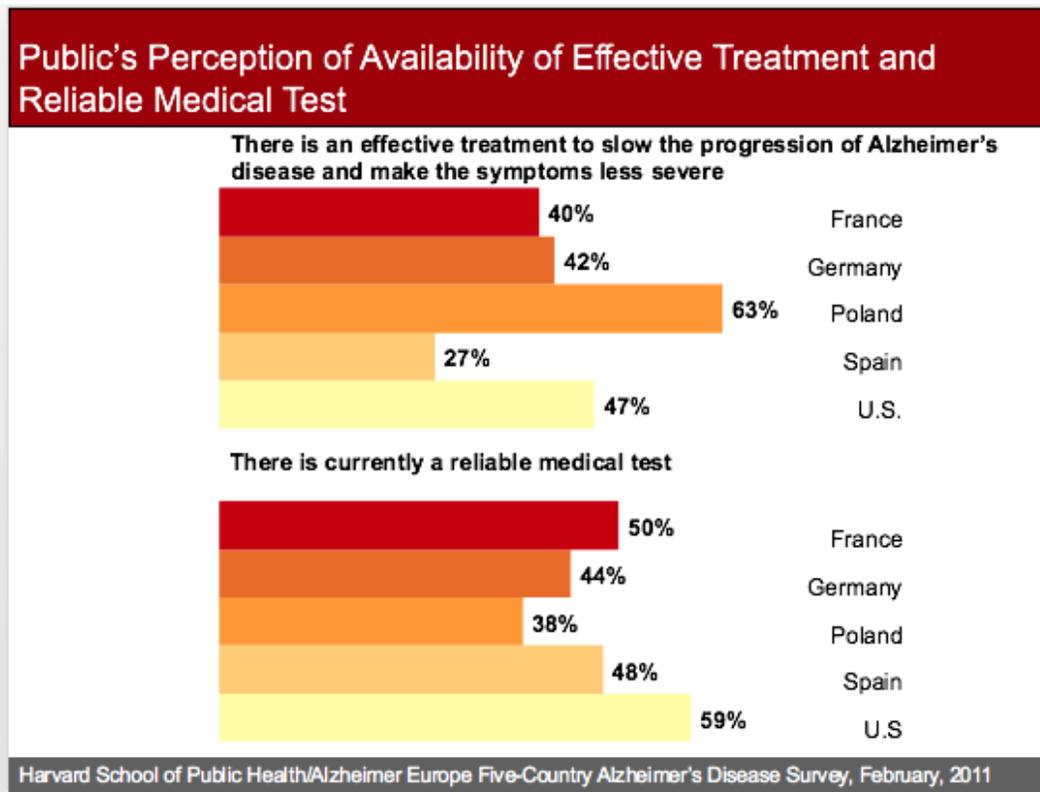


Figure 2

The truth is that current medical test are ineffective in diagnosing Alzheimer’s disease. Neurons affected by Alzheimer’s disease start to deteriorate as much as ten to twenty years before symptoms begin to affect the patient. Typically, patients are diagnosed in the mild stage of Alzheimer’s disease, when memory problems begin. Damage to the brain areas affected by Alzheimer’s disease is already severe at the mild stage of the disease. Degeneration in the hippocampus, the frontal cortex, and occipital lobes is irreversible by this time. With no way to halt or reverse the decline of memory and cognitive abilities, discovering the death of neurotransmitters and nerve cells well before symptoms occur is necessary to alleviate symptoms

and develop better treatments. Having better diagnostic tools will be the only way to enable that to happen (Landau, 2011).

### Current Diagnostic Methods

The Mayo Clinic (2016) has published a set of diagnostic tests because at this time there is no single medical test to determine if a person is suffering from Alzheimer's disease. Diagnosis is difficult and requires extensive and careful medical evaluation. Because neurons affected by Alzheimer's disease begin to decay the amount of healthy neurotransmitters as much as ten to twenty years before symptoms begin to affect the patient, damage is already pronounced at the mild stage of the disease. Typically, patients are diagnosis in the Mild stage of Alzheimer's disease. Brain areas that have already deteriorated when diagnosis has been made are the hippocampus, the frontal cortex, and occipital lobes and at this stage of degeneration the damage is irreversible (Landau, 2011).

The Mayo Clinic tests (2016) include a thorough medical history, physical exams, and neurological exams. The physical tests include testing reflexes, coordination, sight and hearing, and muscle tone and strength. These tests determine if testing for Alzheimer's should proceed. Lab tests determine that conditions such as thyroid disorders, vitamin deficiencies, and diabetes are not causes of memory loss and confusion. An extensive mental status assessment is performed to assess cognitive function.

The Mayo Clinic suggests the use of brain imaging such as CT scans to rule out tumors, strokes, and head injuries as causes for patient's symptoms. MRI scans are used to assess if brain atrophy implicates Alzheimer's disease as the cause of symptoms. Recently improved PET scans use glucose to show brain activity and can also show brain levels of amyloid plaques and tangles, two brain abnormalities associated with Alzheimer's disease. Unfortunately, the new PET scans

are not yet available to all medical doctors. These PET techniques are only found in research and clinical trial settings (Mayo Clinic, 2016).

Cerebrospinal fluid can be tested for biomarkers that indicate a genetic factor for early on-set Alzheimer's disease (Mayo Clinic, 2016). Only a small fraction of 1% of people worldwide have the rare genetic form of Alzheimer's disease, these people tend to show signs of amyloid plaques in PET scans and in cerebrospinal fluid tests. Another biomarker of interest is tau, which is implicated in the development of neurofibrillary tangles that build up in the brains of Alzheimer's disease patients. Notably these tangles are found in the hippocampus or memory center of the brain. Tau mimics the shape of healthy cells and destroys them, however genetic testing for this biomarker is implausible at this time as there is no scan to detect the tau in a living patient (Landau, 2010).

Currently the diagnosis of Alzheimer's disease is difficult because no specific cause has been discovered. With no specific cause identified, there are no reliable treatments to cure or reverse the atrophy that develops in the brain afflicted with Alzheimer's disease. Improved participant numbers in research and clinical trials will lead to a far superior diagnostic system and an opportunity to develop sophisticated tools for earlier diagnosis. In addition to advancing diagnosis increased research will inevitably lead to scientific breakthroughs in the discovery of a cure.

### Economic Burden of Alzheimer's Disease

Alzheimer's disease will affect millions of people if adequate treatment is not discovered, and right now curing Alzheimer's is not plausible in the near future. As life expectancy increases worldwide, the number of aging adults has exponentially risen. With the increase of the aged population, the prevalence of Alzheimer's disease is aggressively rising,

along with a parallel increase in the economic burden of caring for a populace with a chronic incurable disease. In the United States alone we are spending over \$200 billion dollars each year to treat AD patients, with Medicare shouldering the majority of the cost. Chronic disease in our aging population could bankrupt Medicare (National Institute on Aging, 2016). The global economic effect could be devastating. Multiple studies on the financial impact of Alzheimer's disease are anticipating one out of 85 people will suffer from Alzheimer's disease worldwide by the year 2050. Caring for AD patients in that magnitude is expected to cost billions, if not trillions, of dollars. (Brookmeyer, Johnson, Zeigler-Graham & Arrighi, 2007; Brookmeyer, Grey & Kawas, 1998; Rocca et al. 2011).

The annual economic cost of Alzheimer's disease in the United States for lost wages is between 80-100 billion dollars, costing America \$236 billion dollars yearly. Alzheimer's disease is the third largest and costly disease after cancer and heart disease. With lack of proper patient care, exorbitant institutional care, and financial burden on caregivers, this number will only increase. More than 15 million caregivers provide an average of 18 billion hours of unpaid care, and the immediate financial burdens falls heavily on single income family members. Beyond the obvious financial burdens, care contributors lose over \$15,000 in annual income as a result of reducing or quitting work to meet the demands of caregiving. The Alzheimer's Association (2016) commissioned a nationwide scientific survey of more than 3,500 Americans and reported that "[a]larmingly, the survey revealed that many care contributors had to cut back on basic necessities such as food and medical care for themselves and their families. They are 28 percent more likely than other adults to eat less or go hungry because they cannot afford to pay for food" (Alzheimer's Association, 2016, p. 6).

When stacked financially against the annual cost of caring for cancer and heart disease, Alzheimer's is a major contender in the economic health crisis. The Agency for Healthcare Research and Quality (AHRQ) estimates that the direct medical cost (total of all health care cost) for cancer in the United States annually is \$895 billion dollars and the estimate for heart disease is \$753 billion dollars (Agency for Healthcare Research and Quality, 2016).

### Prevention

With the list of chronic diseases growing and the shortage of funding for research being stretched, the major focus today seems to be preventing Alzheimer's disease (Pope, Shue, & Beck, 2003). Focusing on prevention at an early age could reduce risk factors by as much as 25-45%. Reducing the risk of factors believed to be correlated with AD, such as heart disease, high blood pressure, diabetes, obesity, and depression may lead to a decreased risk of developing late on-set Alzheimer's disease, and reduce risk of developing the related diseases as well (Pope, Shue, & Beck, 2003).

Ongoing research is needed to directly relate the correlation between those diseases and Alzheimer's disease. Cognitive abilities decline naturally with age, and when compounded with Alzheimer's disease atrophy and unstable molecules or free radical production is rapid. Loss of connection between neurons creates a permanent loss of communication between the areas of the brain, such as the frontal cortex, the hippocampus, the motor cortex and the sensory cortex. Without these neurons the brain will no longer communicate with body's muscles and organs. Research indicates that there are no straightforward answers on how to prevent Alzheimer's disease. Multiple studies have shown that a multifaceted prevention plan can reduce the risk factors in developing Alzheimer's disease (Brookmeyer, Grey, & Kawas, 1998; Landau, 2011; Pope, Shue, & Beck, 2003).

Facets of healthy lifestyles begin with proper eating habits, physical activity, and mental and social activity. Diets high in fat, saturated fat, and cholesterol have been linked to incidental dementia, but diets rich in Omega-3 fatty acids and fish will lower total fat and total cholesterol and will assist in reducing the risk. Healthy diets also reduce risk of Type 2 diabetes, high blood pressure, heart disease, and obesity -- all diseases correlated with developing Alzheimer's disease (Pope, Shue, & Beck, 2003; Bassil, & Grossberg, 2010).

Low levels of physical activity is a risk factor in Alzheimer's disease. Several large studies show that higher physical activity increases life expectancy by two to five years. Increased physical activity reduces the risk of numerous chronic diseases including heart disease, stroke, breast cancer and colon cancer. When patients develop habits that include physical activity such as hiking or running they are less likely to suffer cognitive impairment (Pope, Shue, & Beck, 2003).

Continued education and cognitive activity through old age can help prolong patients' cognitive abilities and delay the presentation of Alzheimer's disease's effects on memory and cognitive function (Bassil, & Grossberg, 2010). Cognitive improvements can increase quality of life and lower risks of depression. The Cognitive decline that can happen naturally is slightly deterred by an increase in stimulation in the areas of the hippocampus and cerebral cortex (Stern, 2006).

According to Pope, Shue and Beck (2003), "Stress management has received little attention as a risk factor for Alzheimer's disease [...]" (p. 124) Chronic stress may be a risk factor for cognitive decline in Alzheimer's disease. High cortisol, over-responding neuroendocrine and immune systems, and stress induced hormone levels can all lead to hippocampal damage. Reducing chronic stress will help improve quality of life and reduce the

risk factor of chronic disease such as obesity, depression, high blood pressure and hypertension (Pope, Shue, & Beck, 2003)

There are no clinically proven prevention measures at this time. However, including any of the above mentioned prevention methods will decrease the risk of developing any of the correlating diseases' and improve the quality of life in the patient. Healthy habits adopted early will have a positive effect in all areas of the brain, that Alzheimer's disease attacks.

### Conclusion

More research is needed to determine if the prevention methods recommended are in fact plausible preventive measures. Until an empirical cure has been discovered or superior diagnostic system and treatments are in place, prevention is the only tool to combat Alzheimer's disease and effects on the aging populace. Raising awareness of the disease can help people change behaviors that can prevent and delay the disease. Raising awareness will also increase the probability that the disease will get the attention it deserves to develop effective diagnoses and treatments. Raising awareness will ultimately lead to research to find a cure for Alzheimer's disease—the Silent Killer.

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