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The Development of Alzheimer's Disease: An Empirically Approach

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ABSTRACT

Little research has been done on the most appropriate living and care environment for those living with Alzheimer's disease. With current predictions showing that over 16 million people will be living with Alzheimer's disease by the year 2050, it is important that practitioners become aware of how living environments may help or hinder the treatment of the disease. This study is an exploratory longitudinal study aimed at understanding how the disease progresses among different living environments. The study examines the difference in the mean stage of the disease over a 6 year period in 3 living environments, including individuals living at home independently, those living at home or with relatives but with assistance, and those living in an assisted living facility. 374 participants were asked to participate in the study by responding to a 122-question online survey. The study showed that the mean difference in the stage of the disease in early years shows to be lower in those who live at home independently, however, in later years the mean difference is lowest in those living in an assisted living facility. This could suggest that the progression of the disease is slower in familiar environments that involve routine tasks when cognition is mildly impaired. This could also suggest that the development of Alzheimer's disease is slower in an assisted living facility when cognition is more significantly impaired.

Keywords: Alzheimer's disease, empirically test, environment

INTRODUCTION

The prevalence of Alzheimer's disease in the world is growing and is anticipated to continue growing. Alzheimer's disease causes those diagnosed with it to slowly become less able to care for them until independent living is no longer possible. This leaves family members with a difficult decision to make. Will the patient have a better life at home with family or in a long term care facility that has trained nursing staff available?

For the over 5 million people living with Alzheimer's disease this question has been a personal choice for each family with little information available to help them make this difficult decision. The goal of this study is to determine whether the speed of progression of Alzheimer's disease can be associated with the environment in which the patient lives. There is little research that ties the progression of Alzheimer's disease to where the patient lives and no apparent research that compares the progression in two or more different living environments.

This exploratory study sought to create a basis for later, more detailed research. The study was an investigation of the progression of Alzheimer's disease over the last 5 years in patients who have already been diagnosed as possible, probable, or confirmed Alzheimer's disease. In order to study this progression as accurately as possible, the caregivers, close friends, or relatives of the patients were surveyed using an online survey.

This survey included demographic information as well as questions about the cognitive abilities of the patient for the previous 5 years at 1 year intervals. The environment in which the patient lives (whether assisted living or in a private home) was compared with the cognitive abilities of the patient to find any correlation between living environment and the speed of progression of Alzheimer's disease.

Commonality of Alzheimer 's disease

Alzheimer's disease is currently experienced by nearly 44 million people worldwide and by over 5 million people in the world (Prince et al., 2014; U.S. Department of Health & Human Services, 2016). This form of dementia is the most common form for geriatric patients (U.S. Department of Health & Human Services, 2016). Although a large number of people worldwide currently have Alzheimer's disease, only about 25% of those with the disease have been diagnosed and are receiving treatment (Prince et al., 2014). Worldwide, Alzheimer's disease is the leading cause of disability in geriatric patients (Prince et al., 2014).

DSM-V Categorization

While a patient is living he or she can only be diagnosed with "probable" or "possible" Alzheimer's disease. This is because the disease cannot technically be diagnosed until the brain is

autopsied. Alzheimer's disease is categorized in the Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5) as a neurocognitive disorder. Before being diagnosed, the patient must first meet the criteria for major or mild neurocognitive disorder.

In order to diagnose a patient with Alzheimer's disease there must also be a gradual progression of cognitive impairment in one or more domains. Alzheimer's disease can be categorized as either a major or a mild neurocognitive disorder. For a probable major neurocognitive disorder diagnosis there must be evidence of a genetic mutation. There must also be a decline in memory and learning and at least one other cognitive domain. Evidence of a gradual decline in cognition is also required for diagnosis.

Caregiving

Many families choose to care for family members diagnosed with Alzheimer's disease themselves, opting out of assisted living communities. Over 40% of Alzheimer's related family care givers report a high level of emotional stress that directly relates to their role as a caregiver (Prince et al., 2014). Alzheimer's and dementia caregivers seek medical care at a much higher rate than the rest of society, accruing an additional $9.7 billion in healthcare costs in 2014 alone (Alzheimer's Association, 2015).

Caregivers often report that they would feel guilty if they did not personally care for their loved one diagnosed with Alzheimer's disease and felt that they did not have a choice in caring for the family member. Seventy-four percent of these caregivers reported that they were very concerned about their own health and that this concern has significantly increased since becoming a caregiver (NAC/AARP, 2009). Fifteen million people worked as unpaid caregivers for people with Alzheimer's disease in 2014, accruing 17.9 billion hours of unpaid work (Alzheimer's Association, 2015).

Caregivers can be family members or hired help who care for the individual at his or her home or they can be staff members at an assisted living facility or nursing home. Lee, Walker, and Shoup (2001) found that caregivers who work longer hours tend to experience depression at higher rates than those who work fewer hours. The authors also found that caregivers who were unpaid family members often suffered depression at a higher rate than those who were nonfamily paid workers. These feelings of depression often contribute to family members choosing to care for their loved ones longer than they are qualified to do so (Lee et al., 2001). Lee et al. (2001) suggested that hired help in the home can make the patient feel confusion and can cause family members who had previously been caring for the patient to feel inadequate.

Treatment Options for Alzheimer's Disease

Cherrier et al. (2005) found that increased levels of testosterone, even if those levels were increased due to a supplement, helped to improve special and verbal memory functioning in men. The study did not include women, so the effect of testosterone on women was not studied.

In a 2012 study Shaw et al. found that hormone therapy initiated later in life correlates with an increased rate of Alzheimer's disease diagnosis. The authors observed the usage of hormone therapy in correlation with the probability of being diagnosed with Alzheimer's disease. Women who began hormone placement therapy only after menopause showed higher levels of Alzheimer's disease diagnosis later in life (Show et al., 2012).

Azcurra (2012) found that Alzheimer's patients who participated in reminiscence therapy showed a significant improvement in quality of life and engagement with those around them. Azcurra studied only participants who lived in long term care facilities. A total of 135 participants were recruited and were evaluated during a 6-month period. The study found that, although cognition was not improved by the treatment, behavior and quality of life were greatly improved.

Effects on Cognition

Stoirandt (2008) found that changes in cognition are often most notable in aspects of personality even before memory difficulty is noticed. Over time, the disease will create an increasing decline in cognitive ability. This decline will affect both stored memories and the ability to make new memories (Storandt, 2008). According to Storandt (2008), episodic memory is often the first symptom that is noticed by families as an Alzheimer's disuse concern. People who experience episodic memory decline often repeat stories or questions and may leave a task when they are only partially finished with it, forgetting to return to complete the task.

Uc, Rizzo, Anderson, Shi, and Dawson (2004) found that visual search is often impaired in patients with Alzheimer's disease. Visual search allows people to quickly scan a place or document for a specific object or work that they are looking for. Uc et al. found in their 2004 study that individuals diagnosed with Alzheimer's disease reported seeing less during a visual search exercise than participants who were neurologically healthy.

Backman et al. (2005) found that perceptual speed is diminished in patients with Alzheimer's disease. Perceptual speed, which allows individuals to compare and contrast

visually processed information nearly instantaneously, could prove dangerous when diminished. Diminished perceptual speed could lead to grave miscalculations for an individual living with Alzheimer's disease. In a follow up study in 2008 Boyle, Wilson, Schneider, Bienias, and Bennett found that not all patients with Alzheimer's disease experience reduced perceptual speed. The researchers found that those who do not experience this loss can often mask the symptoms of Alzheimer's disease longer than those who do experience a loss in perceptual speed.

Alzheimer's disease nearly always affects executive functioning at some point during the course of the disease (Becker, 2004). Executive functioning is necessary for time management and organizational skills. Individuals who lost executive functioning ability may make major miscalculations in time and may forget that they have already asked a question or told a story. Alzheimer's patients experiencing a loss of executive functioning may also forget where they have even when in familiar places with familiar people (Becker, 2004). Marshall, McGurk, Karow, and Kairy (2007) found that loss in executive functioning may also lead to difficulty solving simple problems or completing simple tasks. The authors explained that this is a result of the inability for individuals with Alzheimer's disease to organize their thoughts. The study found that individuals with Alzheimer's disease and other neurocognitive diseases or disorders became frustrated when given a problem to solve, such as a block design test. The participants in the study were noted to be inconsistent, disorganized, and impatient (Marshall et al., 2007).

Macduffie, Atkins, Flegal, Clark, and Reuter-Lorenz (2012) found that individuals with Alzheimer's disease reported that they were often unsure of the truth and validity of their memories. This was true even after the individuals had been recently given new information to help trigger the memory. Memories that are preserved during Alzheimer's disease are often distorted (Macduffie et al., 2012).

In later stages of the disease, speech and language can be greatly diminished (Taler & Phillips, 2008). Issues with speech and language typically increase as other symptoms become more severe. During their 2001 study, Altman, Kempler, and Andersen asked participants both with and without Alzheimer's disease to recite a sentence of their choosing using correct nouns and verbs. The study found that those with Alzheimer's disease often mistakenly left out words or added unnecessary words to their sentences. Consequently, the individuals who did not have Alzheimer's disease performed significantly better than those with the disease (Altman et al., 2001).

METHODS

This study uses a longitudinal survey design to assess the mean difference of the stages of Alzheimer's disease over a six-year period in three different living environments. The purpose of the design of this study is to compare the living environment (whether the individual lived independently at home, at home but depended on others or in an assisted living environment) with the severity of symptoms at yearly intervals.

Sampling

Because the population being studied have cognitive impairments by nature, it would not likely be beneficial to ask individuals with Alzheimer's disease questions about their own symptoms and cognitive deficiencies. Instead family members, physicians, and caretakers were surveyed. Through the use of an online survey 300 people were targeted from a variety of geographical locations. Although a larger sample will yield a smaller margin of error, a larger study is not possible at this time.

A purposive sampling was used for this study to ensure that all responses are associated with someone who has been diagnosed as probable, possible, or confirmed Alzheimer's disease. Because of the nature of this study it is not necessary to survey populations not affected by the disease. The sample was collected through the use of social media as well as community groups, physicians' offices, and long term care facilities (assisted living facilities, memory care units, and nursing homes).

Procedures

In order to assess the stages of the disease quantitatively, only multiple choice questions from the CDR were asked. The questions were formatted for an online survey. A link to the survey was distributed on social media, through the Alzheimer's Association's TrialMatch website, and well as several other locations. Alzheimer's advocacy groups were also notified of the study and provided with a link to the survey.

A link was also given to long term care facilities, general physicians and gerontologists, psychiatrists, neurologists, and other medical practitioners who may be aware of individuals who are interested in participating in the study. In order to attempt to get representation for both patients who are living in a long term care facility and those who remain living at home with assistance, in home nursing and caregiver services were also provided with a link to the online survey.

The survey included approximately 120 multiple choice questions. Questions include demographic information as well as 36 questions about the patient's ability to remember and function in his or her daily tasks. The participant (the caregiver or family member) was asked to remember and report on the ability of the individual for first 6 years of the individual being diagnosed with probable or possible Alzheimer's disease using 36 questions from the CDR. The questions are repeated for each of the six years. Participants were notified that it was expected that the survey would take approximately 45-60 minutes to complete.

RESULTS

This study will contain a description and overview of the data that was collected and analyzed. This overview will include a description of the sample, the variables, and the scale. The hypotheses will be presented as well as an analysis of the data as it supports or nullifies the hypothesis.

Overview of Data Collection

The study involved responses from 374 participants. Each of these participants is a friend or family member of an individual diagnosed with dementia and is acting as an informant on this person's symptoms. Of the 374 people who agreed to participate, only 273 participants completed enough of the survey to report on at least one year of symptoms. Each participant was asked to take a 122 item questionnaire in order to report on their friend or relative's symptoms over a 6 year period. The results of these 273 participants was analyzed and then compared in order to determine if there was a correlation between the individual's living environment and the speed of progression of the disease.

Participants were recruited through social media, email, word of mouth, and The Alzheimer's Association's Trial Match system. The questionnaire was administered online and

was accessibly by a link provided to each participant. Participants were not required to complete demographic information, but were given requirements that must be met in order to proceed.

Descriptive Statistics

Descriptive statistics were calculated in the form of standard deviation and mean. The number of members in the sample, the standard deviation, and the mean of each of the subgroups can be found in Table 1. It appears that those who live at home independently have a lower mean score than those who live in other settings, but this is to be expected because many individuals will not move into a higher setting of care until it is necessary. The speed of progression can be found in the mean differences between years, which can also be found in Table 1.

Table 1

Participant Numbers, Mean Stage, and Standard Deviations

Year	Living Arrangement	*N*	Standard Deviation	Mean	Mean Difference from Previous Year
Baseline	At home independently	168	.73255	1.13185	n/a
Baseline	At home or with relatives, but with assistance	94	.68748	1.5699	n/a
Baseline	In an assisted living facility	11	.83029	2.0045	n/a
1	At home independently	63	.63202	1.2267	.09485
1	At home or with relatives, but with assistance	129	.65215	1.8393	.2694
1	In an assisted living facility	45	.71537	2.4091	.4046
2	At home independently	37	.70886	1.4903	.2636
2	At home or with relatives, but with assistance	123	.71491	2.1194	.2801
2	In an assisted living facility	54	.81893	2.7402	.3311
3	At home independently	20	.75621	1.5380	.0477
3	At home or with relatives, but with assistance	100	.68429	2.2585	.1391
3	In an assisted living facility	65	.85475	2.8858	.1456
4	At home independently	8	.59062	1.0700	-.468
4	At home or with relatives, but with assistance	19	.61145	1.7118	-.5467
4	In an assisted living facility	72	.74431	2.8555	-.0303
5	At home independently	2	.9091	2.2143	1.1443
5	At home or with relatives, but with assistance	21	.56512	2.2789	.7439
5	In an assisted living facility	13	.38422	2.6923	-0.1632

Hypothesis Testing

Living Environment Correlates to the Speed of Progression of Alzheimer's Disease

The initial hypothesis of this study is that living environment strongly correlates with the progression of Alzheimer's disease. Factors such as regular meals, attention to medication dosage, and outside knowledge of symptoms and memory deterioration may assist in the treatment of the disease. Each of the living arrangements was compared over a six-year period. In order to determine the speed of progression, the mean differences were analyzed among the different living arrangements.

The results supported the hypothesis, with "living at home independently" showing the slowest speed of progression. Table 2 includes the mean differences of each of the living environments over each of the years included in the questionnaire. While living at home independently shows the slowest speed of progression, living at home or with relatives, but with assistance shows the most consistent progression from year to year.

Table 2

Mean Difference by Living Arrangement

Year	Living Arrangement	Mean Difference from Previous Year
Baseline	At home independently	n/a
1	At home independently	.09485
2	At home independently	.2636
3	At home independently	.0477
4	At home independently	-.468
5	At home independently	.5014
Baseline	At home or with relatives, but with assistance	n/a
1	At home or with relatives, but with assistance	.2694
2	At home or with relatives, but with assistance	.2801
3	At home or with relatives, but with assistance	.1391
4	At home or with relatives, but with assistance	-.7385
5	At home or with relatives, but with assistance	.739
Baseline	In an assisted living facility	n/a
1	In an assisted living facility	.4046
2	In an assisted living facility	.3311
3	In an assisted living facility	.1456
4	In an assisted living facility	-.0303
5	In an assisted living facility	-.1632

In early years of the disease, living at home independently shows the slowest rate of progression. The mean difference between the baseline year and year one is 0.09485 in individuals living at home independently, while it is 0.2694 in those living at home or with relatives, but with assistance. The mean difference for this time period in those living in an assisted living facility showed the greatest rate of progression, with a mean difference of 0.4046 from the baseline year to year one.

Between Year 1 and Year 2, the disease continues to progress across all living environments, however, the mean difference is less significant than it is between the baseline year and Year 1. The mean difference between Year 1 and

Year 2 in individuals living at home independently is 0.2636, while the mean difference for those living at home or with relatives but with assistance is slightly higher at 0.2801. Those living in assisted living facilities continue to have a higher rate of progression in Year 2, with a mean difference of 0.3311.

The mean difference continues to show a slower rate of progression in individuals living at home independently between Years 2 and 3. The mean difference in those living independently in Year 3 is 0.0477. The mean difference for those living at home or with relatives but with assistance during the same time period is 0.1391, while the mean difference for individuals living in an assisted living facility was slightly higher at 0.1456. The difference between progressions in the latter two living environments at this stage of the disease is relatively small.

Year 4 shows reduced reporting across multiple living arrangements, with a decrease from 185 participants to only 99 participants. It is likely because of this that there is a negative mean difference between Years 3 and 4. Living at home independently shows a mean difference of -0.468. Living at home or with relatives but with assistance provides a mean difference of - 0.5467. Living in an assisted living facility produced a mean difference of -0.0303.

The number of responses for Year 5 was low, with only two individuals being reported as living at home independently; a decrease of six from the previous year, which had eight participants reporting that individuals lived at home independently in Year 4. Respondents reporting that individuals lived at home or with relatives but with assistance went up in Year 5.

Year four showed 19 individuals living at home or with relatives, while Year 5 showed 21. The greatest numerical decrease in any of the three living environments was in the assisted living facility living environment. This living environment showed a decrease from 72 respondents in Year 4 to only 13 respondents in Year 5.

Implications of Results

These results are important for practitioners who may advise patients and their families on the most appropriate living arrangement for those being diagnosed with probable or possible Alzheimer's disease. Those diagnosed with probable or possible Alzheimer's disease may elect to plan ahead for where they will live and how they will receive care when they are no longer able to make decisions for themselves. These results could help practitioners, families, and patients to develop these plans together.

Once an individual can no longer make decisions about his or her own care, families may be confused about how to make the best decision for caring for their loved one. It is difficult to find research on the benefits of one living environment over another. This research was unable to find any previous research documenting the progression of Alzheimer's disease compared in different living environments. The current research may help families to make decisions for their loved one with more comfort, ease, and confidence.

Potential Impact of Results

The results of this study may assist medical professionals when making recommendations to those who are being diagnosed with possible or probable Alzheimer's disease. Physicians and clinicians often make recommendations about living arrangements for those who are diagnosed with the disease. Knowing what stage of the disease an individual is likely at may assist professionals in making a recommendation that will best suit the individual.

Family members of individuals diagnosed with probable or possible Alzheimer's disease may find this research useful when making decisions about where their loved one will live, especially during later stages of the disease when the individual diagnosed with dementia may not have the cognitive abilities to make sound decisions about his or her living arrangements.

Implications for Practice

Practitioners can use information developed from this study in order to assist individuals with making a plan for their living environment while they still have the cognitive ability to do so. If this is not possible, practitioners can use this research in order to further educate the patient's family about the benefits and limitations of each of the living environments as it applies to the speed of progression of the disease. Assisted living facilities can use the current research in order to assist families inquiring about assisted living intake for individuals with probable or possible Alzheimer's disease.

Recommendations for Future Research

This study is an initial study using the current data. Because of the large data set that was collected during the course of this study, future research may

use the data in order to study more specific areas of the progression of Alzheimer's disease, its symptoms, and various living environments.

Future Research Using Current Data

Using the current data, future researchers could analyze individual cases in order to determine how any change in living environment during the progression of the disease may affect cognition and the speed of the progression of the disease. Testing what happens when an individual changes his or her living environment in any way using the current data would create approximately 300 permutations per participant.

The current data could also be used to determine if specific symptoms appear to be more severe in some living environments over others. This would not test the mean of the symptoms as the current study did, it would instead look at one specific symptom over a period of several years in order to determine if that symptom tends to be more severe in one living environment than in others.

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