The Impact of Alzheimer's Using Social Models

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Abstract

Alzheimer's is a neurological disease that affects many spheres of life beyond its own onset. It has the ability to affect human biology in a way that affects many other disorders and diseases, and can be influenced by a number of external factors, including the environment and an individual's lifestyle. Beyond the black and white science of Alzheimer's that is traditionally studied, the political and economic impacts reflected by our government and public responses play a large role in how we tackle Alzheimer's, and various social aspects of Alzheimer's can affect the psychology of oneself, expanding to relationships and even has the potential to bring about discussions of cultural bias and impact in healthcare and caregiving.

Introduction

Alzheimer's disease belongs to a group of neurological disorders called dementias, which are often characterized by memory loss. Alzheimer's is the most common form of dementia and is associated with not only memory loss, but also language problems, general cognitive decline, and behavioral issues. It is important to note that although Alzheimer's occurs almost exclusively in older individuals, with the early onset mark being under 65 years old, it is not a normal part of aging. Alzheimer's is a gradual disease rather than an abrupt one, and takes many years to fully onset. The multiyear period between normal aging and actual Alzheimer's is called mild cognitive decline, in which people exhibit a milder version of the symptoms of Alzheimer's. Although Alzheimer's is a gradual disease that can take years of slow build up before actually being labeled as Alzheimer's, its consequences are dire once onset has begun, with death ranging from 3-10 years after diagnosis. These consequences are seen in mass numbers globally, with particularly high numbers in the U.S.. According to the Alzheimer's disease research center (2024), there are around 5.7 million people in the United States that have Alzheimer's disease, and that number is expected to triple by 2040. Alzheimer's unfortunately does not have a cure, although many preventative actions exist. Due to its severity, Alzheimer's has been researched extensively. However, many Alzheimer's researchers refuse to consider Alzheimer's as a holistic medical condition instead of a strictly neurological condition. As it is something that affects many different aspects of the human body, Alzheimer's, like any other disease and health problem, can be easily influenced by life choices and environment. Alzheimer's unfortunately does not have a cure, although many preventative actions exist.

The focus of this paper will be on the numerous different aspects of life that can affect and are affected by Alzheimer's, including human biology, society, culture, and everyday lifestyle. Genes and proteins that cause the negative effects of Alzheimer's neurologically are the basis of our research on Alzheimer's and are the most commonly known causes associated with Alzheimer's. Lifestyle and culture, however, are two aspects not as commonly discussed. Ethnoracial identity, social standing, quality of life, education, and many other factors can contribute to Alzheimer's in a more unseen way, which is what is going to be uncovered here.

The Biological Significance of Alzheimer's

The biology of Alzheimer's extends across many areas, although some of them may be underexplored. The typical definition of Alzheimer's is a hippocampal, neurodegenerative

disease with the primary symptom being memory loss. The genetics, epigenetics, and interconnectedness between other diseases are fascinating subjects often overlooked. Epigenetics could potentially be a field that creates modern solutions to problems we previously thought to be unrelated.

Understanding the genes and proteins behind Alzheimer's is foundational to understanding other aspects of Alzheimer's, including better understanding the causes of Alzheimer's. Two types of abnormal tissue, or lesions, are observed in Alzheimer's, both of which are toxic and result in decreased neural plasticity, or ability to form memories. The first kind are neuritic plaques, which contain fibrous amyloid β-protein (Aβ) (Harvard, 2019). These plaques are associated with organelle enlargement, paired helical filaments, instead of straight filaments, that lead to neuropathological disorders in Alzheimer's, and the expression of HLA-DRBI and CD45 genes for antigens for immune cells in the nervous system that engulf excess deposits of Aβ.

The other type of lesion is a neurofibrillary tangle made out of tau proteins, the phosphorylation of which also leads to paired helical filaments similar to those made from the Aβ proteins. Most of the filaments made by tau proteins are not soluble in the brain, as compared to other proteins that are easily dissolved using simple enzymes, making it harder to counteract these lesions in Alzheimer's. Many proteins are also essential in regulating the formation of these lesions. An error in CDK5, a cyclin dependent kinase, leads to the hyperphosphorylation of tau that results in neurofibrillary tangles. A group of genes called the APOE family affects the onset of Alzheimer's, especially the APOE4 gene (Sims, 2020). Individuals with the ε2 and/or ε3 alleles often have early onset of Alzheimer's because these forms of the APOE4 gene encode a protein that stimulates amyloid precursor protein (APP) to create amyloid proteins that cause Alzheimer's.

Epigenetics is a division of genetics that studies how expression of genes can be controlled by certain molecules. Acetyl groups can increase transcription of genes, while methyl groups do the opposite. Epigenetics may not as easily increase susceptibility to Alzheimer's, but it is being targeted for viable therapies. DNA methylation and acetylation are both epigenetic processes that add chemical groups to chromatin to either prevent or enhance the transcription of certain genes. Methylation causes DNA to pack and not be transcribed in certain areas, while acetyl groups do the opposite. Both are necessary to ensure healthy functioning. Two main types of epigenetic inhibitors, DNA methyltransferases (DMNTs) and histone deacetylases (HDACs), are currently being researched for their possible epigenetic benefits. DNMTs are enzymes that primarily methylate cytosines in the promoters of genes (Wiley, 2024). One symptom of Alzheimer's is that DMNTs methylate BDNF genes, genes that express proteins that protect neurons. Turning off their expression leaves neurons unprotected. They also do not provide enough methylation to the alleles of APOE4, which results in increased risk of amyloid protein build up, causing Alzheimer's. While general DMNTs in Alziehmers can lead to negative symptoms, methyl donor S-adenosyl-L-methionine, or SAM, is a DMNT that donates methyl groups, and can be used to methylate the promoters of APP genes in patients to decrease amyloid protein production. HDACs are often overexpressed in Alzheimer's, which leads to decreased cognition and memory formation . However, valproic acid is a type of HDAC that is currently being researched in order to stop over-expression of amyloid. Epigenetic therapy clearly comes with a risk involved with it, but it could also potentially be a way to slow down much of the neurological damage mentioned above (Liu, 2018).

The Societal and Cultural Impact on Alzheimer's

While Alzheimer's is predominantly known as a biological disorder, the methods of treatment provided to patients can have a range of social impacts on both the patients and their family, and can often have an identifiable cultural bias. The largest identifiable behavioral symptom observed in Alzheimer's patients is personality change. There has not been an established reason in the scientific community as to why Alzheimer's and personality are correlated, but four main theories have been presented: common cause, predisposition, pathoplasy, and spectrum.

One theory as to why Alzheimer's relates to personality is that personality disorders are a common cause of Alzheimer's disease. This is thought to have a largely genetic basis despite being a social issue. Genetic variations in the APOE gene can be an indicator of Alzheimer's disease risk and cholesterol regulation, an important factor in diseases closely related to Alzheimer's, such as diabetes (alz.org, 2024). According to a study in 2007 conducted by the Alzheimer's Association, individuals with two ε4 type alleles of the APOE gene were more likely to have Alzheimer's than those with none, and coincidentally, these genes also happen to control traits such as neuroticism which are prevalent in Alzheimer's patients. A study conducted using mice brains found that expression of hippocampal BDNF proteins and TAU proteins create anxiety and autism mimicking disorders and exacerbate memory deficits respectively, creating the mood disorders and disposition commonly seen in Alzhiemers patients. One of the most common factors that can result in overexpression of these proteins is social isolation.

Predisposition and pathoplastic models of Alzheimer's both have a genetic and an epigenetic basis. The key difference between the two is that a smaller factor that could have a mild influence on susceptibility of disease is predisposition, while a larger cause that directly affects the outcome of Alzheimer's is considered pathoplastic. Both often have to do with one's cognition level, which is influenced by a number of factors. Ethnicity plays a major role in this; the significance of music in African American culture has been proven to play a role in higher rhythm based cognition test scores, while the importance of mathematics in east and west Asian cultures leads to higher logic based cognition. Latin cultures often encourage talking and exchanging of ideas while it's considered rude in Anglo-Saxon cultures, affecting communication test scores (APA, 2024). Cultural values, familiar stimuli, and language all affect predisposition and pathoplasticity in AD. Furthermore, modes of knowing, or the idea of collective vs. independent societies, patterns of learned abilities, and even level of education, all of which affect cognition. Ethnicity also influences disparities in access to treatment. Difference in Medicare and Medicaid resources for marginalized communities has resulted in Hispanics and African American families having Alzheimer's incidence rates almost twice as high as those of other ethno-racial communities.

The concept of a spectrum of Alzheimer's symptoms unique to each person is one of the most interesting ideas in Alzheimer's research. This not only makes Alzheimer's much more observable but also allows us to employ the Five Factor Model of personality. Personality is made up of 5 aspects: extroversion/introversion, agreeable/disagreeable, conscientious/unconscientious, neurotic/emotionally stable, and open/closed to experience (Beard, 2004). These five factors make up who we are as people. Diseases that affect behavior, such as Alzheimer's, can result in these personality traits fluctuating. For example, someone who was more agreeable and extroverted before Alzheimer's might take on a more socially inept and neurotic disposition. And, as stated before, the symptoms of Alzheimer's often include things such as aggression, isolation, and anxiety, which are all part of the five factors. In turn,

these symptoms can negatively affect caregivers and families of people with Alzheimer's, as a large emotional and financial burden is an observed characteristic. A possible solution to this could be better access to behavioral resources for people with Alzheimer's. This spectrum of symptoms can often result in three main events for people with Alzheimer's: defining moments, to tell or not to tell, and preservation. A defining moment can occur when a patient has an epiphany about their own situation, such as experiencing anxiety and autism like symptoms. This can lead a patient to an internal debate of whether to open up to their family members, so as to not cause their family stress, which can cause the five factor model of someone's personality to shift. This is finally concluded by a period of preservation in which they try to make sense of the world around them, often resulting in aggressive and neurotic dispositions mentioned before.

The Lifestyle Factors Involved in Alzheimer's

While ethno-racial identity and biological makeup are aspects inherent to us and affect our predisposition to Alzheimer's, our lifestyle and choices we make in our everyday lives can also influence our susceptibility to Alzheimer's. Physical activity and diet in particular are two components that greatly sway Alzheimer's and its consequences. Alzheimer's is a disease that can take many years to develop, as amyloid beta plaques are a result of a very gradual build up of protein, and lifestyle choices that improve cognition and memory can be used to both prevent onset as well as reduce symptoms of Alzheimer's.

Reduced physical activity is often correlated with Alzheimer's disease. Five main aspects of Alzheimer's are affected by exercise: plaque proteins, inflammation, neurotrophins, cognitive function, and cerebral blood flow (CBF). In a study observing transgenic mice, where organisms engaged in both voluntary and forced physical activity, neuritic plaques and neurofibrillary tangles were seen to decrease significantly, and in a few of these mice improvements in cognition and memory were found (Mir, 2020). Another study on mice involving 10 weeks of voluntary physical activity showed a positive relationship between physical activity and increased spatial memory, decreased amyloid plaques and tau phosphorylation, and increased formation of neurons. Aerobic exercises, more commonly known as cardio, have been proven to decrease amyloid in plasma in elderly people by up to 24%, while weight lifting has been proven to help doctors identify cognitive impairments early on in patients (Wlassoff, 2017).

Inflammation is a response caused by cell mediated immunity, including the CD45 antigens on microglia. Excessive inflammatory responses are a common sign of aging and are caused by cytokines, proteins that signal areas containing damaged or compromised cells. Overexpression of cytokines can result in serious damage to neurons, often leading to Alzheimer's. A study on transgenic mice found that 3 weeks of voluntary exercise led to decreased concentrations of cytokines and immune cells. In particular, aerobic exercise has led to decreased activity of many immune cells including natural killer cells, stem cells, and progenitor cells, which can also damage neurons and lead to Alzheimer's. While exercise can downregulate production of proteins that damage neurons, it can upregulate the production of proteins that protect neurons. Neurotrophins are a type of growth factor that take care of glial cells, the most common being BDNF proteins. Exercise increases the production of BDNF proteins and elevates hippocampal and cognitive function.

Finally, cerebral blood flow, or CBF, is another common area of compromise within Alzheimer's. CBF reduces oxidative stress in the brain and results in things like increased neurotrophic expression or neuron formation. CBF decrease in Alzheimer's is usually caused by lower blood vessel quantity and density in the cerebral cortex. Short term exercise programs have shown an increase in CBF and increased endothelial function. This is important because the endothelial lining contains many of the cells that combat inflammatory responses within elderly patients.

Especially in the western world, we incorporate a variety of foods, many lacking nutritional content, into our everyday diets. This can often lead to fluctuating nutrition where it is more difficult to ensure a well balanced, healthy meal. Unbalanced diets can contribute to Alzheimer's. In order to understand how health specialists have managed to create diets designed to combat inflammation and neurodegeneration, we first have to look at what is wrong with current diets, as well as what works within them. The two main dietary aggressors in Alzheimer's are saturated fats and cholesterol. These fats block blood vessels, which can result in cardiac diseases as well as clogging of cerebral blood vessels, resulting in reduced CBF. Alzheimer's incidence rates in Japan have increased from 1% to 7% due to the westernization of their otherwise healthful traditional diet (alz.org, 2024). Diets high in unhealthy fats lead to cognitive impairment and decline of the microbiome, a miniature ecosystem full of essential bacteria that live in your gut and tracts. Fat buildup in the brain caused by overconsumption combined with the decline of metabolic bacteria in your body can lead to severe neurological consequences.

Diets high in vitamins, microelements, fatty acids (monounsaturated and polyunsaturated), flavonoids, polyphenols, probiotics, and other important nutrients are an essential part of any healthy lifestyle. Omega-3's in particular have been linked to improved cognition as our brains are made out of fatty acids like omega-3. This information has led to the creation of the DASH diet, or dietary approaches to hypertension diet (alz.org, 2024). The DASH diet contains mainly fruits and vegetables and limits animal product intake to optimize antioxidant intake, which reduces free radicals and relieves the oxidative stress AD patients experience. Many trials of this diet have been done at varying sodium intake levels and proved that blood pressure is best reduced when a high nutrient and low sodium diet is in place. Reduced blood pressure in turn helps accelerate CBF and reduce the risk of Alzheimer's. Exercise and diet are important parts of your life, and even just simple everyday choices can have long term positive effects.

The Psychological Progression of Alzheimer's Patients

In this study, we will be using original data collected from family members of those with Alzheimer's to show how the psychological disposition of Alzheimer's patients can affect their family members, as well as try to use this data to personalize bedside care for Alzheimer's patients.

The methods for this study were sending out a survey to forums for people with Alzheimer's and hospitals serving Alzheimer's patients, so we recognize the response bias that comes with this method. The results are qualitative.

On average, the responses were largely from the grandchildren of Alzheimer's patients, indicating that care for elderly patients is largely provided by younger generations. Our demographics for patients were mostly caucasian females, and the age of the caretakers ranged from 25-34. All caretakers agreed that the care, while expensive, was about what they

expected. We will refrain from commenting on the efficiency of economic systems established within healthcare to treat Alzheimer's patients as we do not have conclusive data on the matter. Patients did not go through any significant life changes prior to exhibiting symptoms of Alzheimer's, therefore we cannot comment on the causality of traumatic events and Alzheimer's.

In this study, I will be displaying the results of three separate respondents. Our first respondent claimed that the main psychological changes in their patient were suspicion and paranoia. While cultural norms did not factor into the care of their patient, our responder claims that the city they reside in was the largest factor, environmentally speaking, related to the care of their patient.

Our second responder is a very interesting case in the sense that the main strain psychologically speaking wasn't any personality trait, but rather how providing care for their parent affected the sibling dynamics between the responder's aunts and uncles. Their culture played a very strong role in the care of their patient, as putting elders in homes is strictly against their culture, straining their family dynamic even further when it was necessary to put the patient in special care.

Our third responder takes yet another perspective. This responder's grandmother seemed to play the largest role in the care of the responder's grandfather, our patient. Psychologically, our responder says that the patient displayed short periods of memory loss, and by the end had impaired speech function. They also commented that the relationship between the grandmother and grandfather became less of an emotional relationship, and more task oriented as the grandmother took on the role of the primary caretaker. Religious norms largely affected the way the grandmother cared for the grandfather, as she was taught to treat everyone with love and kindness, and to be in tune with people's wants and needs. Our responder believes that the intimacy of their grandparents' relationship largely affected her ability to provide for her husband.

Based on the three responders, a personal model I would develop would be a combination of environmental factors related to residence, heightened anxious personality traits, the cultural significance of caring for the elderly, and personal morals and interpersonal relationships. Paying more attention to these factors in healthcare is a must to make healthcare more personalized and efficient.

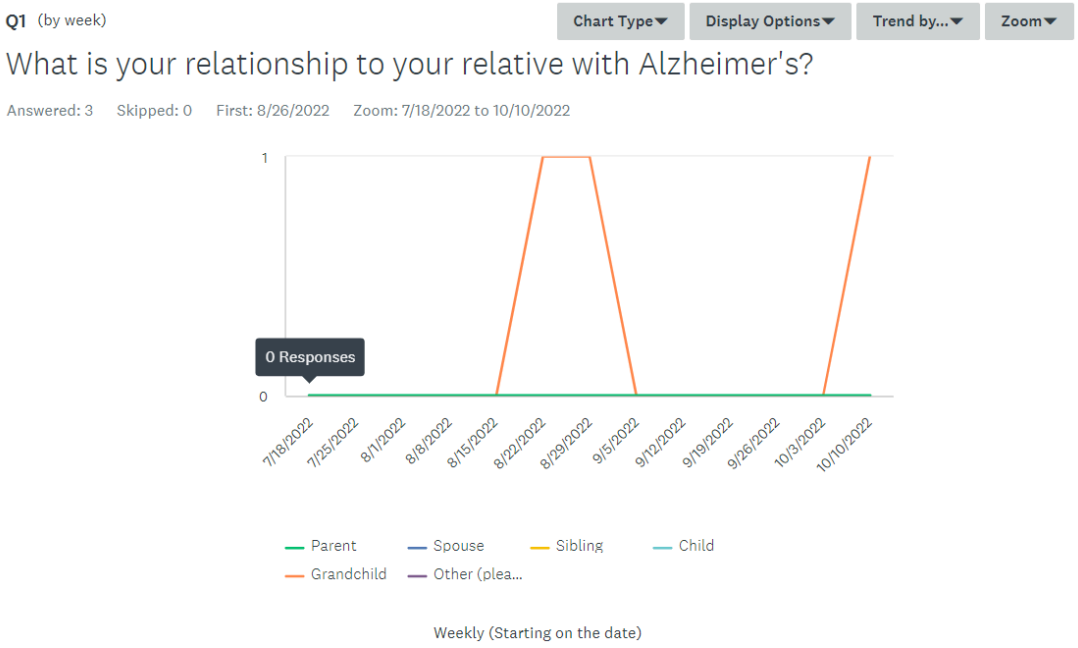

Figure 1: Relationship of Responders to their Patient with Alzheimer's

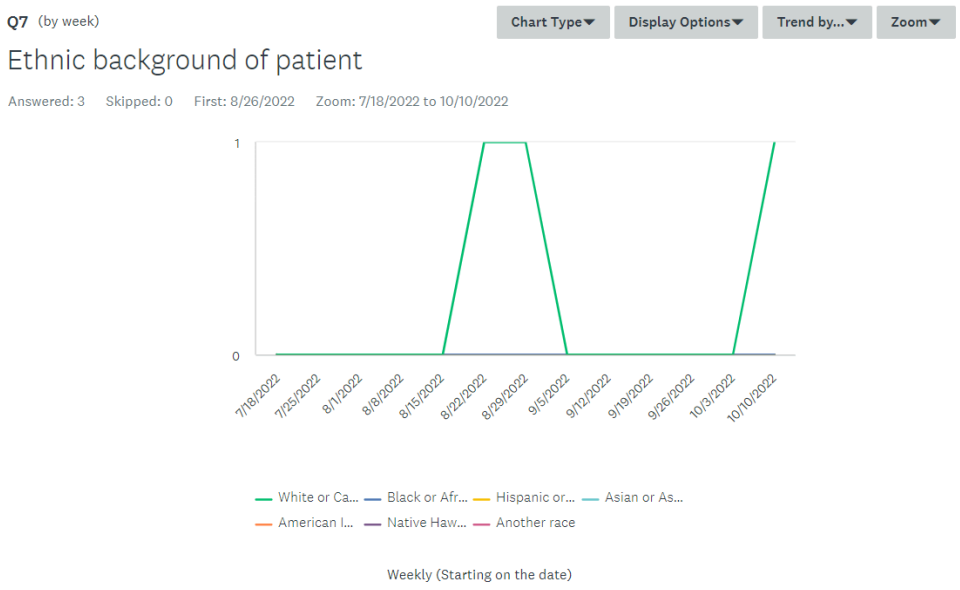

Figure 2: The Ethnic Background of Alzheimer's Patients

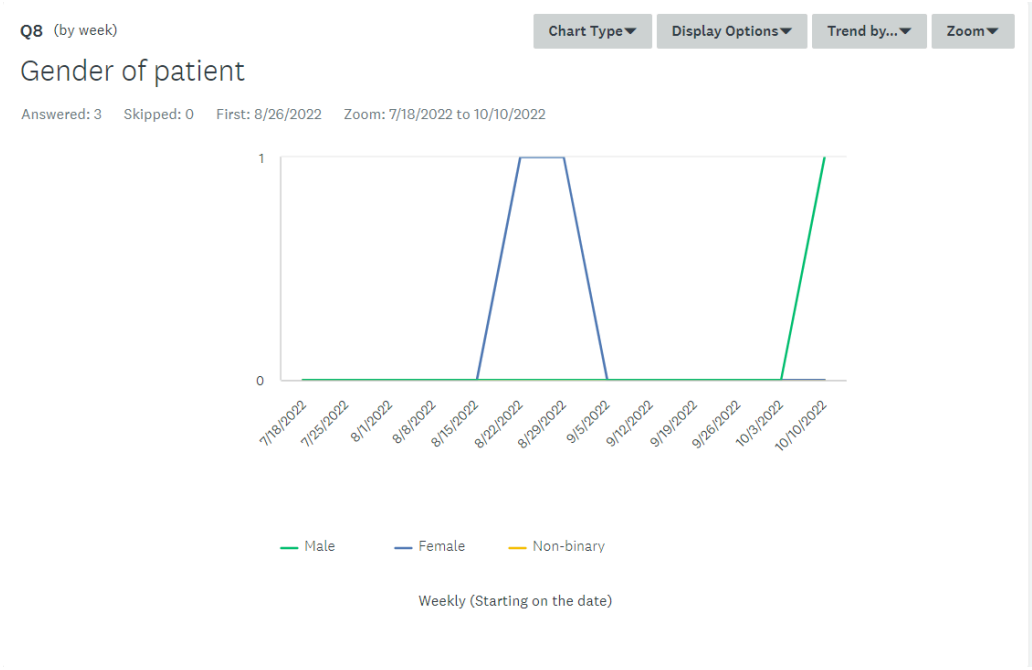

Figure 3: The Gender of Alzheimer's Patients

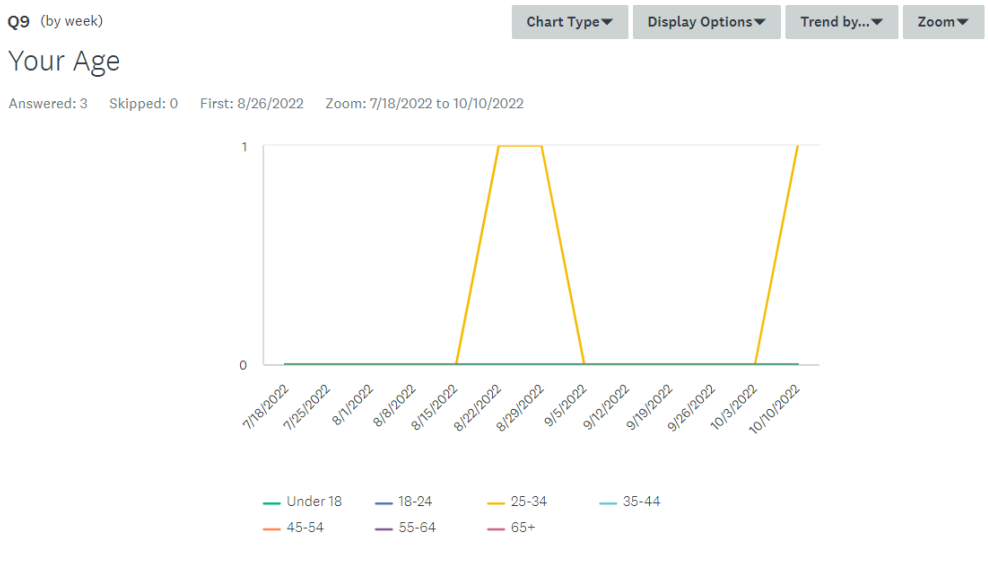

Figure 4: The Age of Responders related to Alzheimer's Patients

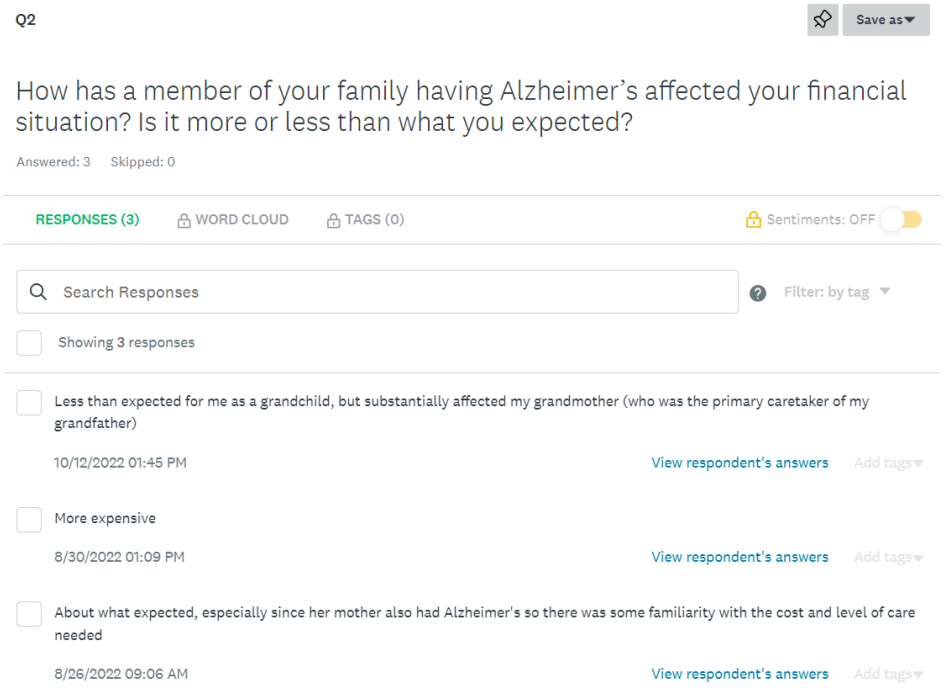

Figure 5: Responses as to how the Financial Situation of patients with Alzheimer's is affected

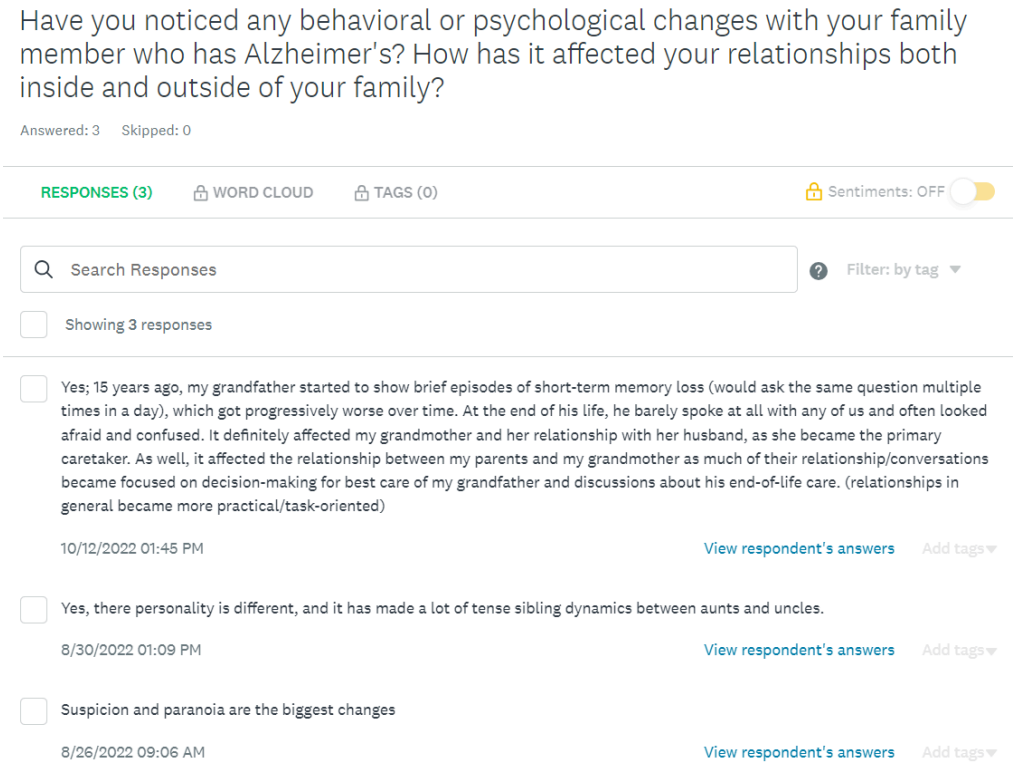

Figure 5: Responses as to whether or not Patients with Alzheimer's have Psychologically Progressed throughout their Prognosis and how this has affected Familial Relationships

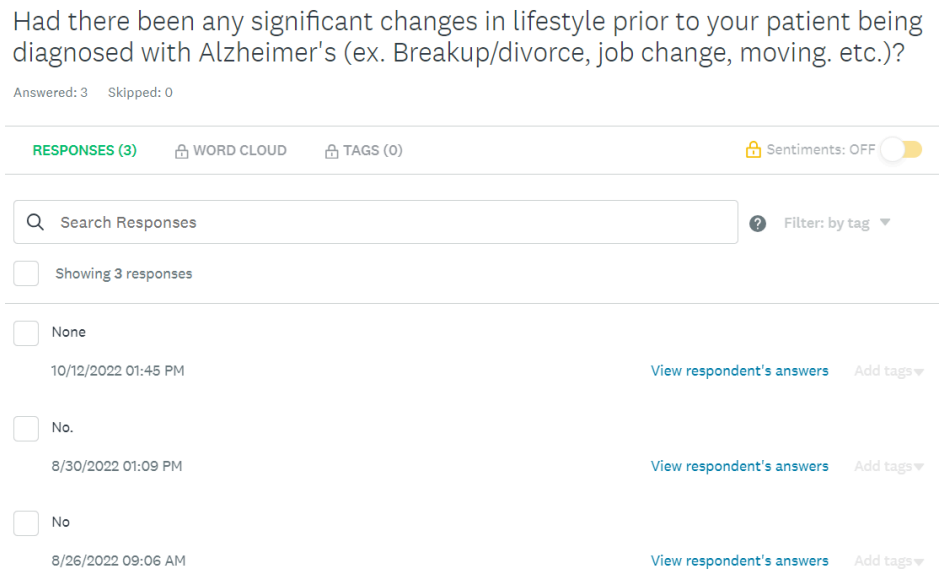

Figure 6: Responses as to whether or not there were any Major/Traumatic Life events that would have affected the Alzheimer's Diagnosis

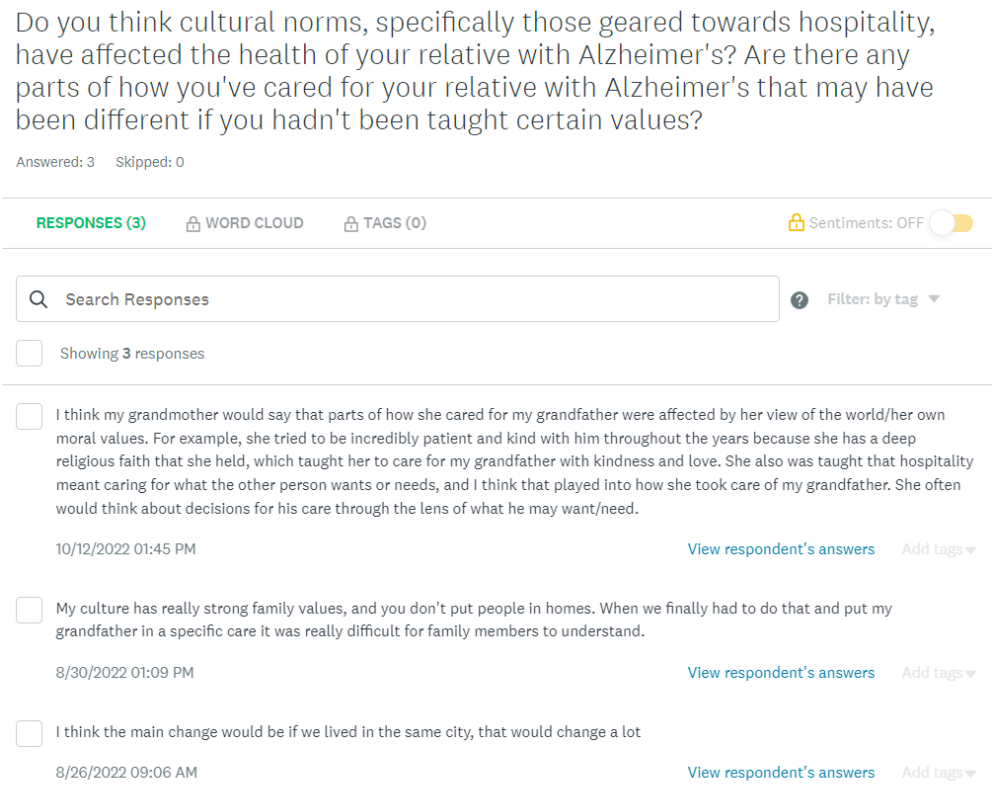

Figure 7: Responses as to whether or not Cultural Norms and Values have affected the care of Alzheimer's Patients

Conclusion

Alzheimer's is a highly sensitive and complex condition that is affected by a multitude of factors. While we may not have a cure to Alzheimer's yet, many different therapies and preventative measures are currently being researched and have yielded positive results, and in our constantly evolving technological world, we expect to see more and more breakthroughs everyday. We can identify biological, social, and lifestyle as some of the main categories that affect Alzheimer's, but that doesn't mean that these are the only aspects of life that can influence Alzheimer's. Keeping this in mind, practicing healthy living as well as striving to make changes within our communities benefits us both physically and mentally, both of which are necessary to prevent Alzheimer's, as well as any other diseases.

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