EXPLORING RACIAL AND ETHNIC DISPARITIES IN ALZHEIMER'S DISEASE AND RELATED DEMENTIAS: PREVALENCE, HEALTHCARE UTILIZATION, AND COSTS

by

Michael E. Myers II

Liberty University

A Dissertation Presented in Partial Fulfillment
Of the Requirements for the Degree
Doctor of Philosophy

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ABSTRACT

Objective: This study aims to investigate the disparities in prevalence rates, healthcare utilization patterns, and healthcare costs associated with Alzheimer's Disease and Related Dementias (ADRD) among various racial and ethnic groups over time.

Methods: Utilizing data from the medical expenditure panel survey over a five-year period, this study employs factorial logistic regression to analyze ADRD prevalence rates and multivariate analysis of variance to examine healthcare utilization and costs. The analysis focuses on weighted populations to account for the representation of racial and ethnic groups, ensuring the generalizability of the findings.

Results: The study identifies statistically significant disparities in ADRD prevalence, healthcare utilization, and associated costs across different racial and ethnic groups after controlling for demographic factors such as gender, income, and education. While some disparities were consistent over the years, others varied, indicating complex interactions between demographic characteristics and ADRD outcomes. Notably, the findings suggest lower healthcare utilization and higher costs among certain minority groups, highlighting systemic disparities within the healthcare system.

Conclusions: The disparities in ADRD prevalence, healthcare utilization, and costs underscore the need for comprehensive policy interventions tailored to address the unique challenges faced by different racial and ethnic groups. This study advocates for enhancing insurance coverage, improving access to financial assistance, and focusing on preventive care to mitigate the identified disparities. Future research should incorporate additional variables and utilize datasets that include institutionalized patients to provide a more complete picture of ADRD disparities.

Keywords: Alzheimer’s Disease, dementia, healthcare utilization, healthcare expenditures, healthcare costs, ADRD, prevalence

Dedication

This dissertation is lovingly dedicated to my wife, Ellie, and our children, Logan, Violet, and Jason. Ellie, your unwavering support and boundless love have been my constant source of strength and inspiration throughout this journey. Logan and Violet, your joyful spirits and infectious laughter have been the light that guided me through the most challenging moments. This achievement reflects my dedication and, more importantly, a testament to the enduring patience, sacrifices, and encouragement that each of you has graciously contributed. This work is a tribute to our collective journey, a celebration of our shared dreams, and a symbol of my deep gratitude and love for our family.

Acknowledgments

The journey to completing this dissertation has been one of immense learning and personal growth, and it would not have been possible without the support and guidance of many individuals whom I have had the privilege to work with and learn from. I extend my deepest gratitude to my Committee Chair, Dr. Williams, whose insightful feedback, unwavering support, and academic rigor have been instrumental in shaping this research. I am equally thankful to Committee Members Dr. Cozart and Dr. Reed, whose expertise and thoughtful guidance have significantly contributed to my scholarly development and the quality of this work. The meticulous review and valuable input from Dr. Assaid on my SAS code were crucial in ensuring the accuracy and reliability of my analyses. Each of these esteemed professionals has left a lasting impact on my academic journey, and I am profoundly grateful for their dedication, patience, and commitment to my success. This dissertation is a reflection of my efforts and a testament to the collective wisdom and support these remarkable individuals have generously provided.

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List of Abbreviations

Agency for Healthcare Research and Quality (AHRQ)

Akaike Information Criterion (AIC)

Alzheimer’s Disease (AD)

Alzheimer’s Disease and related dementias (ADRD)

Andersen Behavioral Model (ABM)

Apolipoprotein E (APOE)

Centers for Medicare & Medicaid Services (CMS)

Computer-Assisted Personal Interviewing (CAPI)

Confidence interval (CI)

Cerebrospinal fluid (CSF)

Dementia with Lewy bodies (DLB)

Emergency Room (ER)

Food and drug administration (FDA)

Frontotemporal lobar degeneration (FTLD)

General educational development (GED)

Household Component (HC)

Highschool Diploma (HSD)

Hippocampal sclerosis (HS)

Indigenous and Asian-Pacific (IAP)

Institutional Review Board (IRB)

Insurance Component (IC)

Lower limit (LL)

Mean (M)

Medical Expenditure Panel Survey (MEPS)

Medical Provider Component (MPC)

Mild cognitive impairment (MCI)

Multiple Races Reported (MRR)

Multivariate analysis of variance (MANOVA)

National Institute on Aging (NIA)

National Institute for Health and Care Excellence (NICE)

National Institutes of Health (NIH)

Odds ratio (OR)

Parkinson’s disease (PD)

Phosphorylated tau (p-tau)

Standard deviation (SD)

Statistical analysis system (SAS)

Total tau protein (t-tau; N)

Upper limit (UL)

Wechsler Adult Intelligence Scale (WAIS)

CHAPTER ONE: INTRODUCTION

Overview

As the population ages, we are experiencing an increase in age-related cognitive decline and associated diseases, including Alzheimer's disease and related dementias (ADRD). ADRD affects millions of individuals worldwide, causing a significant burden on healthcare systems, families, and caregivers. Research has shown that racial and ethnic disparities exist in the prevalence and outcomes of ADRD, with specific minority populations experiencing a disproportionately higher burden of the disease (Matthews et al., 2018). Addressing these disparities is critical to developing effective interventions and policies to mitigate the impact of ADRD on these vulnerable populations.

Several studies have documented the higher prevalence of ADRD among racial and ethnic minority groups in the United States (Chen & Zissimopoulos, 2018; Matthews et al., 2018; Shiekh et al., 2021). For example, Black people are two to three times more likely to develop Alzheimer's disease than White individuals (Alzheimer's Association, 2022a). Similarly, Hispanics are 1.5 times more likely to develop Alzheimer's disease than White individuals (Matthews et al., 2018). These disparities are particularly concerning given the rapidly growing minority populations in the United States.

The reasons for these racial and ethnic disparities in ADRD prevalence are complex and multifactorial. Socioeconomic factors, such as lower levels of education and income, have been associated with a higher risk of developing ADRD (Mayeda et al., 2016). Additionally, certain health conditions that are more prevalent among minority populations, such as hypertension and diabetes, have been linked to an increased risk of ADRD (Gottesman et al., 2017). Genetic factors may also play a role in the higher prevalence of ADRD among certain minority groups (Reitz et al., 2013).

These ADRD prevalence and outcomes disparities highlight the urgent need to address racial and ethnic disparities in healthcare and research. By understanding the underlying factors contributing to these disparities, researchers and policymakers can develop targeted interventions and policies to reduce the burden of ADRD on minority populations. Such efforts may include increasing access to healthcare, promoting early detection and intervention, and improving the cultural competence of healthcare providers.

By 2050, the prevalence of ADRD is expected to triple, highlighting the urgency to understand and address the disparities in ADRD prevalence, healthcare utilization, and costs among various racial and ethnic groups (National Academies of Sciences, Engineering, and Medicine et al., 2018.) Previous research on ADRD disparities has focused on specific racial and ethnic groups, such as Black and Hispanic populations (Chen & Zissimopoulos, 2018). While these studies have been instrumental in highlighting disparities, there is a need for research to include a broader range of racial and ethnic groups and to address the inconclusive data in the current literature on cost disparities.

By utilizing data from the Medical Expenditure Panel Survey (MEPS), this study aims to examine a more diverse and representative sample of the United States population, thereby contributing to a comprehensive understanding of ADRD prevalence disparities and their underlying causes. In addition, the study will investigate disparities in healthcare costs for ADRD patients across different racial and ethnic groups, addressing the existing gaps and inconclusiveness in the current literature.

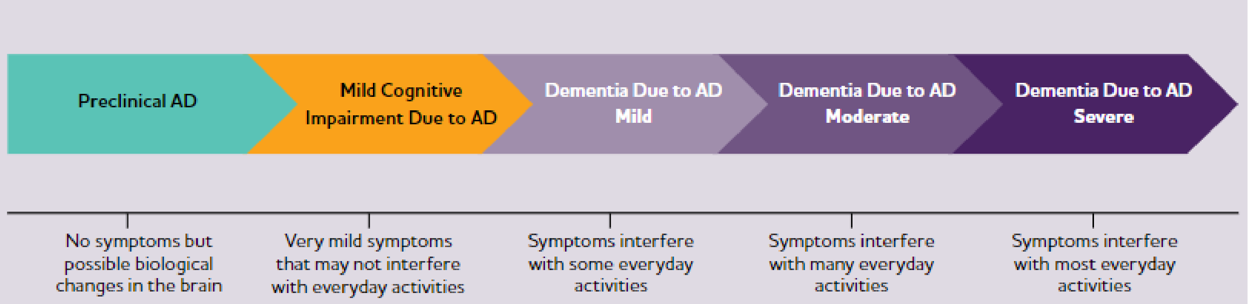
The findings of this study could have broader implications for public health, healthcare providers, and policymakers, informing targeted interventions and resource allocation strategies to address these disparities and ultimately enhancing the quality of care and support available to under-served populations.

Background

ADRD refers to conditions characterized by cognitive decline, memory loss, and impaired mental functioning. Alzheimer's disease is the most common type of dementia, with about 60-80 percent of people living with dementia resulting from the progression of AD (Faieta et al., 2021; Landeiro et al., 2020; Meng et al., 2020; National Institute for Health and Care Excellence [NICE], 2018). These conditions can significantly impact a person's daily life, independence, and overall quality of life. Recent studies have shown that over half of those suffering from AD have other factors contributing to dementia expression as well, such as Frontotemporal lobar degeneration (FTLD), Parkinson’s disease (PD), Cerebrovascular disease, dementia with Lewy bodies (DLB), or Hippocampal sclerosis (HS) creating mixed pathology AD (Alzheimer's Association, 2022a; Brenowitz et al., 2016; Kapasi et al., 2017).

Figure 1

Alzheimer's Disease Continuum



Note. Although these arrows are of equal size, the components of the AD continuum are not equal in duration.

AD progression can be defined by a continuum with three main categories: preclinical AD, mild cognitive impairment (MCI), and dementia, which Figure 1 displays (Alzheimer's Association, 2022a). Preclinical AD consists of individuals who may have brain changes but have yet to express symptoms (Alzheimer's Association, 2022a). AD patients with dementia are split into three categories, which include mild, moderate, and severe symptoms (Alzheimer's Association, 2022a).

MCI is marked by the emergence of clinical symptoms, including a memory decline, changes in behavior, apathy, depression, and a reduction in language and visuospatial function (Alzheimer's Association, 2022a; Faieta et al., 2021). The characteristics of cognitive impairment create an immense burden for family or friends to help care for the patient, resulting in over $271 billion in unpaid care in 2021 (Alzheimer's Association, 2022a; Faieta et al., 2021; Knopman et al., 2021). As the disease progresses from MCI to dementia, more severe symptoms begin to appear including encephalopathy, delirium, behavioral changes, changes to the sense of smell, anxiety, and agitation (Meng et al., 2020). The progression of ADRD causes ever-increasing difficulty in care, impacting patient and caregiver well-being (Meng et al., 2020).

Family history remains a prominent risk factor for AD (Tsai et al., 2019). Though a complete diagnosis cannot be determined until after death through an autopsy, some biomarkers can be measured through cerebrospinal fluid (CSF), such as the proteins tau, phosphorylated tau (p-tau), and amyloid beta (Aβ), enabling a tentative diagnosis (Khoury & Ghossoub, 2019). The hallmark levels to diagnose AD are a 50 percent increase in Aβ, a 200 percent increase in total tau (t-tau), and a 300 percent increase in p-tau (Khoury & Ghossoub, 2019). Other tests that can help determine a tentative diagnosis of mild cognitive impairment or Alzheimer's disease include assessments of cognitive abilities, neurological exams, brain imaging, genetic testing, and blood tests (Alzheimer's Association, n.d.). These tests can provide valuable information to support a tentative diagnosis; however, they may not definitively confirm the presence of MCI or Alzheimer's, as there can be overlapping symptoms and findings with other conditions. As a result, further evaluations and monitoring may be needed to confirm or refine the diagnosis over time. (Alzheimer's Association, n.d.).

Some other risk factors that need to be considered are age, preventable factors, and genetics (Alzheimer's Association, 2022a). Each aspect increases the chances of developing AD but does not guarantee its development. Of these risk factors, age carries the most significant weight in developing AD, with 5 percent of 65–74, 13.1 percent of 75–84, and adults over 85 being the greatest at 33.2 percent (Alzheimer's Association, 2022a). Apolipoprotein E (APOE) is a critical protein involved in lipid metabolism, that comes in three isoforms: e2, e3, and e4 (Alzheimer's Association, 2022a; Belloy et al., 2019). These isoforms, determined by genetic variation at the APOE gene locus, differ due to slight changes in the amino acid sequence of the APOE protein (Liu et al., 2013). Each individual inherits two alleles of the APOE gene, one from each parent, which combine to determine their APOE isoform expression pattern. The different APOE isoforms are associated with varying risks for certain diseases, particularly ADRD (Liu et al., 2013). E2 is the least common among the three and is generally considered protective against Alzheimer's disease; e3 is considered neutral, and e4 is associated with an increased risk of developing ADRD (Liu et al., 2013). In addition, e2 has been linked to a lower risk of cardiovascular disease due to its association with lower cholesterol levels, whereas e4 has been linked with higher levels (Liu et al., 2013).

Preventable risk factors can be prevented by controlling diet, exertion, level of instruction, brain exercise, and human interaction (Alzheimer's Association, 2022a). A poor diet can lead to cardiovascular disease, which affects the brain when the supply of oxygen diminishes the brain’s functionality (Alzheimer's Association, 2022a; Mergenthaler et al., 2013). Studies have also shown that those with higher achievement in the educational system have decreased risks of acquiring AD as they grow older (Alzheimer's Association, 2022a; Hendrie et al., 2018).

Though ADRD typically affects the older population, other demographic factors such as sex and race affect the likelihood of an individual developing this disease. Women are more likely to develop ADRD, with 12 percent of women developing the disease; they account for two-thirds of all ADRD cases (Alzheimer's Association, 2022a). However, even with women developing ADRD more often than men, it is uncertain if it is due to an underlying factor or if it is a byproduct of women living longer than men and men being more likely to die of other conditions such as cardiovascular issues before developing ADRD (Alzheimer's Association, 2022a). Racially, Black and Hispanic persons have an increased prevalence of ADRD in older adults compared to White persons, with 19 percent of Black persons over age 65 and 14 percent of Hispanic persons developing ADRD, with White persons with ADRD making up only 10 percent (Alzheimer's Association, 2022a). The data acquired in community studies may be subject to potential biases, as minority communities tend to be less likely to utilize care facilities for their loved ones than White communities, potentially affecting the accuracy of the reported numbers. Another contributing factor is a lack of education for minorities, which could increase the risk of developing ADRD later in life (Rosselli et al., 2022).

ADRD affects the patient and their caregivers. In the United States, 83 percent of caregivers are unpaid; 48 percent assist patients with AD (Alzheimer's Association, 2022a). This significantly impacts the caregiver's well-being financially, physically, and mentally. In the United States, an estimated time cost of 16 billion hours goes unpaid, costing approximately

$271.6 billion annually (Alzheimer's Association, 2022a). This equates to a lifetime cost for each ADRD patient of $377,621 of unpaid work that can negatively impact the lifestyle of each caregiver (Alzheimer's Association, 2022a). The burden of caregiving for ADRD patients has been shown to increase the caregiver's disease and health complications rate, with 38 percent saying that their stress level is high or greater (Alzheimer's Association, 2022a). This burden has also been proven to significantly affect caregivers' mental health, with up to 40 percent experiencing depression and others succumbing to a decrease in their cognitive ability compared to non-caregivers (Alzheimer's Association, 2022a).

ADRD treatment currently consists of six drugs that the U.S. Food and Drug Administration (FDA) has permitted: memantine, rivastigmine, donepezil, galantamine, aducanumab, and memantine combined with donepezil (Alzheimer's Association, 2022a). Besides aducanumab, the treatments above temporarily treat AD signs, but the primary brain degradation is unaffected (Alzheimer's Association, 2022a). In 2021, aducanumab recently received approval from the FDA, working by diminishing the collection of Aβ (Alzheimer's Association, 2022a). However, the underlying causes of ADRD are not treated; it is not a cure and may not work for every patient (Alzheimer's Association, 2022a). Donepezil, rivastigmine, and galantamine treat ADRD symptoms by increasing the concentration of the neurotransmitter acetylcholine (Alzheimer's Association, 2022a). At the same time, memantine downregulates a neurotransmitter called glutamate, which has been shown to overstimulate neurons when overexpressed, causing damage to the brain (Alzheimer's Association, 2022a).

The history of ADRD

ADRD was discovered in 1906 by Dr. Alois Alzheimer while treating a patient suffering from profound amnesia, suspicions regarding their relatives, and worsening mental faculties

(Alzheimer's Association, 2022b; Strassnig & Ganguli, 2005). Dr. Alzheimer noted while conducting an autopsy that the brain displayed a strange coating encompassing nerve cells and a reduction in brain size (Alzheimer's Association, 2022b). The disease belatedly acquired its name from an associate of Dr. Alzheimer, Emil Kraepelin, in 1910 when he wrote *Psychiatrie* (Alzheimer's Association, 2022b; Fox, 1986). In 1968, researchers Jack Tinker and Robert Reilly developed a cognitive measurement spectrum known as the Wechsler Adult Intelligence Scale (WAIS) to assess cognitive abilities in adults. This new scale was then paired with the blossoming skill of assessing the amount of damaged tissue and brain abnormalities, which helped to advance the study of ADRD (Alzheimer's Association, 2022b; Blessed et al., 1968).

In 1974, the National Institute on Aging (NIA), a critical federal structure supporting ADRD investigation under the National Institutes of Health (NIH), brought about the acceptance of AD as the chief reason dementia developed in patients in 1976 (Alzheimer's Association, 2022b). To complement and help stimulate the NIA, establishing the Alzheimer’s Association as a private entity in 1980 became the foremost volunteer health association for ADRD research, wellness, and assistance (Alzheimer's Association, 2022b).

The prevalence of ADRD continues to rise globally, disproportionately impacting specific demographic groups. Previous studies have shed light on the existence of significant healthcare disparities related to ADRD, including differences in prevalence, healthcare utilization, and healthcare costs among various racial, ethnic, and socioeconomic groups (Alzheimer's Association, 2022a; Mayeda et al., 2016; Zahodne et al., 2017). These disparities have been linked to various factors, such as genetic predisposition, access to healthcare, socioeconomic status, and cultural barriers (Barnes & Bennett, 2014). Geography can be a significant contributor to access to healthcare. Healthcare facilities may be too far apart in rural or remote areas, leading to longer travel times and creating barriers to timely and adequate care (Nielsen et al., 2017). Geographic factors can be further exacerbated by socioeconomic factors such as income, education, and employment status, where people living in economically disadvantaged areas may be unable to afford transportation or out-of-pocket expenses (McMaughan et al., 2020).

Studies have shown that individuals from lower socioeconomic backgrounds and minority populations are less likely to receive timely diagnoses and appropriate treatment for ADRD, further exacerbating healthcare utilization disparities (Alzheimer's Association, 2022a). For instance, research has demonstrated that Black and Hispanic persons are at a higher risk of developing ADRD than White persons (Mayeda et al., 2016). This elevated risk has been attributed to genetic and environmental factors, disparities in healthcare access, and socioeconomic conditions (Barnes & Bennett, 2014).

In terms of healthcare costs, the economic burden of ADRD is substantial and encompasses direct medical expenses, long-term care services, and informal caregiving (Hurd et al., 2013). Research indicates that minority populations and those with lower socioeconomic status often shoulder a disproportionate share of these costs, leading to financial strain and reduced access to necessary care (Alzheimer's Association, 2022a). Considering the increasing prevalence of ADRD and related healthcare disparities, it is essential to explore these issues further and create targeted interventions to enhance health equity and improve outcomes for all individuals affected.

Problem Statement

The problem is a lack of ethnic representation for the disparities in the prevalence and healthcare utilization and inconclusive cost disparities of ADRD. Current studies have focused on specific racial and ethnic groups, such as Black and Hispanic persons. Although these studies have been instrumental in highlighting disparities, research must include a broader range of racial and ethnic groups. Investigating prevalence among other minority populations will also help create a complete understanding of ADRD prevalence disparities and their underlying causes. The literature is inconclusive about whether the healthcare costs for ADRD vary by ethnic/racial background (Aranda et al., 2021; Lin et al., 2022; Ornstein et al., 2018; Park & Chen, 2020). Using the data from the Medical Expenditure Panel Survey (MEPS), it is possible to look at a broader range of racial and ethnic groups, sample a larger, more generalized region of the United States, and add to the current literature on the disparities in cost for ADRD patients.

Purpose Statement

The purpose of this study is to provide a comprehensive perspective on the burden of ADRD across racial and ethnic groups and related social determinants of health over time. This dissertation describes the disparities in prevalence, healthcare utilization, and costs of ADRD across racial and ethnic groups and related social determinants of health over time. By utilizing data from MEPS, this study aims to incorporate Asian persons into prevalence and utilization and further examine cost disparities, thereby contributing to a comprehensive understanding of ADRD prevalence disparities.

In addition to analyzing prevalence, the study will investigate disparities in healthcare costs for ADRD patients across different racial and ethnic groups. The research uses a nationwide dataset to provide insights into cost disparities at a broader geographical scale than previous localized studies.

Significance of the Study

ADRD proliferates in the U.S., with AD being the most common form of dementia and accounting for approximately 1 in 9 individuals over 65 having ADRD, equating to about 6.5 million people (Alzheimer's Association, 2022a). Since 1990, individuals with ADRD have doubled (Nichols et al., 2019; Zong et al., 2022). ADRD is a complex disease affecting individuals from all backgrounds, but racial and ethnic disparities have been documented in its prevalence, diagnosis, treatment, and outcomes. These disparities have important implications for healthcare utilization, costs, and care interventions. As the global population ages, the prevalence of age-related cognitive decline and associated diseases is expected to triple by 2050 (National Academies of Sciences, Engineering, and Medicine et al., 2018). This study will, therefore, contribute timely and vital insights to address this growing challenge and work towards a more equitable healthcare landscape for all ADRD patients.

The quality of life for ADRD patients and their caregivers is a crucial aspect to consider when addressing the overall impact of these conditions. ADRD patients often experience progressive cognitive decline, functional impairment, and behavioral changes that can significantly affect their daily lives and well-being (Alzheimer's Association, 2022a). As the disease progresses, patients may require assistance with activities of daily living, such as dressing, bathing, and eating, placing a considerable burden on their caregivers (Alzheimer's Association, 2022a). Caregivers, often family members, are crucial in supporting and caring for ADRD patients. They may experience high-stress levels, emotional strain, and physical exhaustion, adversely impacting their well-being and quality of life (Schulz & Martire, 2004). Caregiving can also lead to financial strain and reduced social engagement, further contributing to the challenges faced by caregivers (Schulz & Martire, 2004). Minority caregivers may face unique challenges that could further exacerbate the difficulties associated with caregiving. These challenges may include cultural barriers, limited access to healthcare resources and support services, and increased stigma surrounding ADRD within specific communities (Connell et al., 2001). Addressing these disparities is essential to ensure equitable access to care and support for ADRD patients and their caregivers across all racial and ethnic groups.

Research Questions

RQ1: What are the differences in prevalence rates of ADRD among various ethnic and racial groups over time?

RQ2: How do healthcare utilization patterns for ADRD differ among various ethnic and racial groups over time?

RQ3: How do healthcare costs for ADRD differ among various racial and ethnic groups over time?

Methods

MEPS is a large-scale, nationally representative survey conducted by the Agency for Healthcare Research and Quality (AHRQ) in the United States. MEPS is designed to provide reliable estimates of healthcare costs, access, and quality at the national and regional levels. It is one of the most comprehensive data sources in the U.S. healthcare system. MEPS collects detailed information on healthcare utilization, expenditures, payment sources, insurance coverage, health status, and demographic and socioeconomic characteristics of individuals and families.

Data from MEPS over five years was analyzed using statistical analysis system (SAS) Studio version 3.81 for computation for all patients diagnosed with and without ADRD. The assessment considered the entire group while examining subgroups based on race/ethnicity. Descriptive statistics were used to calculate the frequencies, percentages, means, and standard deviations to describe the distribution of ADRD prevalence, healthcare utilization, and costs among various ethnic and racial groups, providing an overview of the disparities. Bivariate analysis using chi-square tests was used to examine the associations between the ethnic/racial groups and prevalence, healthcare utilization, and costs to help identify significant differences between the groups. Logistic regression was performed for prevalence and Multivariate analysis of variance (MANOVA) for costs and utilization to model the relationships between ethnic/racial groups and prevalence, healthcare utilization, and expenses, allowing the ability to control for potential confounding factors and identify the unique contribution of each variable to the disparities. MANOVA was used to test for interaction effects between ethnic/racial groups in the regression models to explore whether the disparities vary under different conditions or subpopulations.

Limitations

Notwithstanding the potential contributions of this study to our understanding of disparities in prevalence, healthcare utilization, and costs among different ethnic and racial groups for ADRD, several limitations should be acknowledged:

1. Secondary data analysis: The use of the MEPS data, while valuable, limits the study to the variables and categories already collected by the survey. This may constrain the analysis of certain aspects of ADRD disparities and preclude the examination of other potentially relevant factors not included in MEPS.
2. Cross-sectional nature of the data: Although MEPS is a longitudinal survey, each round of data collection is cross-sectional, which may not capture the full range of factors contributing to the disparities over time or account for changes in healthcare policies and practices that could affect the observed differences.

3. Self-reported data: MEPS data relies on self-reported information from respondents, which may be subject to recall bias, social desirability bias, or inaccuracies. This could affect the reliability of the findings related to healthcare utilization, costs, and other variables.
4. Potential confounding factors: While the study will attempt to control for relevant variables, there may still be unobserved or unmeasured factors that could contribute to the observed disparities. These unaccounted confounding factors may limit the causal inferences that can be drawn from the study.
5. Generalizability: Although MEPS is a nationally representative survey, the results may need to be more generalizable to other countries or healthcare systems with different structures, policies, and sociocultural contexts.
6. Sample size for smaller racial and ethnic groups: The sample size for some racial and ethnic groups in MEPS may be relatively small, limiting the statistical power to detect significant differences or make definitive conclusions about disparities among these groups.
7. Nonresponse and attrition: MEPS is subject to nonresponse bias due to survey participants needing to provide complete information or drop out over time, which may affect the representativeness of the data and the validity of the findings.
8. Data lag: MEPS data is released with a lag, typically two years after the data is collected. This may limit the ability to examine recent trends or changes in healthcare utilization, costs, and disparities.
9. Gender data inconsistency: The MEPS datasets for the years included in the study displayed inconsistencies in gender data representation. Specifically, only two of the five

years, 2018 and 2020, of data analyzed provided details on both gender and sex. The exclusion of gender from our analysis due to these inconsistencies might limit the comprehensiveness of our findings. Since gender is a crucial variable in healthcare utilization and disease prevalence studies, this limitation may affect the depth of insights into the influence of gender on racial and ethnic disparities in ADRD prevalence, healthcare utilization, and costs. Therefore, the findings of this study must be interpreted keeping this limitation in mind. Future studies that include complete and consistent gender data across all years are essential for a more holistic understanding of the racial and ethnic disparities in ADRD-related healthcare.

Despite these limitations, the proposed study has the potential to provide valuable insights into the disparities in ADRD prevalence, healthcare utilization, and costs among different ethnic and racial groups, which can inform targeted interventions and policy recommendations aimed at reducing these disparities and promoting equitable healthcare for all ADRD patients.

Assumptions

In conducting this study, several assumptions are made:

1. Data quality and representativeness: The MEPS data is assumed to be high quality, accurate, and representative of the U.S. population. This assumption is crucial to the validity and generalizability of the findings.
2. Reliability of self-reported data: The study assumes that the self-reported information provided by respondents in MEPS, such as healthcare utilization and costs, is reliable and accurately reflects their experiences. This assumption is essential to the credibility of the results.

3. Consistency in diagnosis and reporting: The study assumes that the diagnosis and reporting of ADRD are consistent across different ethnic and racial groups, healthcare providers, and geographic locations. Inconsistencies in diagnosis or reporting could bias the results.
4. Causality: The study assumes that the observed relationships between ethnic and racial groups and the disparities in ADRD prevalence, healthcare utilization, and costs are causal, even though the study design and data may not allow for definitive causal inferences.

These assumptions provide the foundation for the proposed study. They are essential for interpreting the findings and drawing conclusions about the disparities in ADRD prevalence, healthcare utilization, and costs among ethnic and racial groups. Recognizing and addressing these assumptions will help ensure the validity and reliability of the study results and guide the development of targeted interventions and policy recommendations to reduce these disparities and promote equitable healthcare for all ADRD patients.

Organization

Chapter 1 of this study will contain an overview and information about the researched disease. Chapter 2 will review the literature supporting this study and the findings. Chapter 3 will collect information about the method used in this study and the hypothesis of the predicted outcome. Chapter 4 will outline the research conclusions and detail the results obtained throughout the study. Chapter 5 will conclude the investigation by discussing how the research will expand on the current literature, the limitations of the research, and any suggestions for future studies.

Definitions

1. *Alzheimer's Disease* - A disease gradually reduces intellectual, behavioral, and functional faculties by affecting the brain's neurons (Alzheimer's Association, 2022a).
2. *Alzheimer's Disease and Related Dementias* – Refers to the most common forms of dementia (National Institute of Neurological Disorders and Strokes [NIH], n.d.).
3. *Dementia with Lewy bodies* – An atypical agglomerate of alpha-synuclein in neurons is called Lewy bodies (Alzheimer's Association, 2022a). When Lewy bodies grow in the area of the cortex, it can turn into dementia (Alzheimer's Association, 2022a).
4. *Frontotemporal lobar degeneration* - A syndrome caused by an increasing drop in mental function and speech and the deterioration of the frontal and anterior temporal lobes (Rabinovici & Miller, 2010).
5. *Parkinson's disease* – An aggregate of alpha-synuclein builds inside of the substantia nigra located in the brain, causing nerve cells to degrade and yield less dopamine (Alzheimer's Association, 2022a).

CHAPTER TWO: LITERATURE REVIEW

Overview

The literature review will explore the prevalence and incidence of ADRD among different ethnicities in the United States, identifying factors contributing to these disparities, such as social determinants of health and cultural beliefs. It will also examine differences in healthcare utilization among different ethnicities, including medication adherence, hospice care, and nursing home services. Factors influencing these disparities, such as access to healthcare resources and cultural attitudes toward end-of-life care, will also be analyzed. Additionally, the review will investigate differences in healthcare costs among different ethnicities, including total expenditures and out-of-pocket expenses.

To further understand these disparities and identify potential interventions, the Andersen Behavioral Model (ABM) will be employed to study healthcare utilization and access among individuals with ADRD. ABM is a theoretical framework used extensively to understand healthcare utilization and disparities among hard-to-reach populations. The model's emphasis on individual-level and contextual factors has guided the development of interventions to improve healthcare outcomes and reduce healthcare disparities. ABM emphasizes predisposing, enabling, and need factors and has been used to identify factors influencing healthcare utilization and access among individuals with ADRD, including racial/ethnic disparities. By using this model to identify and address the factors contributing to healthcare disparities among individuals with ADRD, interventions can be tailored to these individuals' unique needs and circumstances and incorporate the perspectives of family members and other caregivers.

Theoretical Basis

Understanding ABM

Ronald M. Anderson developed the ABM in 1968 while pursuing his doctorate at Purdue University, which subsequently became the foundation of his dissertation (Andersen, 1995). Dr. Anderson (1995) initially created this model to comprehend the factors influencing family decisions regarding health service utilization, quantify and elucidate equitable access to healthcare, and utilize the gathered insights to inform policies that promote equitable healthcare access. ABM has since become a widely accepted theoretical framework for examining healthcare utilization among individuals and populations. This is evident from the over 6,000 citations for his most cited work and nearly 33,000 total citations (Research.com, n.d.).

The model consists of three interrelated components: predisposing factors, enabling factors, and needs (Andersen, 1995). Predisposing factors are individual-level factors that can facilitate or impede the use of healthcare services, such as age, gender, and health beliefs (Andersen, 1995). First, predisposing factors are essential to research because they can affect an individual's likelihood of seeking care and their ability to access and use health services (Andersen, 1995). For example, individuals with lower levels of education may have limited health literacy, which can lead to barriers to accessing health care services (Andersen, 1995). Enabling factors can enable or hinder healthcare utilization, such as access to healthcare facilities, health insurance coverage, and social support (Andersen, 1995). Secondly, enabling factors are essential to research because they can significantly impact an individual's access to healthcare services (Andersen, 1995). For instance, individuals without insurance coverage may have limited access to preventive services or delay seeking care until their condition becomes more severe (Andersen, 1995). Finally, needs are the perceived or actual need for healthcare services, which is influenced by factors such as health status, the severity of illness, and other medical conditions (Andersen, 1995). Need factors are essential to research because they determine an individual's motivation to seek care and the type and level of care needed (Andersen, 1995). For example, individuals with chronic conditions may require ongoing care and support from healthcare providers, while individuals with acute conditions may require more urgent and intensive care (Andersen, 1995).

ABM emphasizes the significance of predisposing, enabling, and need factors in understanding healthcare utilization and access. This has informed the development of interventions to address barriers and enhance access to health services (Andersen, 1995). Based on this understanding, interventions have been designed to increase insurance coverage, expand healthcare provider availability, and improve facility access, recognizing that these factors substantially impact an individual's ability to access healthcare services (Gresenz et al., 2006; Kominski et al., 2017). Additionally, the model guides the development of interventions addressing predisposing factors like language barriers, health literacy, and cultural competence, which can influence an individual's likelihood of seeking care and ability to access and use health services (Betancourt et al., 2003). Andersen's model also highlights the importance of tailoring interventions to the specific needs of individuals and communities (Andersen, 1995). By emphasizing need factors such as an individual's perceived or evaluated health status, the model has informed the development of individualized and patient-centered care interventions (Epstein et al., 2010).

Andersen's model has undergone several revisions and adaptations since its introduction in 1968. For example, Aday and Andersen (1974) integrate systematic healthcare concepts, encompassing current policy, available resources, and organizational factors, expanding the outcome of interest beyond healthcare utilization and encompassing consumer satisfaction. Later, Aday and Andersen (1981) argued that access to health care should be equitable, meaning that individuals with similar needs should receive similar levels of care, regardless of their social, economic, or cultural background. Aday and Andersen’s (1981) article proposed several dimensions of equity that could be applied to Andersen's model, including horizontal equity (equal treatment for individuals with similar healthcare needs), vertical equity (different levels of care for individuals with varying levels of necessity), and spatial equity (equal access to care regardless of geographic location). The authors also introduced the concept of healthcare disparities, highlighting the unequal distribution of healthcare services and outcomes among different populations (Aday & Andersen, 1981). These changes were significant because they allowed the ABM to more accurately capture the complexities of healthcare systems and better inform policy decisions and interventions. By considering a broader range of factors and outcomes, Aday and Andersen's adaptations made the model more relevant to contemporary healthcare challenges, facilitating a deeper understanding of the factors that drive healthcare utilization and access.

Evans and Stoddart (1990) expand on the previous concept by including health status (both perceived and evaluated) as an outcome of interest alongside consumer satisfaction. This version incorporates personal health practices as antecedents to these outcomes, acknowledging that health outcomes and satisfaction are not solely determined by utilizing healthcare services (Evans & Stoddart, 1990). This revised model underscores a public health approach towards prevention in which personal health practices (such as smoking, diet, and exercise) are integrated as influential factors affecting health outcomes (Evans & Stoddart, 1990). Evans and Stoddart's modifications made the model more relevant to contemporary healthcare challenges, ultimately facilitating a deeper understanding of the factors influencing healthcare utilization and outcomes. This improved understanding has allowed researchers, practitioners, and policymakers to develop more targeted and effective interventions and policies that address the specific needs of individuals and communities. The changes made by Evans and Stoddart highlighted the importance of a holistic approach to healthcare, emphasizing the need to consider both healthcare services and personal health practices in addressing population health. This shift in focus has contributed to developing more comprehensive health promotion and disease prevention strategies, including integrating health education and behavior change initiatives alongside healthcare service providers such as patient-centered medical homes (Reid et al., 2010).

Gelberg et al. (2000) contributed to the development of the model by examining the factors that influence healthcare utilization among underserved people due to their limited access to healthcare services, including Black persons with Alzheimer's Disease (Gelberg et al., 2000). This focus on social determinants has contributed to a broader understanding of health disparities and has informed the development of multi-level interventions that address the root causes of these disparities. The expanded model has facilitated collaboration among researchers and practitioners from various disciplines, such as public health, social work, and healthcare policy, to understand better and address the complex needs of vulnerable populations. This interdisciplinary approach has led to more comprehensive strategies for reducing healthcare disparities and promoting health equity.

The various adaptations and revisions of ABM by Aday and Andersen (1974; 1981), Evans and Stoddart (1990), and Gelberg et al. (2000) have collectively contributed to a more nuanced understanding of healthcare utilization and access. These changes have highlighted the importance of considering a range of factors, including policy, organizational, and social determinants, to address healthcare disparities and comprehensively promote equitable access to care. The modifications to the original model have fostered interdisciplinary collaboration, enabling researchers and practitioners from diverse fields to work together towards a common goal of health equity. The insights provided by the adapted models have also informed policy development, leading to more targeted and effective strategies for addressing vulnerable populations' unique needs and barriers.

Addressing critiques and expanding perspectives on ABM

While Andersen's model has been widely used to understand healthcare utilization, some perspectives challenge the theory. One critique of the model is that it needs to fully capture the multifaceted nature of patient-centered access, which involves physical access to services and the ability to obtain benefits that meet the individual's unique health needs and preferences. (Levesque et al., 2013). Levesque et al. (2013) proposed a revised framework, the Conceptual Framework of Access to Health Services, which incorporates the multidimensional nature of patient-centered access, including timeliness, appropriateness, acceptability, and availability of services. The revised framework highlights the importance of tailoring healthcare services to the needs and preferences of individuals and populations, acknowledging the diverse and complex nature of healthcare access (Levesque et al., 2013). The critique is significant because it acknowledges the evolving nature of healthcare access and the need for a more patient-centered approach to healthcare delivery. It also recognizes the importance of considering the social determinants of health, such as cultural beliefs, socioeconomic status, and language barriers, which can significantly impact an individual's ability to access healthcare services.

Wolinsky and Johnson's (1991) critique of Andersen's model is focused on its applicability to older adults and their use of health services. The authors argue that the model may only partially capture older adults' unique needs and circumstances, which can significantly impact their utilization of health services (Wolinsky & Johnson, 1991). They suggest that the model's emphasis on predisposing, enabling, and need factors may need to adequately consider age-related factors impacting healthcare utilization and access for older adults (Wolinsky & Johnson, 1991). Wolinsky and Johnson (1991) propose a revised model incorporating age-related factors such as cognitive function, physical function, and social support, which they argue are critical determinants of healthcare utilization among older adults. They also suggest that the model should consider the impact of chronic conditions and comorbidities, which are more prevalent among older adults and can affect their utilization of health services (Wolinsky & Johnson, 1991). Wolinsky and Johnson's (1991) critique of Andersen's model is important because it recognizes the need to consider older adults' unique needs and circumstances when studying healthcare utilization and access. Healthcare utilization and access can vary significantly across different populations. A one-size-fits-all approach may not be appropriate, recognizing the growing population of older adults with unique needs and challenges in accessing health care services. The authors argue that the model's focus on predisposing, enabling, and need factors might not sufficiently address age-related factors affecting health service utilization among older adults (Wolinsky & Johnson, 1991). Wolinsky and Johnson (1991) highlight the necessity for tailored frameworks that consider specific needs, circumstances, and population characteristics.

Racial and ethnic disparities in healthcare utilization among individuals with ADRD using ABM

ABM is a valuable framework for studying healthcare utilization and access among individuals with ADRD, particularly in understanding the disparities in healthcare utilization and access based on race/ethnicity. The model provides a comprehensive framework for identifying the individual and contextual factors that influence healthcare utilization and access, which can inform the development of interventions to improve healthcare delivery and reduce healthcare disparities in ADRD.

A study by Sisco et al. (2014) used Andersen's model to investigate the racial/ethnic disparities in healthcare utilization and access among older adults with ADRD. The study found significant differences in healthcare utilization and access based on race/ethnicity, with Black and Hispanic persons having lower utilization rates than White persons (Sisco et al., 2014). The study also identified predisposing factors such as language barriers, cultural beliefs, and mistrust of the healthcare system, as well as enabling factors such as health insurance and access to transportation, as significant predictors of healthcare utilization and access among individuals with ADRD (Sisco et al., 2014). Similarly, a study by Jimenez et al. (2012) examined predisposing, enabling, and need factors that could impact healthcare utilization and access among Hispanic persons with ADRD. Specifically, the authors focused on cultural factors as predisposing factors that might influence healthcare use among this population. They explored cultural beliefs about dementia and caregiving roles, as well as the potential impact of these beliefs on individuals' likelihood of seeking and accessing healthcare services. The study found significant disparities in healthcare utilization and access based on race/ethnicity, with Hispanic individuals having lower utilization rates than White individuals (Jimenez et al., 2012). The study also identified cultural factors, such as beliefs about dementia and caregiving roles, as significant barriers to healthcare utilization and access among Hispanic individuals with ADRD (Jimenez et al., 2012).

Summary

ABM is an essential theoretical framework widely used to understand healthcare utilization and healthcare disparities among underserved populations. The model's emphasis on individual-level and contextual factors has guided the development of interventions to improve healthcare outcomes and reduce healthcare disparities. Applying Andersen's model to the study of ADRD among different ethnicities in the United States has provided essential insights into the factors influencing healthcare utilization and healthcare disparities for this population. While the model is not without limitations, it remains a crucial tool for understanding healthcare utilization and differences and guiding the development of interventions to improve healthcare outcomes for all individuals and populations.

Related Literature

ADRD is a progressive neurodegenerative disease that affects memory, thinking, and behavior. It is a significant public health issue affecting millions of individuals and their families worldwide. ADRD is a complex disease affecting individuals from all backgrounds, but racial and ethnic disparities have been documented in its prevalence, diagnosis, treatment, and outcomes (Kornblith et al., 2022). These disparities have important implications for healthcare utilization, costs, and care interventions. This literature review explores the existing evidence on racial and ethnic disparities in healthcare related to ADRD, focusing on cognitive status, healthcare utilization, and healthcare costs.

Education and income are critical social determinants of health that contribute to racial and ethnic disparities in ADRD (Montez et al., 2019). Significant disparities exist in educational attainment by race and ethnicity in the United States. In 2020, 37.5 percent of White adults over 25 had a bachelor's degree or higher, compared to 27.8 percent of Black adults and 20.8 percent of Hispanic adults (U.S. Census Bureau, 2021). Similarly, disparities in income are evident, with White households earning a median income of $76,057 in 2019, while Black and Hispanic households earned $45,438 and $56,113, respectively (Semega et al., 2020).

Cognitive Status

The literature suggests significant disparities in the prevalence and incidence of ADRD among different ethnicities in the United States. According to Kornblith et al. (2022), the incidence rate of dementia was highest among Hispanic persons at 20.7 per 1,000 people, followed by Black persons at 19.4 per 1,000 people, Asian persons at 12.4 per 1,000 people, and White persons at 11.5 per 1,000 people. Chen & Zissimopoulos (2018) found similar results, with Black persons having a prevalence rate of 19.3 percent, Hispanic persons at 16.7 percent, and White persons at 7.4 percent. Moreover, a systematic review and meta-analysis conducted by Shiekh et al. (2021) found that compared to White persons, Black persons were 1.33 times more likely to develop ADRD, Asian persons showed a lower rate at 0.86, and Hispanic persons showed no difference.

Recent studies have shown that there has been little progress in reducing relative racial disparities in the incidence and prevalence of dementia in the United States (Power et al., 2021). A study by Power et al. (2021) found that from 2000 to 2016, the incidence and prevalence of dementia remained higher among Black persons than White persons. Chen and Zissimopoulos (2018) found that Hispanic (16.7 percent) and Black (19.3 percent) older adults had a higher prevalence of cognitive impairment than White (7.4 percent) older adults, which could be related to lower education and income levels in these populations. The disparities in the prevalence and incidence of ADRD among different ethnicities could be attributed to various factors, including differences in social determinants of health, such as education, income, and access to healthcare (Chen & Zissimopoulos, 2018).

The literature suggests that cultural factors such as cultural beliefs regarding ADRD, the stigma surrounding ADRD, caregiving roles and responsibilities, language barriers, health literacy, mistrust in the healthcare system, and alternative medicine may also contribute to the disparities in the prevalence and incidence of ADRD among different ethnicities (Shiekh et al., 2021). In some cultures, dementia may be perceived as a natural part of aging rather than a medical condition requiring intervention (Alzheimer's Association, 2022a). This can result in delayed diagnosis and treatment. Even when recognized, the stigma associated with dementia can be a significant barrier to seeking help and receiving appropriate care. Stigma may be more prevalent in some cultural groups, leading to underdiagnosis and undertreatment of ADRD (Alzheimer's Association, 2022a). Cultural norms around caregiving can impact the recognition and management of ADRD. In some cultures, family members may be expected to care for older relatives, which can lead to reluctance to seek professional help (Jimenez et al., 2012). Limited English proficiency can create communication barriers between patients and healthcare providers, resulting in difficulty in obtaining accurate diagnoses and appropriate care (Sisco et al., 2014). Low health literacy can be a barrier to understanding and managing ADRD, particularly among individuals from diverse cultural backgrounds who may not be familiar with the healthcare system or medical terminology (Betancourt et al., 2003). A history of discrimination or negative experiences with healthcare providers can lead to mistrust of the healthcare system, which may delay seeking care or underutilizing healthcare services (Sisco et al., 2014). Some cultural groups may prefer traditional or alternative medicine over Western medicine, impacting their willingness to seek conventional medical care for ADRD (Jimenez et al., 2012).

Higher levels of education have been associated with better cognitive health outcomes, including a lower risk of developing ADRD (Montez et al., 2019). In a study conducted by Mayeda et al. (2019), the authors found that lower educational attainment was associated with higher ADRD prevalence among Black and Hispanic individuals compared to White individuals. This finding suggests that the disparities in educational attainment may contribute to the observed racial and ethnic disparities in ADRD prevalence.

Healthcare utilization

Income disparities may influence healthcare utilization among individuals with ADRD. Lower-income individuals may face financial barriers to accessing appropriate healthcare, which can exacerbate racial and ethnic disparities in ADRD outcomes (Alzheimer's Association, 2022a). The relationship between income and healthcare utilization is complex. It may be influenced by factors such as insurance coverage and the availability of healthcare providers in a given area (Alzheimer's Association, 2022a).

ADRD is a progressive disease often requiring resources such as medication and end-of-life care, including hospice and nursing home services. However, research has identified significant disparities in using these resources among different ethnicities in the United States. For instance, Olchanski et al. (2022) found that Black and Hispanic ADRD patients were less likely to use medication for their condition than White patients, with medication non-adherence of 42 percent for White patients, 50 percent for Black patients, and 51 percent for Hispanic patients and a medication discontinuation rate of 21 percent for White patients, 32 percent for Black patients, and 27 percent for Hispanic patients. Additionally, Black (8 percent) and Hispanic (9 percent) patients were less likely to adhere to medication regimens, potentially indicating a lack of access to healthcare resources (Olchanski et al., 2022). Similarly, Zhu et al. (2022) found that Black (9.6 percent) and Hispanic (11.4 percent) patients with ADRD were less likely to initiate and persistently use anti-dementia medications than White patients.

Lin et al. (2022) found that Black and Hispanic ADRD patients were less likely to use hospice services than White patients, with 50.5 percent of White patients, 38.2 percent of Black patients, and 42.9 percent of Hispanic patients opting to use hospice care. Minority patients were more likely to have hospitalizations at the end of life, which may indicate a lack of access to hospice services, with White patients being admitted to the emergency department 9.7 percent of the time and being hospitalized 6.1 percent of the time, compared to 18.1 percent and 15.5 percent for Black patients, and 14.4 percent and 11.1 percent for Hispanic patients respectively (Lin et al., 2022). Similarly, Rivera-Hernandez et al. (2018) found that Black (16.3 percent) and Hispanic (12.7 percent) ADRD patients were more likely to be admitted to nursing homes with lower quality ratings than White (21.5 percent) patients using several measures such as rehospitalization rate, whether the facility was for profit or not, and Centers for Medicare & Medicaid Services (CMS) rating. Temkin-Greener et al. (2021) also found that Black nursing home residents with ADRD were more likely to have end-of-life hospitalizations than White residents, 40.66 and 29.53 percent, respectively. Additionally, residents in facilities with higher proportions of Black residents were 7.9 percent more likely to have end-of-life hospitalizations (Temkin-Greener et al., 2021). Lusk et al. (2022) found significant disparities in the incidence, outcomes, and healthcare utilization for ADRD patients among different ethnicities in the United States as well, finding that Black and Hispanic patients were more likely to have higher rates of ADRD incidence, more severe outcomes, and lower utilization of healthcare resources (Rivera-Hernandez et al., 2018).

These disparities may be due to various factors, including differences in access to healthcare and cultural beliefs about end-of-life care. For example, cultural attitudes toward death and dying may impact the likelihood of hospice services. Black and Hispanic patients may be less likely to have access to healthcare resources (Lin et al., 2022; Rivera-Hernandez et al., 2018). There was a common theme that minority patients did not receive the same quality of care as White patients. This also was amplified by the fact that most facilities where minority patients were admitted did not have adequate resources for ADRD patients, thus resulting in higher hospitalizations.

Healthcare costs

The cost of ADRD care varies by race and ethnicity, with Black and Hispanic individuals experiencing higher per-person costs for ADRD care than White individuals (Alzheimer's Association, 2022a). This disparity may be due to differences in disease severity, access to care, and the types of services utilized (Alzheimer's Association, 2022a). Furthermore, lower-income individuals may face more significant financial burdens from ADRD-related costs, exacerbating existing disparities (Alzheimer's Association, 2022a).

Total expenditure

ADRD is a costly disease that places a significant financial burden on patients and their families. Research has identified disparities in healthcare costs among different ethnicities in the United States. For example, Ornstein et al. (2018) found that ADRD patients from minority groups had higher Medicare expenditures and healthcare utilization than White patients. The study found that Black patients had higher Medicare expenditures, with an average of $205,000 from disease onset to expiry, compared to White patients, who averaged $118,000 (Ornstein et al., 2018). Hispanic patients displayed a similar cost to White patients, though they typically lived one year longer after diagnosis than White or Black patients (Ornstein et al., 2018). On the contrary, Lin et al. (2022) noted while studying Medicare hospice expenditures that there was no significant difference by race or ethnicity, with White patients paying $4,097, Black patients paying $3,372, and Hispanic patients paying $3,372 on average. Another study by Park & Chen (2020) showed similar results, finding that yearly expenditure for Black, Hispanic, White, and Asian persons is $24,752, $24,318, $21,830, and $20,040, respectively.

These disparities in healthcare costs may be due to various factors, including differences in access to healthcare resources, disease severity, duration, and cultural attitudes toward healthcare. For example, minority patients may be less likely to have access to preventative healthcare services, leading to more severe and costly ADRD outcomes. These studies showed that the total cost of healthcare was highest among Black ADRD patients, even among other minorities. However, the studies differed on whether Hispanic patient costs were significantly higher than White patients. Further investigation is needed to determine whether differences in total costs exist.

Out-of-pocket costs

Research has found significant disparities in out-of-pocket costs for ADRD care among different ethnicities in the United States. For example, Park and Chen (2020) found that among Medicare beneficiaries with cognitive deficits or ADRD, White patients had the highest out-of-pocket expenditures, with an average of $4,037 per year, followed by Asian patients with an average of $1,903 per year, Black persons following with an average of $1,897, while Hispanic patients had the lowest out-of-pocket expenditures, with an average of $1,415 per year. Aranda et al. (2021) further examined out-of-pocket costs by focusing on health disparities in different ethnicities. They determined that Black and Hispanic persons and those with less education experience a higher out-of-pocket cost than White persons (Aranda et al., 2021). They also observed that out-of-pocket costs were exceptionally high in the last year of life in ADRD patients living in the community (Aranda et al., 2021).

These disparities in out-of-pocket costs may be attributed to differences in access to healthcare resources, disease severity and duration, and cultural attitudes toward healthcare. To address these disparities, interventions may include improving insurance coverage and increasing access to financial assistance programs to reduce out-of-pocket costs, increasing access to preventative healthcare services, improving cultural competency among healthcare providers, and increasing education and awareness about ADRD in diverse communities.

These studies disagreed on whether out-of-pocket costs were higher among minority ethnicities than White persons (Aranda et al., 2021; Park & Chen, 2020). One study showed that the prices were lower for minorities, whereas the other determined that they were higher, especially in the last year of life. Further research is needed to determine whether or not a disparity in out-of-pocket costs exists.

Summary

By examining the disparities in healthcare for minorities with ADRD, it is possible to identify groups disproportionately affected by this disease yet may also have limited resources to combat this disadvantage. Current research shows disparities in some aspects of healthcare and is uncertain in others. Further research is needed to expand on existing knowledge and help identify areas lacking research; thus, examining incidence, healthcare utilization, and costs are essential pieces to the puzzle. The current gaps are that most studies investigating healthcare costs for minorities are localized and do not represent the entire population. Another gap is the conflicting results of different studies, which show differences in costs for other ethnicities. Finally, current literature is limited to self-reported cognitive identification and does not include a diagnosis of ADRD.

Summary

ABM is a valuable framework for studying healthcare utilization and access among individuals with ADRD, particularly in understanding the disparities in healthcare utilization and access based on race/ethnicity. The model's emphasis on predisposing, enabling, and need factors, as well as its extensions to include personal health practices and outcomes, has been used to identify the factors that influence healthcare utilization and access among individuals with ADRD, including racial/ethnic disparities. The model can inform the development of interventions to reduce healthcare disparities and improve access to care for individuals with ADRD, particularly those from racial/ethnic minority groups. By using the model to identify and address the factors contributing to healthcare disparities among individuals with ADRD, interventions can be tailored to these individuals' unique needs and circumstances and incorporate the perspectives of family members and other caregivers.

CHAPTER THREE: METHODS

Overview

This study uses a longitudinal cohort study design focusing on logistic regression for prevalence and MANOVA for costs and utilization with a weighted population. The chosen design is appropriate for examining differences in dementia care access, treatment, and outcomes among diverse groups over an extended period. It also allows for assessing causal relationships between variables and controls for confounding factors and selection bias. The chosen method's rationale, the MEPS dataset usage appropriateness, and the statistical procedures for each hypothesis will be discussed. By providing a comprehensive overview of the methodology, this chapter guides understanding of the research process and ensures the study's replicability.

Design

A longitudinal cohort study design focusing on logistic regression for prevalence and MANOVA for costs and utilization with a weighted population is a research method to study changes over time and investigate causal relationships between variables while minimizing confounding factors and controlling for selection bias. This method combines multiple elements: the longitudinal cohort, logistic regression, MANOVA, and weighted population. The longitudinal cohort study design enables the assessment of causal relationships between variables, logistic regression is used to model binary outcomes such as prevalence, MANOVA is used to compare means across groups on multiple dependent variables simultaneously, and weighting is used to account for the different sizes and representation of racial and ethnic groups in the dataset, ensuring that biases are reduced and the accuracy and generalizability of the findings are increased (Kane et al., 2020).

In a longitudinal cohort study, a group of individuals is followed over an extended time, and data on relevant variables are collected at multiple points. This design allows researchers to observe changes in the variables over time, assess causal relationships, and explore the temporal dynamics of the phenomena under investigation (Twisk, 2013). One of the benefits of this design is that it can provide robust evidence of cause-effect relationships since it accounts for the timing of events. It is particularly suitable for studying the natural progression of diseases, the impact of interventions, and the evolution of disparities among different populations (Power et al., 2013).

Logistic regression is used when the dependent variable is binary and estimates the probability that a given input point belongs to a certain class (Field, 2018). Logistic regression models the probability that the dependent variable belongs to a particular category and is widely used in fields like medicine for disease prediction (Field, 2018). The coefficients in logistic regression are interpreted as the log odd of the outcome variable and by exponentiating these coefficients, it gives the odds ratio which is easier to interpret (Field, 2018).

The rationale for using a longitudinal cohort study with a propensity score-matched control group is as follows. First, the design is suitable for analyzing the natural progression of dementia in different racial and ethnic groups and other factors on dementia care disparities. The longitudinal aspect allows for observing changes over time, which is crucial in understanding the evolution of racial and ethnic disparities in dementia care (Power et al., 2021). Second, the propensity score-matched control group provides a means to control for potential confounders, such as socioeconomic status, educational background, and comorbidities, which might otherwise influence the findings (Kane et al., 2020). This method creates a control group compared to the group of interest in all observed characteristics except for the exposure, in this case, race or ethnicity. Finally, the chosen research design is supported by the existing literature. Several studies have used longitudinal cohort designs with propensity score-matched control groups to investigate disparities in healthcare costs (Fukuda et al., 2021; Kamdar et al., 2023; Sharma et al., 2016; Zhu et al., 2022). Moreover, topic-specific, peer-reviewed literature has also shown the value of this design in analyzing racial and ethnic disparities in dementia care (Lusk et al., 2022; Zhu et al., 2022).

Research Questions

RQ1: What are the differences in prevalence rates of ADRD among various ethnic and racial groups over time?

RQ2: How do healthcare utilization patterns for ADRD differ among various ethnic and racial groups over time?

RQ3: How do healthcare costs for ADRD differ among various racial and ethnic groups over time?

Hypotheses

The hypotheses for this study are:

H_{a1}: There is a statistically significant difference over time in prevalence rates of ADRD among various ethnic and racial groups controlling for gender, income, and education.

H_{a2}: There is a statistically significant difference over time in healthcare utilization patterns for ADRD among various ethnic and racial groups controlling for gender, income, and education.

H_{a3}: There is a statistically significant difference over time in healthcare costs for ADRD among various racial and ethnic groups, controlling for gender, income, and education.

Participants and Setting

The participants for this study are drawn from a secondary data source, MEPS. MEPS is a nationally representative survey conducted by the Agency for Healthcare Research and Quality

(AHRQ) that collects information on healthcare utilization, expenditures, and access to care in the United States (Agency for Healthcare Research and Quality [AHRQ], n.d.). The data for the study is collected from the MEPS database for the years 2015-2020, focusing on individuals diagnosed with ADRD across various racial and ethnic groups.

The population for this study consists of adults in the United States aged 65-85 diagnosed with ADRD. ADRD primarily affects older adults, with the risk increasing with age. The prevalence of Alzheimer's disease, the most common form of dementia, doubles approximately every five years after age 65 (Alzheimer's Association, 2022a). The sample is drawn from the MEPS database using population weights based on 2022 U.S. Census data of 59.3, 13.6, 6.1, and 18.9 percent for White, Black, Asian, and Hispanic people respectively, to ensure representation of different racial and ethnic groups, including Hispanic, Non-Hispanic White, Non-Hispanic Black, and Non-Hispanic Asian populations. The sample size is determined based on the available data within MEPS. It is sufficient to detect minimum effect sizes with a statistical power of .8 at the .05 alpha level, as recommended by Field (2018).

Demographic information and healthcare utilization variables, as described in Table 1, is obtained from the MEPS database for the sampled participants (AHRQ, n.d.). This information describes the sample and identify potential differences in healthcare utilization and access among racial and ethnic groups.

The setting for this study is the United States, as the MEPS database provides nationally representative data on healthcare utilization and access for individuals diagnosed with ADRD. By utilizing this secondary data source, the study aims to identify disparities in healthcare utilization and access among different racial and ethnic groups and inform the development of targeted interventions to promote health equity and improve healthcare outcomes for all individuals affected by ADRD.

Instrumentation

The instrument used for this study is MEPS, a nationally representative survey conducted by the AHRQ. MEPS collects information on healthcare utilization, expenditures, and healthcare access in the United States (AHRQ, n.d.). The survey is designed to provide reliable estimates of healthcare utilization, expense, and access to care for the civilian non-institutionalized population (Cohen et al., 2009).

MEPS consists of multiple components, including the Household Component (HC), the Medical Provider Component (MPC), and the Insurance Component (IC). The HC collects data from individuals and their families, while the MPC and IC collect data from medical providers and employers, respectively (AHRQ, n.d.). This study’s data is primarily drawn from the HC, as it contains detailed information on demographics, health conditions, and healthcare utilization and expenditure.

MEPS HC is a comprehensive and validated instrument used in numerous peer-reviewed studies investigating various aspects of healthcare utilization, expenditure, and access (Novak et al., 2020; Ornstein et al., 2018; Park & Chen, 2020). The data from MEPS HC is collected through five in-person interviews conducted over two years, each capturing information for a specific time frame (AHRQ, n.d.). The survey contains questions about demographics, health conditions, healthcare utilization, and expenditure, making it appropriate for this study to examine healthcare utilization and access disparities among individuals with ADRD.

MEPS is widely recognized for its reliability and validity. It employs a rigorous data collection process, including Computer-Assisted Personal Interviewing (CAPI) technology and verifying reported healthcare events through the MPC (Cohen et al., 2009). The survey has undergone various evaluations to ensure its reliability and validity, documented in multiple publications (Cohen et al., 2009).

The AHRQ granted permission to use the MEPS data as a publicly available dataset. All data used for this study is accessed and analyzed per the AHRQ guidelines to ensure the confidentiality and privacy of the survey respondents.

Procedures

The following procedures are implemented to conduct this study, ensuring the research is carried out systematically and ethically. These procedures are designed to provide clear guidance for replication by other researchers.

1. Obtain IRB Approval: The first step was to obtain Institutional Review Board (IRB) approval for the study. This process involved submitting a detailed research proposal outlining the study's objectives, research questions, methodology, and ethical considerations to the IRB. Once approval was granted, the study commenced.
2. Access MEPS Data: The MEPS data from 2015 to 2020 is accessed and downloaded from the AHRQ website. This publicly available data does not require specific permission to access or analyze.
3. Data Preparation: The MEPS data was cleaned and prepared for analysis by excluding irrelevant variables and ensuring the data is formatted consistently across the years.
4. Sample Selection: The study's target population was identified within the MEPS data based on the inclusion criteria discussed earlier. The sample was refined by excluding participants with missing or incomplete data on the relevant variables.
5. Data Analysis: Employing a longitudinal cohort study design, complemented by logistic regression for analyzing prevalence and MANOVA for examining costs and utilization

within a weighted population, is an effective research strategy to explore temporal changes and discern causal connections among variables. This approach effectively mitigates potential confounding factors and curtails selection bias. It amalgamates several critical components: the longitudinal cohort framework allows for the investigation of causal links among variables; logistic regression is adept at handling binary outcomes like prevalence; MANOVA facilitates simultaneous comparisons of group means across multiple dependent variables; and the application of weighting adjusts for the varied sizes and representations of racial and ethnic groups in the dataset. This multifaceted method enhances the study's robustness, ensuring that biases are minimized and the results' accuracy and applicability are amplified, as noted by Kane et al. (2020).

6. Interpretation of Findings: The results of the data analysis were interpreted in light of the study's objectives and research questions. Any observed healthcare utilization and cost disparities are discussed concerning the existing literature and potential underlying factors contributing to these disparities.
7. Reporting Results: The study's findings are reported clearly and concisely, following the guidelines for presenting research results in a doctoral dissertation. Tables, figures, and other visual aids were used to communicate the results effectively.
8. Ethical Considerations: All ethical guidelines and requirements were followed throughout the study, including maintaining the confidentiality of the participants' information and ensuring that the data is used solely for this research.

All necessary documents, such as IRB approval, consent forms, data collection protocols, and other relevant materials, are included in the dissertation’s appendices to provide a comprehensive record of the study's procedures.

Data Analysis

The data analysis for this study involves a combination of descriptive and inferential statistical analyses to address the research questions and hypotheses. The following outlines the statistical procedures employed, the rationale for their selection, and the assumptions associated with each analysis.

1. Descriptive Statistics: Descriptive statistics, such as means and frequencies, were calculated for all relevant variables in the study (e.g., healthcare utilization, access, and demographic factors). This analysis provides an overview of the sample characteristics and the distribution of the variables in the dataset, which informs subsequent inferential analyses. Descriptive statistics are essential for summarizing the data and providing a foundation for further analysis (Field, 2018).
3. Bivariate Analyses: Bivariate analyses, such as chi-square tests were conducted to examine the relationships between demographic factors (e.g., age, gender, race/ethnicity) and healthcare utilization and access among individuals with ADRD. These analyses provide preliminary evidence of disparities in healthcare utilization and access based on demographic factors. Bivariate analyses help explore relationships between variables and identify potential predictors of healthcare utilization and access (Field, 2018). Assumptions for each bivariate analysis were tested as appropriate (e.g., normality, homogeneity of variance). No violations of these assumptions were noted.
4. Multivariate Analyses: Logistic regression and MANOVA analyses were conducted to examine the independent effects of demographic factors on healthcare utilization while controlling for other relevant covariates. This analysis provides more robust evidence of healthcare utilization and access disparities and identify the specific factors that

contribute to these disparities. Regression analyses are appropriate for examining the independent effects of multiple predictors on an outcome variable and controlling for potential confounders (Field, 2018). Assumptions for each regression analysis were tested (e.g., linearity, multicollinearity, homoscedasticity) and met. The effect size will be reported using the appropriate statistic for each inferential analysis and interpreted according to established conventions. The alpha level for all statistical tests will be set at .05, consistent with standard practice in the field (Field, 2018).

By conducting these statistical analyses, this study comprehensively examines healthcare utilization and access disparities among individuals with ADRD and identify the demographic factors contributing to these disparities. The chosen statistical procedures are consistent with the research questions, hypotheses, and the type of data collected, and they are supported by research textbooks (Field, 2018).

CHAPTER FOUR: FINDINGS

Overview

The analysis aims to provide a comprehensive perspective on the burden of ADRD. This study performs descriptive and inferential statistical analyses using SAS Studio version 3.81 for computation. The descriptive analysis analyzes the data across various demographic categories, including race, ethnicity, gender, income, and education. This study uses inferential statistics to answer the following research questions.

Research Questions

RQ1: What are the differences in prevalence rates of ADRD among various ethnic and racial groups over time?

RQ2: How do healthcare utilization patterns for ADRD differ among various ethnic and racial groups over time?

RQ3: How do healthcare costs for ADRD differ among various racial and ethnic groups over time?

Hypotheses

H_{a1}: There is a statistically significant difference over time in prevalence rates of ADRD among various ethnic and racial groups controlling for gender, income, and education.

H_{a2}: There is a statistically significant difference over time in healthcare utilization patterns for ADRD among various ethnic and racial groups controlling for gender, income, and education.

H_{a3}: There is a statistically significant difference over time in healthcare costs for ADRD among various racial and ethnic groups, controlling for gender, income, and education.

Descriptive Statistics

The descriptive statistics provide an understanding of the characteristics of the sample from the population. The following statistics provide an initial insight into the data on ADRD prevalence rates, healthcare utilization patterns, and healthcare costs. These findings set the stage for subsequent inferential statistical analyses that delve into testing the hypotheses.

Table 1 describes the sample characteristics across study participants. The percentage of females in the sample remained relatively consistent throughout the years, ranging from 56.17 percent to 57.89 percent, while the rates of males ranged from 42.11 percent to 43.83 percent. There is a shift toward an older age group, with an increase in the 70-74 and 75-79 age groups and a decrease in the 65-69 age groups, with inconsistent fluctuations settling around the average throughout the study for the 80-84 and >85 age groups. The sample also mainly remained consistent for racial groups, with Whites slightly decreasing from 86.60 percent in 2016 to 85.92 percent in 2020 and slightly increasing for the other racial categories, Blacks increasing from 7.61 to 8.03 percent, IAP increasing from 4.09 to 4.28 percent, and MRR increasing from 1.69 to 1.76 percent. Most of the sample population identified as non-Hispanic, with a slight decrease in percentage from 93.45 to 92.55 percent. There is a noticeable shift toward higher education over the five years in the sample set; specifically, participants with no degree decreased from 16.61 to 9.78 percent, while the percentages of patients with a Bachelor’s, Master’s, or Doctorate Degree increased instead. ADRD diagnosis remained relatively consistent throughout the observation period, ranging from 0.31 to 0.42 percent. Additionally, the sample shows a decline in the percentage of Poor/Negative income, from 9.73 to 8.53 percent, Near Poor, from 5.06 to 4.80 percent, Low-Income from 16.70 to 15.86 percent, and an increase in High-Income, from 40.76 to 43.56 percent. Finally, there is a slight shift away from the West, 21.73 to 20.95 percent, and Midwest, 22.64 to 22.08, toward the South, 36.55 to 37.86 percent.

Table 1

Demographic and Socioeconomic Characteristics of the sample population

Variables	2016		2017		2018		2019		2020	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Sex										
Male	179,242,664	42.29	177,228,992	43.83	153,678,996	42.72	148,632,813	42.11	152,184,504	42.89
Female	244,611,703	57.71	227,130,002	56.17	206,050,386	57.28	204,311,538	57.89	202,613,750	57.11
Race										
White	367,078,593	86.60	348,753,471	86.25	310,765,998	86.39	302,559,683	85.72	304,840,066	85.92
Black	32,270,636	7.61	30,742,556	7.60	27,768,728	7.72	28,321,991	8.02	28,504,917	8.03
Indigenous and Asian-Pacific	17,329,911	4.09	17,144,518	4.24	14,301,768	3.98	15,424,916	4.37	15,191,725	4.28
Multiple Races Reported	7,175,228	1.69	7,718,448	1.91	6,892,888	1.92	6,637,762	1.88	6,261,548	1.76
Ethnicity										
Hispanic	27,746,769	6.55	26,921,151	6.66	25,635,808	7.13	24,818,714	7.03	26,432,373	7.45
Non-Hispanic	396,107,598	93.45	377,437,844	93.34	334,093,573	92.87	328,125,638	92.97	328,365,881	92.55
Highest Degree Achieved										
Don’t Know/Refused	2,153,063	0.51	2,486,387	0.61	2,072,812	0.58	1,480,911	0.42	1,308,659	0.37
No Degree	70,389,266	16.61	52,898,545	13.08	40,834,031	11.35	39,621,068	11.23	34,712,824	9.78
High School Diploma/GED	193,843,012	45.73	189,137,153	46.77	166,698,433	46.34	165,641,656	46.93	159,139,073	44.85
Bachelor's Degree	67,117,623	15.84	65,763,543	16.26	60,842,197	16.91	61,593,876	17.45	66,536,983	18.75
Master's Degree	45,143,945	10.65	45,043,408	11.14	38,713,917	10.76	38,047,874	10.78	41,572,673	11.72
Doctorate Degree	14,446,243	3.41	11,788,846	2.92	12,324,269	3.43	11,872,977	3.36	13,381,973	3.77
Other Degree	30,761,216	7.26	37,241,113	9.21	38,243,722	10.63	34,685,990	9.83	38,146,069	10.75
ADRD Diagnosis										
Yes	1,651,857	0.39	1,693,967	0.42	1,125,399	0.31	1,267,023	0.36	1,299,307	0.37
No	422,202,510	99.61	402,665,027	99.58	358,603,982	99.69	351,677,329	99.64	353,498,948	99.63
Region										
Northeast	80,859,309	19.08	76,658,982	18.96	67,134,667	18.66	65,053,062	18.43	67,809,038	19.11
Midwest	95,973,701	22.64	87,188,206	21.56	75,344,498	20.94	76,891,361	21.79	78,322,648	22.08
South	154,936,403	36.55	149,590,915	36.99	141,001,175	39.20	133,065,664	37.70	134,342,779	37.86
West	92,084,955	21.73	90,920,891	22.49	76,249,042	21.20	77,934,265	22.08	74,323,789	20.95
Age										
65-69	124,981,871	29.49	117,509,029	29.06	103,073,188	28.65	100,418,442	28.45	99,313,827	27.99
70-74	106,990,556	25.24	104,578,346	25.86	93,897,708	26.10	91,155,564	25.83	93,565,207	26.37
75-79	77,127,239	18.20	76,655,686	18.96	69,620,500	19.35	68,509,245	19.41	69,537,204	19.60
80-84	66,706,446	15.74	54,154,625	13.39	44,667,467	12.42	43,843,272	12.42	46,976,878	13.24
>=85	48,048,254	11.34	51,461,307	12.73	48,470,518	13.47	49,017,828	13.89	45,405,139	12.80
Poverty Category										
Poor/Negative	41,220,862	9.73	36,448,977	9.01	33,767,666	9.39	34,467,570	9.77	30,273,355	8.53
Near Poor	21,448,241	5.06	22,535,960	5.57	16,732,228	4.65	17,026,996	4.82	17,035,894	4.80
Low Income	70,765,153	16.70	63,261,292	15.64	56,409,675	15.68	53,919,629	15.28	56,273,958	15.86
Middle Income	117,643,015	27.76	115,426,528	28.55	100,600,153	27.97	98,350,622	27.87	96,663,447	27.24
High Income	172,777,096	40.76	166,686,237	41.22	152,219,659	42.32	149,179,534	42.27	154,551,599	43.56
Total	423,854,367	100.00	404,358,994	100.00	359,729,381	100.00	352,944,352	100.00	354,798,255	100.00

Note. n = Sample size and % = percent. Poverty Category was computed based on the poverty level percentage with 100% being the poverty line. Poor/Negative represents less than 100%, Near Poor 100-125%, Low Income 125-200%, Middle Income 200-400%, and High income being greater than 400%.

Table 2 presents the expenditures across the sample population. For those with ADRD, the mean total healthcare expenditure fluctuated across the years, with the highest average spending being $27,494 (SD = $2,879) in 2018 and the lowest average being $23,430(SD = $918) in 2017. For individuals without ADRD, the mean total healthcare expenditure remained relatively consistent across the years, ranging from $20,332 (SD = $654) in 2020 to $21,944 (SD = $652) in 2019. Out-of-pocket expenditures for individuals with ADRD suggest a consistent increase from $1,942 (SD = $167) in 2016 to $4,584 (SD = $1,830) in 2020, more than doubling during the observation period. Patients without ADRD also showed an overall increase, though not as much, with the lowest increase in 2016 at $2,036 (SD = $101) and $2,521 (SD = $128) in 2019.

Table 2

Expenditures across the sample population

Variables	2016		2017		2018		2019		2020	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
With ADRD										
Total Healthcare Expenditure	$26,286	$1,662	$23,430	$918	$27,494	$2,879	$24,333	$2,243	$25,260	$2,283
Out Of Pocket Expenditure	$1,942	$167	$3,745	$430	$4,398	$1,947	$3,812	$1,108	$4,584	$1,830
Without ADRD										
Total Healthcare Expenditure	$21,390	$862	$20,580	$701	$21,311	$665	$21,944	$652	$20,332	$654
Out Of Pocket Expenditure	$2,036	$101	$2,156	$133	$2,448	$127	$2,521	$128	$2,492	$224

Note. Amounts were adjusted to 2023 currency based on the GDP price index supplied by the Bureau of Economic Analysis. M = Mean, and SD = standard

There is a noticeable downward trend in total income from $33,083 (SD = $1,786) in 2016 to $27,080 (SD = $1,521) in 2019 until the final year of the sample period $37,808 (SD = $4,639) in 2020 for the ADRD group, displayed in Table 3. The family income for this group saw an increasing trend over the years, starting from a mean of $61,671 (SD = $3,839) in 2016 to $89,514 (SD = $9,642) in 2020. In terms of family income as a percentage of the poverty line for individuals with ADRD, there is generally an increasing trend, from a mean of 337 percent (SD = 21 percent) in 2016 to 444 percent (SD = 50 percent) in 2020. For study participants without ADRD, the total individual income remained relatively stable with a slight increase but was higher compared to those with ADRD, ranging from a mean of $44,641 (SD = $1,063) in 2016 to $46,502 (SD = $945) in 2020. The family income fluctuated but slightly increased overall, with a low of $77,585 (SD = $1,916) in 2017 and a high of $82,819 (SD = $1,976) in 2019. Family income as a percentage of this group’s poverty line is generally higher than that of those with ADRD, ranging from a mean of 435 percent (SD = 11 percent) in 2016 to 451 percent (SD = 10 percent) in 2020, increasing overall.

Table 3

Income across the sample population

Variables	2016		2017		2018		2019		2020	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
With ADRD										
Total Individual Income	$33,083	$1,786	$26,408	$959	$28,329	$2,158	$27,080	$1,521	$37,808	$4,639
Family Income	$61,671	$3,839	$51,945	$2,439	$63,679	$2,654	$76,212	$4,518	$89,514	$9,642
Family Income as % of Poverty Line	337%	21%	276%	8%	329%	16%	377%	21%	444%	50%
Without ADRD										
Total Individual Income	$44,641	$1,063	$45,789	$1,090	$46,380	$1,050	$46,981	$1,010	$46,502	$945
Family Income	$77,903	$2,060	$77,585	$1,916	$80,445	$1,896	$82,819	$1,976	$80,761	$1,835
Family Income as % of Poverty Line	435%	11%	434%	11%	445%	10%	457%	10%	451%	10%

Note. Amounts were adjusted to 2023 currency based on the GDP price index supplied by the Bureau of Economic Analysis. M = Mean, and SD = standard

Table 4 denotes medical visits across the sample population; for those with ADRD, office-based provider visits fluctuated but have primarily decreased over the years, with a mean of 8.60 (SD = 0.81) visits in 2016 and a mean of 5.40 (SD = 0.56) in 2020. Emergency Room (ER) visits showed the same trend, with 0.92 (SD = .017) visits in 2016 decreasing to 0.59 (SD = .011) visits. Inpatient hospital visits also fluctuated but again showed a downward trend, with 0.50 (SD = 0.07) visits in 2016 to 0.38 (SD = 0.07) in 2020. However, the average nights in the hospital for ADRD patients varied, with a low of 1.01 (SD = 0.06) in 2018 and a high of 3.54 (SD = 0.61) in 2020. For those without ADRD, all provider and physician visit categories were more frequent than those with ADRD, but nights in the hospital, inpatient visits, and ER visits were all higher.

Table 4

Medical Visits across the sample population

Variables	2016		2017		2018		2019		2020	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
With ADRD										
Office-Based Provider Visits	12.33	1.16	12.26	0.73	16.04	0.81	10.81	0.62	8.69	0.83
Office-Based Physician Visits	8.60	0.81	6.99	0.62	7.12	0.53	6.79	0.37	5.40	0.56
Outpatient Dept Provider Visits	0.56	0.08	0.53	0.06	0.65	0.04	0.59	0.07	1.41	0.46
Outpatient Dept Physician Visits	0.26	0.04	0.29	0.04	0.41	0.03	0.32	0.05	0.36	0.07
Inpatient Hospital Discharges	0.50	0.07	0.36	0.05	0.20	0.02	0.31	0.03	0.38	0.07
Nights in Hospital for Discharges	2.61	0.42	2.24	0.30	1.01	0.06	1.71	0.21	3.54	0.61
Emergency Room Visits	0.92	0.17	0.63	0.08	0.36	0.03	0.58	0.06	0.59	0.11
Without ADRD										
Office-Based Provider Visits	16.56	0.56	16.05	0.42	17.15	0.40	17.96	0.52	15.11	0.38
Office-Based Physician Visits	9.59	0.27	9.44	0.24	9.68	0.21	9.61	0.23	8.17	0.20
Outpatient Dept Provider Visits	1.82	0.16	1.95	0.16	2.21	0.14	2.52	0.14	2.66	0.16
Outpatient Dept Physician Visits	0.69	0.09	0.73	0.06	0.96	0.07	1.11	0.07	1.09	0.09
Inpatient Hospital Discharges	0.36	0.02	0.34	0.02	0.33	0.02	0.34	0.02	0.27	0.02
Nights in Hospital for Discharges	1.74	0.15	1.78	0.14	1.69	0.15	1.81	0.20	1.51	0.16
Emergency Room Visits	0.50	0.03	0.48	0.02	0.50	0.02	0.55	0.03	0.43	0.02

Note. M = Mean, and SD = standard deviation.

Summary

The provided data reflects changes in demographics, healthcare expenditure, income, and medical visits over the survey timeframe. The expenses for total healthcare and out-of-pocket costs fluctuated across the years for individuals with and without ADRD, with generally higher expenditures for those with ADRD. There is a noticeable upward trend in family income as a percentage of the poverty line. In contrast, total individual income fluctuated over the years, with a general downward trend for ADRD patients. For participants without ADRD, total individual and family income remained relatively stable over the years, and these values were generally higher than those observed in the ADRD group. Family income as a percentage of the poverty line is also generally higher for individuals without ADRD than those with ADRD. The medical visits data showed fewer provider and physician visits for those with ADRD over the years but more hospital stays.

Inferential Statistics

H_{a1}: There is a statistically significant difference over time in prevalence rates of ADRD among various ethnic and racial groups controlling for gender, income, and education.

Factorial logistic regression analysis is employed to investigate the differences in prevalence rates of ADRD over time among various ethnic and racial groups, controlling for gender, income, education, and other demographic factors. The sample size varied by year, with 2016 having a size of 423,854,367 observations, 2017 a sample of 404,358,994 observations, 2018 a sample of 359,729,381 observations, 2019 a sample of 352,944,352 observations, and 2020 a sample of 354,798,255 observations. The assumptions of factorial logistic regression are more flexible than other models, needing the dependent variables to be categorial, members in each group to be exclusive and exhaustive, and the sample size to be significant (Boateng & Abaye, 2019). The research meets these assumptions. The model uses the Wald Chi-Square Test to denote statistical significance for the factorial logistic regression test, with the following p-values for 2016-2020, respectively 0.0033, <.0001, <.0001, 0.0022, and <.0001, indicating that the independent variables in the model significantly predict the log odds of being diagnosed with ADRD.

As described in Table 6, throughout the study, the data generally falls short of statistically significant variations in the prevalence rates of ADRD across different sex, racial, ethnic, educational, and income groups. Where some categories were statistically relevant, it was not consistent across all years. However, interactions between groups are noted and cause the prevalence rates of ADRD to be significant when combined. For instance, interactions between sex and race, sex and highest degree achieved, race and ethnicity, race and highest degree achieved, and highest degree achieved and poverty category are generally significant.

Table 6

Results From a Factorial Logistic Regression Analysis to Investigate the Differences in Prevalence Rates of ADRD Patients

Variables	2016				2017				2018				2019				2020			
		95% CI				95% CI				95% CI				95% CI				95% CI		
	OR	*LL*	*UL*	*p*	*OR*	*LL*	*UL*	*p*	*OR*	*LL*	*UL*	*p*	*OR*	*LL*	*UL*	*p*	*OR*	*LL*	*UL*	*p*
Sex																				
Male																				
Female	1.36	(0.90,	2.06)	0.139	0.90	(0.59,	1.39)	0.647	1.12	(0.64,	1.93)	0.695	1.05	(0.69,	1.61)	0.808	1.15	(0.74,	1.78)	0.545
Race																				
White																				
Black	1.71	(1.05,	2.77)	0.031	1.42	(0.84,	2.40)	0.192	0.89	(0.33,	2.36)	0.808	1.64	(0.86,	3.13)	0.133	1.36	(0.69,	2.69)	0.369
Indigenous and Asian-Pacific	0.70	(0.30,	1.65)	0.411	0.30	(0.09,	1.00)	0.051	0.45	(0.20,	0.99)	0.046	1.56	(0.68,	3.57)	0.290	2.10	(0.97,	4.57)	0.061
Multiple Races Reported	0.39	(0.09,	1.75)	0.217	0.45	(0.11,	1.91)	0.277	0.30	(0.06,	1.54)	0.149	0.64	(0.14,	2.89)	0.561	0.72	(0.18,	2.94)	0.642
Ethnicity																				
Hispanic	1.18	(0.68,	2.02)	0.557	0.97	(0.53,	1.75)	0.908	1.57	(0.90,	2.72)	0.109	2.38	(1.19,	4.74)	0.014	1.93	(1.19,	3.15)	0.008
Non-Hispanic																				
Highest Degree Achieved																				
Don’t Know/Refused	3.46	(1.30,	9.18)	0.013	8.95	(2.95,	27.17)	0.000	7.24	(2.73,	19.24)	<0.001	1.06	(0.15,	7.52)	0.950	<0.001	(<0.001,	<0.001)	<0.001
No Degree	1.83	(1.20,	2.80)	0.006	1.36	(0.79,	2.34)	0.263	1.65	(0.84,	3.25)	0.147	1.44	(0.80,	2.59)	0.219	2.59	(1.56,	4.30)	0.000
HS Diploma/GED																				
Bachelor's Degree	1.33	(0.75,	2.36)	0.326	1.43	(0.81,	2.54)	0.217	0.98	(0.47,	2.03)	0.955	0.72	(0.39,	1.34)	0.300	0.62	(0.30,	1.29)	0.203
Master's Degree	0.61	(0.20,	1.87)	0.384	1.25	(0.54,	2.89)	0.602	0.46	(0.13,	1.62)	0.224	0.92	(0.39,	2.19)	0.851	0.94	(0.46,	1.94)	0.869
Doctorate Degree	0.47	(0.10,	2.17)	0.329	0.80	(0.21,	2.96)	0.731	0.41	(0.09,	2.00)	0.268	0.44	(0.10,	1.94)	0.277	1.21	(0.39,	3.74)	0.745
Other Degree	1.21	(0.50,	2.90)	0.673	1.57	(0.54,	4.53)	0.403	1.62	(0.51,	5.19)	0.411	0.51	(0.19,	1.38)	0.184	0.32	(0.14,	0.73)	0.007
Poverty Category																				
Poor/Negative	1.25	(0.70,	2.24)	0.457	1.11	(0.59,	2.09)	0.742	1.06	(0.51,	2.18)	0.879	0.74	(0.33,	1.64)	0.449	0.70	(0.31,	1.60)	0.400
Near Poor	1.03	(0.43,	2.48)	0.944	1.42	(0.64,	3.17)	0.390	0.50	(0.17,	1.48)	0.207	0.64	(0.24,	1.71)	0.366	1.04	(0.40,	2.70)	0.941
Low Income	0.98	(0.54,	1.78)	0.951	1.19	(0.68,	2.08)	0.532	0.82	(0.41,	1.65)	0.575	1.41	(0.79,	2.52)	0.243	1.08	(0.55,	2.10)	0.826
Middle Income																				
High Income	0.89	(0.00,	0.00)	0.703	0.41	(0.20,	0.83)	0.013	0.65	(0.29,	1.43)	0.277	0.85	(0.47,	1.53)	0.584	1.31	(0.77,	2.23)	0.310

Note. CI = confidence interval, OR = odds ratio, LL = lower limit, and UL = upper limit. The Wald Chi-Square Test was used to denote statistical significance for the factorial logistic regression test. The p-values were as follows for 2016-2020 respectively 0.003, <0.001, <0.001, 0.002, and <0.001.

The analyses for H_{a2} and H_{a3} used multiple ANOVA analyses comparing the F statistic and p-value to denote model significance. A p-value of <.05 denotes specific significant groups, focusing on least square means analysis for ADRD diagnosis and ethnicity and Tukey's for race to investigate the differences in healthcare utilization patterns over time for ADRD among various ethnic and racial groups while controlling for gender, income, and education. The analysis uses a sample of 423,854,367 people in 2016, 404,358,994 people in 2017, 359,729,381 people in 2018, 352,944,352 people in 2019, and 354,798,255 people in 2020. The large sample size justifies the assumption of normality and homoscedasticity (Ito, 2005).

H_{a2}: There is a statistically significant difference over time in healthcare utilization patterns for ADRD among various ethnic and racial groups controlling for gender, income, and education.

Throughout the study, the analyses generally found statistically significant differences in healthcare utilization over time across various ethnic and racial groups, even after controlling for variables such as gender, income, and education. As represented in Table 7, patients with ADRD generally have fewer preventative visits and more reactionary care. Patients with ADRD showed an average of 5 (SD 1.19, p=0.004) fewer office-based provider visits, with only 2018 being insignificant and an average of 2 (SD 0.19, p=0.01) fewer outpatient department provider visits across the observational period. The results are mainly insignificant for office-based physician visits, outpatient department provider visits, inpatient hospital discharges, nights in the hospital, and ER visits.

Hispanic patients mostly have fewer visits overall compared to non-Hispanic patients. Though the results are mainly significant, two of the five years are insignificant for nights in the hospital and ER visit data. Specifically, Hispanics have an average of 4 (SD 0.73, p<0.001) fewer office-based provider visits, 1 (SD 0.45, p<0.001) fewer office-based physician visits, 1 (SD 0.24, p<0.001) fewer outpatient department provider visits, 0.5 (SD 0.11, p<0.001) fewer outpatient department physician visits, 0.1 (SD 0.03, p<0.001) fewer inpatient hospital visits compared to non-Hispanics over time. Hispanics also have an average of 0.4 (SD 0.25, p=0.01) more nights in the hospital and 0.1 (SD 0.04, p<0.001) more ER visits than non-Hispanics over time.

Table 7

Results From a MANOVA Analysis to Investigate the Differences in Healthcare Utilization Patterns for ADRD Patient

Variables	With ADRD		Without ADRD			Hispanic		Non-Hispanic		
	M	*SD*	*M*	*SD*	*p*	*M*	*SD*	*M*	*SD*	*p*
2016										
Office-Based Provider Visits	12.33	1.83	16.56	0.56	0.011	13.17	1.18	16.78	0.60	<0.001
Office-Based Physician Visits	8.60	1.19	9.59	0.27	0.241	8.73	0.79	9.64	0.29	<0.001
Outpatient Dept Provider Visits	0.56	0.11	1.82	0.16	0.003	0.65	0.18	1.89	0.17	<0.001
Outpatient Dept Physician Visits	0.26	0.06	0.69	0.09	0.083	0.40	0.16	0.71	0.10	<0.001
Inpatient Hospital Discharges	0.50	0.09	0.36	0.02	0.023	0.28	0.04	0.36	0.02	<0.001
Nights in Hospital for Discharges	2.61	0.53	1.74	0.15	0.060	1.76	0.44	1.74	0.16	0.823
Emergency Room Visits	0.92	0.21	0.50	0.03	<0.001	0.37	0.05	0.51	0.03	<0.001
2017										
Office-Based Provider Visits	12.26	2.47	16.05	0.42	0.006	12.89	1.10	16.26	0.45	<0.001
Office-Based Physician Visits	6.99	1.10	9.44	0.25	0.002	9.30	0.68	9.44	0.26	0.492
Outpatient Dept Provider Visits	0.53	0.11	1.95	0.16	0.002	1.47	0.45	1.98	0.17	<0.001
Outpatient Dept Physician Visits	0.29	0.08	0.73	0.00	0.044	0.56	0.13	0.74	0.00	0.002
Inpatient Hospital Discharges	0.36	0.08	0.34	0.02	0.849	0.23	0.04	0.35	0.02	<0.001
Nights in Hospital for Discharges	2.24	0.63	1.78	0.14	0.404	1.20	0.33	1.82	0.15	<0.001
Emergency Room Visits	0.63	0.12	0.48	0.02	0.058	0.49	0.07	0.48	0.03	0.894
2018										
Office-Based Provider Visits	16.05	2.77	17.15	0.40	0.552	14.51	1.24	17.35	0.42	<0.001
Office-Based Physician Visits	7.12	0.71	9.68	0.21	0.009	9.74	0.77	9.67	0.23	0.714
Outpatient Dept Provider Visits	0.65	0.19	2.21	0.14	0.006	0.78	0.12	2.32	0.15	<0.001
Outpatient Dept Physician Visits	0.41	0.16	0.96	0.07	0.048	0.49	0.09	1.00	0.07	<0.001
Inpatient Hospital Discharges	0.20	0.05	0.33	0.02	0.089	0.27	0.04	0.34	0.02	<0.001
Nights in Hospital for Discharges	1.01	0.34	1.69	0.15	0.324	1.38	0.30	1.71	0.16	0.029
Emergency Room Visits	0.36	0.09	0.50	0.02	0.144	0.50	0.07	0.50	0.02	0.836
2019										
Office-Based Provider Visits	10.81	1.63	17.96	0.52	0.000	12.72	0.60	18.33	0.55	<0.001
Office-Based Physician Visits	6.79	0.72	9.61	0.23	0.001	8.70	0.49	9.67	0.24	<0.001
Outpatient Dept Provider Visits	0.59	0.15	2.52	0.14	0.000	0.85	0.21	2.64	0.15	<0.001
Outpatient Dept Physician Visits	0.32	0.10	1.11	0.07	0.004	0.43	0.09	1.16	0.07	<0.001
Inpatient Hospital Discharges	0.31	0.06	0.34	0.02	0.630	0.24	0.04	0.35	0.02	<0.001
Nights in Hospital for Discharges	1.71	0.48	1.81	0.20	0.892	1.53	0.46	1.83	0.21	0.060
Emergency Room Visits	0.58	0.09	0.55	0.03	0.797	0.42	0.05	0.56	0.03	<0.001
2020										
Office-Based Provider Visits	8.69	0.94	15.11	0.38	<0.001	10.82	0.79	15.43	0.40	<0.001
Office-Based Physician Visits	5.40	0.64	8.17	0.20	0.000	6.31	0.48	8.31	0.21	<0.001
Outpatient Dept Provider Visits	1.41	0.53	2.66	0.16	0.037	2.11	0.61	2.70	0.18	<0.001
Outpatient Dept Physician Visits	0.36	0.11	1.09	0.09	0.023	1.01	0.27	1.09	0.09	0.254
Inpatient Hospital Discharges	0.38	0.08	0.27	0.02	0.105	0.17	0.02	0.28	0.02	<0.001
Nights in Hospital for Discharges	3.54	1.29	1.51	0.16	0.000	0.90	0.16	1.57	0.17	<0.001
Emergency Room Visits	0.59	0.11	0.43	0.02	0.053	0.31	0.04	0.44	0.02	<0.001

Note. M = mean, and SD = standard deviation. For model significance, both the F-statistic and p-value were used.

Table 8 displays the healthcare utilization delineated by racial category. White patients generally show more office-based provider visits, office-based physician visits, outpatient department provider visits, and outpatient department physician visits than other racial groups. However, these are only sometimes statistically significant throughout the sample period. Black patients had an average of 4 (SD 0.84, p=0.031) fewer office-based provider visits than White patients and 0.4 (SD 0.04, p=0.024) more nights in the hospital than IAP patients across the observational period. IAP patients showed an average of 4 (SD 0.92, p<0.001) fewer office-based provider visits, 3 (SD 0.38, p=0.029) fewer office-based physician visits, 1 (SD 0.15, p<0.001) fewer outpatient department provider visits, and 0.1 (SD 0.03, p=0.008) fewer nights in the hospital than White patients across the observational period.

Table 8

Results From a MANOVA Analysis to Investigate the Differences in Healthcare Utilization Patterns for ADRD Patients (cont.)

Variables	White		Black		IAP		MRR		White vs Black	White vs IAP	White vs MRR	Black vs IAP	Black vs MRR	IAP vs MRR
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*p*	*p*	*p*	*p*	*p*	*p*
2016														
Office-Based Provider Visits	17.25	0.60	13.03	0.78	10.06	0.58	12.25	0.66	0.019	<0.001	0.008	0.101	0.812	0.274
Office-Based Physician Visits	9.76	0.28	9.21	0.48	7.10	0.53	8.30	0.45	0.727	<0.001	0.381	0.206	0.768	0.501
Outpatient Dept Provider Visits	1.91	0.19	1.32	0.23	0.69	0.04	1.71	0.15	0.056	<0.001	0.648	0.032	0.397	0.008
Outpatient Dept Physician Visits	0.72	0.10	0.60	0.15	0.34	0.03	0.45	0.15	0.515	0.003	0.190	0.135	0.505	0.576
Inpatient Hospital Discharges	0.36	0.02	0.40	0.04	0.18	0.02	0.49	0.10	0.505	0.002	0.454	0.003	0.608	0.087
Nights in Hospital for Discharges	1.64	0.16	3.22	0.75	0.85	0.28	2.20	0.14	0.054	0.021	0.495	0.006	0.350	0.129
Emergency Room Visits	0.48	0.03	0.60	0.05	0.51	0.04	1.06	0.26	0.100	0.835	0.148	0.575	0.258	0.215
2017														
Office-Based Provider Visits	16.61	0.45	12.48	1.10	11.01	0.71	15.29	1.11	0.003	<0.001	0.515	0.383	0.236	0.050
Office-Based Physician Visits	9.70	0.27	7.98	0.30	7.21	0.50	7.91	0.34	0.011	0.000	0.079	0.388	0.949	0.554
Outpatient Dept Provider Visits	2.01	0.18	1.50	0.14	1.26	0.10	2.34	0.52	0.166	0.060	0.717	0.611	0.376	0.259
Outpatient Dept Physician Visits	0.73	0.07	0.70	0.09	0.69	0.07	0.63	0.05	0.787	0.841	0.682	0.967	0.808	0.866
Inpatient Hospital Discharges	0.35	0.02	0.33	0.04	0.30	0.04	0.25	0.02	0.723	0.648	0.237	0.788	0.401	0.720
Nights in Hospital for Discharges	1.72	0.15	2.57	0.29	1.45	0.13	1.97	0.08	0.158	0.728	0.817	0.236	0.617	0.689
Emergency Room Visits	0.49	0.03	0.56	0.04	0.31	0.04	0.40	0.03	0.333	0.072	0.314	0.034	0.138	0.472
2018														
Office-Based Provider Visits	17.46	0.41	14.73	1.70	14.32	0.85	18.78	2.24	0.126	0.475	0.672	0.930	0.240	0.400
Office-Based Physician Visits	9.80	0.22	9.34	1.11	7.04	0.38	10.77	1.95	0.689	<0.001	0.655	0.073	0.557	0.099
Outpatient Dept Provider Visits	2.26	0.16	2.03	0.30	1.19	0.11	2.48	0.11	0.556	0.001	0.776	0.088	0.579	0.116
Outpatient Dept Physician Visits	0.96	0.07	1.03	0.27	0.70	0.08	1.38	0.11	0.795	0.151	0.474	0.303	0.580	0.265
Inpatient Hospital Discharges	0.35	0.02	0.28	0.04	0.16	0.03	0.24	0.02	0.132	<0.001	0.260	0.041	0.736	0.406
Nights in Hospital for Discharges	1.77	0.16	1.39	0.30	0.61	0.09	1.29	0.14	0.253	<0.001	0.418	0.025	0.876	0.241
Emergency Room Visits	0.51	0.02	0.53	0.07	0.32	0.07	0.33	0.03	0.793	0.028	0.050	0.053	0.093	0.950
2019														
Office-Based Provider Visits	18.29	0.54	14.24	1.31	19.54	3.91	14.05	1.09	0.004	0.758	0.035	0.210	0.934	0.206
Office-Based Physician Visits	9.80	0.25	8.57	0.60	8.53	0.75	7.63	0.59	0.067	0.145	0.115	0.968	0.532	0.560
Outpatient Dept Provider Visits	2.60	0.15	2.16	0.27	1.41	0.17	2.80	0.29	0.252	0.000	0.802	0.125	0.475	0.106
Outpatient Dept Physician Visits	1.12	0.07	1.09	0.14	0.67	0.13	1.58	0.17	0.884	0.008	0.252	0.179	0.283	0.033
Inpatient Hospital Discharges	0.34	0.02	0.38	0.04	0.22	0.05	0.44	0.09	0.435	0.027	0.411	0.020	0.629	0.061
Nights in Hospital for Discharges	1.75	0.23	1.90	0.21	2.11	0.66	3.18	1.07	0.689	0.619	0.247	0.767	0.295	0.417
Emergency Room Visits	0.56	0.03	0.54	0.06	0.51	0.13	0.58	0.09	0.825	0.734	0.858	0.816	0.786	0.697
2020														
Office-Based Provider Visits	15.75	0.42	11.48	1.06	9.52	0.71	12.73	1.32	0.001	<0.001	0.153	0.146	0.576	0.147
Office-Based Physician Visits	8.40	0.23	7.21	0.51	5.54	0.36	6.98	0.73	0.044	<0.001	0.137	0.017	0.816	0.166
Outpatient Dept Provider Visits	2.79	0.18	1.71	0.28	1.50	0.20	2.90	0.32	0.001	0.000	0.893	0.607	0.157	0.110
Outpatient Dept Physician Visits	1.11	0.10	0.86	0.18	0.96	0.15	1.19	0.26	0.243	0.531	0.791	0.745	0.360	0.571
Inpatient Hospital Discharges	0.28	0.02	0.28	0.04	0.16	0.03	0.21	0.05	0.969	0.003	0.355	0.032	0.413	0.548
Nights in Hospital for Discharges	1.45	0.17	2.23	0.74	1.51	0.62	1.80	0.81	0.317	0.933	0.697	0.470	0.713	0.798
Emergency Room Visits	0.42	0.02	0.55	0.09	0.27	0.04	0.44	0.08	0.191	0.006	0.851	0.010	0.434	0.134

Note. M = mean, SD = standard deviation, IAP = Indigenous and Asian-Pacific, and MRR = Multiple Races Reported. For model significance, both the F-statistic and p-value were used. Tukey's was then ran post-hoc to determine specific significant groups.

H_{a3}: There is a statistically significant difference over time in healthcare costs for ADRD among various racial and ethnic groups, controlling for gender, income, and education.

During the observation period, the analysis showed a significant difference over time in healthcare costs for ADRD among various racial and ethnic groups while controlling for gender, income, and education. Over the study period, patients with ADRD generally have a lower average individual income at $15,517.00 (SD $2,111.68, p=0.005) less, family income at $11,298.40 (SD $4,441.75 p=0.047) less, and family income as a percent of the poverty line at 91.92percent (SD 22.74percent, p=0.008) less, as denoted in Table 9. However, they also tend to have higher out-of-pocket expenses at $1,365.65 (SD $696.25, p=0.014). The total healthcare expenditure was also higher, but the results are primarily insignificant throughout the sample period.

This observation shows that Hispanics have both lower healthcare expenditure and lower income across the board, with significant findings. Specifically, Hispanics have a lower total healthcare expenditure at $2,053.00 (SD $1,327.47 p<0.001), out-of-pocket expenditure at $1,329.57 (SD $155.58, p<0.001), individual income at $21,364.60 (SD $1,431.62, p<0.001), family income at $28,728.20 (SD $2729.31, p<0.001), and family income as a percentage of the poverty line at 187 percent (SD 14 percent, p<0.001).

Table 9

Results From a MANOVA Analysis to Investigate the Differences in Healthcare Expenditure Patterns for ADRD Patients

Variables	With ADRD		Without ADRD			Hispanic		Non-Hispanic		
	M	*SD*	*M*	*SD*	*p*	*M*	*SD*	*M*	*SD*	*p*
2016										
Total Healthcare Expenditure	$26,286	$2,714	$21,390	$863	0.054	$18,473	$1,698	$21,614	$913	<0.001
Out Of Pocket Expenditure	$1,942	$376	$2,036	$101	0.794	$957	$126	$2,112	$109	<0.001
Total Individual Income	$33,083	$2,736	$44,641	$1,065	0.001	$26,530	$1,705	$45,861	$1,120	<0.001
Family Income	$61,671	$5,379	$77,903	$2,060	0.009	$50,726	$2,980	$79,739	$2,169	<0.001
Family Income as % of Poverty Line	337%	29%	435%	11%	0.003	261%	15%	446%	11%	<0.001
2017										
Total Healthcare Expenditure	$23,430	$2,771	$20,580	$705	0.268	$17,039	$1,500	$20,846	$749	<0.001
Out Of Pocket Expenditure	$3,745	$925	$2,156	$133	0.001	$930	$110	$2,251	$144	<0.001
Total Individual Income	$26,408	$2,295	$45,789	$1,091	<0.001	$28,253	$1,770	$46,953	$1,149	<0.001
Family Income	$51,945	$4,522	$77,585	$1,919	<0.001	$56,229	$3,395	$78,993	$2,012	<0.001
Family Income as % of Poverty Line	276%	22%	434%	11%	<0.001	283%	15%	444%	11%	<0.001
2018										
Total Healthcare Expenditure	$27,494	$4,482	$21,311	$665	0.035	$23,371	$2,808	$21,174	$681	0.001
Out Of Pocket Expenditure	$4,398	$1,973	$2,448	$127	0.001	$1,312	$181	$2,542	$138	<0.001
Total Individual Income	$28,329	$2,761	$46,380	$1,050	<0.001	$27,079	$2,170	$47,800	$1,061	<0.001
Family Income	$63,679	$5,725	$80,445	$1,896	0.013	$52,173	$3,295	$82,557	$1,940	<0.001
Family Income as % of Poverty Line	329%	29%	445%	10%	0.001	273%	18%	458%	10%	<0.001
2019										
Total Healthcare Expenditure	$24,333	$2,892	$21,944	$652	0.370	$19,071	$1,743	$22,171	$675	<0.001
Out Of Pocket Expenditure	$3,812	$1,138	$2,521	$128	0.036	$1,361	$263	$2,614	$135	<0.001
Total Individual Income	$27,080	$2,697	$46,981	$1,010	<0.001	$22,685	$1,527	$48,742	$1,066	<0.001
Family Income	$76,212	$7,592	$82,819	$1,976	0.335	$49,384	$3,382	$85,323	$2,080	<0.001
Family Income as % of Poverty Line	377%	38%	457%	10%	0.027	250%	17%	472%	11%	<0.001
2020										
Total Healthcare Expenditure	$25,260	$3,303	$20,332	$654	0.109	$18,116	$1,816	$20,530	$691	0.001
Out Of Pocket Expenditure	$4,584	$1,836	$2,492	$224	0.021	$935	$104	$2,625	$246	<0.001
Total Individual Income	$37,808	$5,466	$46,502	$945	0.023	$26,097	$1,750	$48,111	$997	<0.001
Family Income	$89,514	$11,514	$80,761	$1,835	0.167	$57,155	$4,087	$82,696	$1,952	<0.001
Family Income as % of Poverty Line	444%	58%	451%	10%	0.818	283%	18%	465%	10%	<0.001

Note. M = mean, and SD = standard deviation. For model significance, both the F-statistic and p-value were used.

Table 10 displays the expenditure patterns and comparisons for different racial groups. Whereas these values were not always statistically significant, generally, IAP patients have lower total healthcare and out-of-pocket expenditures than other racial groups. White patients demonstrate a higher out-of-pocket expenditure, total individual income, family income, and family income as a percent of the poverty line than other racial groups. Whereas Black patients generally have lower incomes across all categories.

When comparing White patients to Black patients over time, White patients showed a higher average out-of-pocket expenditure at $1,109 (SD $145, p<0.001), individual income at $15,621 (SD $1,423, p<0.001), family income at $28,322 (SD $2,427, p<0.001), and family income as a percentage of the poverty line at 164 percent (SD 13 percent, $p<0.001$) over the observation period. White patients also showed a higher individual income at $12,322 (SD $1,901, $p=0.002$) than IAP patients. At the same time, Black patients showed to have lower family income at $31,876 (SD $4,623, $p<0.001$) and family income as a percentage of the poverty line at 102 percent (SD 20 percent, $p=0.008$).

Table 10

Results From a MANOVA Analysis to Investigate the Differences in Healthcare Expenditure Patterns for ADRD Patients (cont.)

Variables	White		Black		IAP		MRR		White vs Black	White vs IAP	White vs MRR	Black vs IAP	Black vs MRR	IAP vs MRR
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*p*	*p*	*p*	*p*	*p*	*p*
2016														
Total Healthcare Expenditure	$21,677	$968	$21,551	$1,623	$14,466	$999	$23,809	$1,810	0.953	0.001	0.641	0.005	0.637	0.065
Out Of Pocket Expenditure	$2,186	$115	$1,097	$107	$934	$107	$1,270	$206	<0.001	<0.001	0.021	0.360	0.592	0.304
Total Individual Income	$46,507	$1,184	$30,634	$1,840	$33,060	$2,450	$37,468	$3,780	<0.001	0.000	0.090	0.538	0.215	0.480
Family Income	$80,074	$2,259	$54,419	$2,591	$77,540	$4,636	$69,613	$7,782	<0.001	0.744	0.367	0.003	0.198	0.539
Family Income as % of Poverty Line	451%	12%	290%	14%	371%	24%	366%	43%	<0.001	0.028	0.150	0.026	0.202	0.937
2017														
Total Healthcare Expenditure	$20,059	$585	$22,326	$1,875	$27,823	$1,877	$21,727	$1,340	0.352	0.477	0.665	0.622	0.894	0.596
Out Of Pocket Expenditure	$2,289	$153	$1,403	$116	$1,088	$150	$1,883	$535	<0.001	<0.001	0.505	0.177	0.429	0.203
Total Individual Income	$47,484	$1,200	$32,336	$1,371	$37,846	$1,819	$36,174	$674	<0.001	0.007	0.012	0.147	0.405	0.758
Family Income	$79,721	$2,135	$52,639	$2,074	$83,305	$3,258	$62,069	$2,630	<0.001	0.660	0.027	<0.001	0.247	0.033
Family Income as % of Poverty Line	450%	12%	289%	12%	399%	15%	341%	10%	<0.001	0.142	0.008	0.001	0.207	0.233
2018														
Total Healthcare Expenditure	$21,783	$723	$21,777	$3,021	$11,830	$877	$18,843	$1,352	0.999	<0.001	0.354	0.004	0.497	0.036
Out Of Pocket Expenditure	$2,613	$147	$1,631	$131	$1,212	$175	$1,175	$156	0.001	<0.001	<0.001	0.196	0.139	0.890
Total Individual Income	$48,428	$1,201	$30,206	$1,695	$32,333	$3,358	$45,417	$1,778	<0.001	<0.001	0.610	0.603	0.014	0.050
Family Income	$83,016	$2,131	$50,772	$3,026	$85,896	$7,068	$70,000	$3,017	<0.001	0.756	0.159	0.000	0.049	0.213
Family Income as % of Poverty Line	463%	11%	282%	16%	386%	29%	409%	17%	<0.001	0.032	0.308	0.005	0.023	0.702
2019														
Total Healthcare Expenditure	$21,872	$708	$23,223	$1,657	$20,899	$2,355	$22,666	$1,884	0.480	0.731	0.842	0.465	0.896	0.706
Out Of Pocket Expenditure	$2,633	$147	$1,387	$138	$2,731	$699	$2,004	$197	<0.001	0.907	0.081	0.103	0.082	0.395
Total Individual Income	$48,905	$1,112	$35,488	$1,842	$34,046	$2,844	$34,561	$2,532	<0.001	<0.001	0.000	0.685	0.825	0.914
Family Income	$84,932	$2,254	$58,355	$2,968	$95,790	$9,349	$59,498	$4,852	<0.001	0.305	0.001	0.001	0.887	0.005
Family Income as % of Poverty Line	473%	12%	323%	16%	420%	27%	337%	25%	<0.001	0.127	0.001	0.008	0.738	0.096
2020														
Total Healthcare Expenditure	$20,230	$694	$21,214	$2,932	$18,258	$1,814	$27,320	$5,063	0.749	0.393	0.317	0.431	0.457	0.211
Out Of Pocket Expenditure	$2,627	$231	$1,284	$166	$2,588	$1,293	$1,621	$118	<0.001	0.976	0.035	0.338	0.415	0.503
Total Individual Income	$48,264	$1,042	$32,817	$1,742	$38,067	$2,800	$41,723	$2,526	<0.001	0.004	0.163	0.163	0.094	0.513
Family Income	$83,342	$1,975	$53,292	$2,860	$86,325	$8,396	$68,488	$5,326	<0.001	0.733	0.089	0.000	0.097	0.135
Family Income as % of Poverty Line	468%	11%	304%	16%	419%	28%	387%	22%	<0.001	0.133	0.081	0.001	0.080	0.538

Note. M = mean, SD = standard deviation, IAP = Indigenous and Asian-Pacific, and MRR = Multiple Races Reported. For model significance, both the F-statistic and p-value were used. Tukey's was then ran post-hoc to determine specific significant groups.

CHAPTER FIVE: CONCLUSIONS

Overview

This chapter synthesizes the findings derived from this study, outlining their implications within the broader academic and practical context. It discusses each research question in the light of ABM, addressing the study's broader implications, inherent limitations, and recommendations for future investigations in ADRD, mainly focusing on racial and ethnic disparities and related social determinants of health over time.

Discussion

Ethnic and Racial Variations in ADRD Prevalence Rates

Delving into the disparities in ADRD prevalence rates across various racial and ethnic groups is crucial for a comprehensive understanding of the disease's societal impact. This study highlights the significant influence of socioeconomic and educational factors. By integrating these findings, this study contributes to a deeper understanding of the multifaceted interplay between demographic characteristics and ADRD prevalence, thereby enriching the discourse on healthcare equity in the context of ADRD.

Analysis of Prevalence Rates

The study's findings are consistent with previous literature, showing inconsistent results for the prevalence rates with mostly insignificant results. Existing literature presents mixed findings on the significance of ethnic and racial disparities in ADRD prevalence rates, with works of Shiekh et al. (2021) and Chen and Zissimopoulos (2018) showing mixed findings and Kornblith et al. (2022) showing a higher prevalence rate for minority categories. For instance, Shiekh et al. (2021) conducted a systematic review and meta-analysis with mixed results, with some studies showing significant results while others were insignificant. Chen and

Zissimopoulos demonstrated that both Black, 2.18 times, and Hispanic, 1.47 times, individuals were more likely to develop ADRD compared to White individuals. Kornblith et al. (2022) showed that compared to White patients, American Indian or Alaska Native patients were 1.05 times more likely, Asian patients were 1.2 times more likely, Black patients were 1.54 times more likely, and Hispanic patients were 1.92 times more likely, though not all results were significant. By comparing this study's results with existing research, we can enhance our understanding of the intricate patterns of ADRD prevalence. This comparative approach illuminates the unique socioeconomic and cultural influences on ADRD and underscores the specific challenges and needs of these communities, thereby enriching our insights into the broader societal impact of the disease.

A critical examination of the methodologies used in the studies mentioned above reveals potential reasons for these variances. For instance, this study's findings are in agreement with Kornblith et al. (2022), who reported a higher incidence of ADRD among Hispanic individuals, followed by Black, Asian, and White individuals. Specifically, both studies identify a notably higher incidence of ADRD among Black and Hispanic individuals. However, a key distinction emerges for IAP individuals; unlike Kornblith et al. (2022), who noted a higher rate, this study reports a lower prevalence rate for IAP individuals. This discrepancy could be due to the current study's grouping of various minority races into one category, combining Indigenous and Asian-Pacific races, due to a limited sample size, as opposed to how Kornblith et al. (2022) maintained separate categorization. This difference highlights the importance of granular racial and ethnic categorization in ADRD research to capture the nuances of prevalence across diverse populations.

The findings of Chen and Zissimopoulos (2018) provided similar results, noting a higher likelihood of ADRD among Hispanics and Blacks than Whites, reinforcing the existence of racial and ethnic disparities in ADRD prevalence. This concurrence adds weight to the argument that racial and ethnic factors play a significant role in the prevalence rates of ADRD.

In agreement with Shiekh et al. (2021), this study also found a higher likelihood of ADRD among Blacks and a lower prevalence among Asians. However, a notable contrast arises with Hispanics; this study indicates a higher likelihood for Hispanics to develop ADRD compared to non-Hispanics, differing from the findings of Shiekh et al. (2021). This contrast might demonstrate varying methodologies or demographic contexts between the studies, underscoring the complexity of ADRD prevalence across different ethnicities and the need for context-specific research approaches.

These comparisons collectively illustrate the multifaceted nature of ADRD prevalence among various racial and ethnic groups. They validate the observed disparities in this study and highlight the need for nuanced, contextually informed research to unravel the intricate patterns of ADRD prevalence across diverse populations.

Socioeconomic Factors Influencing ADRD Prevalence Rates

The disparities observed in ADRD prevalence rates across diverse communities are significantly influenced by a range of socioeconomic factors (Chen & Zissimopoulos, 2018; Shiekh et al., 2021). Studies by Chen and Zissimopoulos (2018) and Shiekh et al. (2021) underline the critical role of variables such as education and income levels in shaping these variations, reflecting broader societal inequalities and health inequalities.

Lower education and income levels have been associated with higher prevalence rates of ADRD, with Chen and Zissimopoulos (2018) showing that compared to those with less than a high school education, those with a high school education were 0.43 times as likely, and those with a college education were 0.32 times as likely to develop ADRD. This was substantiated by the results of this study, showing that those with higher education were less likely to have ADRD. This correlation may be due to several intertwined factors, including limited access to healthcare resources, less awareness and understanding of the disease, and reduced availability of or engagement with preventive health measures, which are more common in socioeconomically disadvantaged communities. Furthermore, financial constraints can lead to delayed diagnosis and treatment, further exacerbating the progression of the disease and its impact on individuals and their families.

Systemic disparities in healthcare delivery and accessibility, often more pronounced in marginalized communities, may contribute to these disparities. Such systemic challenges include disparities in insurance coverage, accessibility of healthcare services, and quality of care. The interplay between these socioeconomic factors results in a significant underdiagnosis of ADRD in certain groups, underlining the need for targeted strategies to understand and mitigate the impact of these disparities on ADRD prevalence (Findley et al., 2023).

Education as a Determinant of Cognitive Health

Education emerges as a critical factor in exploring the determinants of cognitive health, particularly in the context of ADRD. Research has demonstrated a correlation between educational attainment and the prevalence of ADRD in vulnerable populations (Hendrie et al., 2018; Mayeda et al., 2019). Individuals with higher levels of education tend to exhibit a lower risk of developing ADRD, suggesting that educational attainment is a protective factor against cognitive decline. Conversely, lower educational levels are associated with an increased risk of ADRD (Alzheimer’s Association, 2022a; Hendrie et al., 2018).

This link highlights the multifaceted impact of education on cognitive health. Education equips individuals with knowledge and skills, influencing cognitive reserve, problem-solving abilities, and access to health-promoting resources and information. This aligns with the ABM conceptualization of education as an enabling resource beyond mere academic learning. It encompasses a broader spectrum of cognitive stimulation and social engagement, vital for maintaining cognitive function and delaying the onset of dementia symptoms.

Therefore, the association between education and ADRD is not merely correlational but suggestive of deeper, causative mechanisms through which education positively impacts brain health, long-term. This understanding is crucial for developing targeted interventions and policies to reduce ADRD disparities, especially in underserved and vulnerable communities. By prioritizing education opportunities and promoting lifelong learning, we can potentially mitigate the risk factors associated with ADRD and enhance overall cognitive resilience in these populations.

Intersectionality of Demographic Factors

In examining ADRD prevalence, the concept of intersectionality proves to be crucial in understanding how various demographic factors intertwine to influence disease outcomes. The analysis of this study reveals significant variations in ADRD prevalence when considering the combined effects of different demographic characteristics, such as sex, race, and educational attainment. These variations are not just additive but interactive, suggesting a complex interplay of multiple social determinants of health.

For example, the intersection of sex and race presents a unique set of challenges and risk profiles in ADRD prevalence. Similarly, race and educational attainment are critical in determining the likelihood of developing ADRD. These intersections are particularly salient in understanding the disparities observed in different demographic groups. Chen and Zissimopoulos (2018) have made significant contributions to this discourse, highlighting how higher prevalence rates in Hispanic and Black populations are intricately linked to socioeconomic factors, notably lower education and income levels.

Healthcare Utilization Patterns in ADRD Across Racial and Ethnic Groups

Understanding and addressing disparities in healthcare access and quality among individuals with ADRD across different racial and ethnic groups is imperative. This study found significant results aligning with existing literature, such as the works of Olchanski et al. (2022) and Zhu et al. (2022), to help unravel the complex interplay of factors influencing healthcare utilization in ADRD patients within the broader context of healthcare equity.

Disparities in Healthcare Utilization

This study’s analysis of healthcare utilization patterns among ADRD patients highlights critical disparities, resonating with recent research findings. Olchanski et al. (2022) and Zhu et al. (2022) show a significant gap in medication adherence and discontinuation rates, particularly among Black and Hispanic ADRD patients. For instance, Olchanski et al. (2022) identified significant disparities in medication adherence among Black and Hispanic ADRD patients compared to White ADRD patients.

Healthcare Cost Disparities in ADRD Across Racial and Ethnic Groups

Understanding the racial and ethnic disparities in healthcare costs associated with ADRD is vital for comprehending the financial burden different demographic groups bear. The notable disparities in total healthcare expenditure and out-of-pocket costs among different racial and ethnic groups, as evidenced in Tables 9 and 10 of this study, present a compelling picture that aligns with and expands upon existing research in the field. The significant findings of this study, delve into the disparities in healthcare costs among various ethnic and racial groups, contributing to a broader understanding of ADRD's economic impact.

Disparities in Total Healthcare Expenditure

The investigation of this study reveals notable disparities in total healthcare expenditure among different racial and ethnic groups. This study builds upon findings from Ornstein et al. (2018), who demonstrated higher Medicare expenditures among Black ADRD patients than among White patients, spending an average of $86,647 more, showing that Black individuals consistently incur higher total expenses than their White counterparts. This expense disparity, as detailed in Tables 9 and 10, extends across various racial categories over different years.

Out-of-Pocket Expenditures and Systemic Issues

A nuanced aspect of this study is the examination of out-of-pocket expenditures, revealing another layer of disparity. Echoing Park and Chen (2020) showing that White patients spend on average double the out-of-pocket costs as minority races, and Aranda et al. (2021) show that Black patients account for 33% of the total cost of ADRD in the U.S., analysis shows considerable differences in out-of-pocket costs among ethnic and racial groups. The differential burden of healthcare costs borne by patients from various backgrounds is suggestive of deeper systemic issues, such as unequal insurance coverage and variable access to affordable healthcare services.

Socioeconomic Status and Healthcare Costs

The varying socioeconomic statuses of different racial and ethnic groups partially contribute to the disparities observed in healthcare costs. Previous research noted by Montez et al. (2019) has shown that lower income and educational attainment, prevalent among certain minority groups, play a significant role in the increased financial burden of healthcare. These factors and potential systemic biases in healthcare pricing and insurance policies contribute to observed disparities.

Applying the Andersen Behavioral Model to ADRD Disparities

The ABM offers a structured perspective and comprehensive framework for analysis for understanding the disparities in ADRD prevalence rates among different racial and ethnic groups. By categorizing influencing factors into predisposing characteristics, enabling resources, and needs, ABM allows for a nuanced understanding of these disparities' complexities.

Within the framework of ABM, predisposing factors such as race and ethnicity significantly influence ADRD prevalence. This aligns with this study's findings, indicating varied health outcomes across racial and ethnic groups, shaped by demographic and social structures. The observed higher rates of ADRD among certain groups can be linked to these predisposing characteristics.

Policy Interventions and Healthcare Equity

The application of ABM in this study advocates for comprehensive policy interventions aimed at reducing disparities. Strategies to enhance insurance coverage, improve access to financial assistance, and focus on preventive care are essential to address the multifaceted challenges in ADRD care across different communities. To effectively reduce disparities and ensure equitable healthcare access across diverse communities, it is crucial to implement a multi-tiered strategy.

One way to address this is to develop policies that expand coverage to include comprehensive ADRD care, including early screening, diagnosis, and ongoing treatment. This could involve advocating for legislative changes to existing health insurance schemes or introducing new insurance products tailored to the needs of ADRD patients. Another strategy would be establishing and promoting programs financially supporting individuals and families affected by ADRD. This could include subsidies for medical expenses, tax incentives for caregivers, or grants for home modifications to accommodate ADRD patients. Finally, investment in community-based preventive care programs that emphasize early detection and lifestyle interventions to delay the onset of ADRD is crucial. Initiatives could include public awareness campaigns, support for caregiver education, and funding for research into preventive measures.

The proposed policy interventions aim to construct a more inclusive and supportive healthcare system by adopting these strategies. This approach addresses the immediate challenges ADRD patients and their families face and contributes to the long-term goal of reducing healthcare disparities and fostering equity in ADRD care.

Implications

The findings from this study unveil a complex web of disparities in ADRD prevalence, healthcare utilization, and associated costs among various racial and ethnic groups. Through the lens of ABM, these disparities are not merely empirical observations but echo the more profound systemic disparities embedded within the healthcare landscape. These disparities transcend into real-world implications impacting diverse demographic groups' lives, healthcare experiences, and financial burdens, thereby necessitating a discourse for equitable healthcare reforms.

In light of these findings, it is crucial to consider the implications of this study on major federal legislation around ADRD patients, particularly the Older Americans Act and the role of Senior Centers. These entities are pivotal in providing community-based support and services to older Americans, including those affected by ADRD. The study’s insights could inform enhancements to these programs, ensuring they more effectively address the nuanced needs of diverse racial and ethnic communities impacted by ADRD. This could involve advocating for legislative amendments to the Older Americans Act to increase funding for ADRD-specific services at Senior Centers and to promote culturally sensitive care and education initiatives tailored to the needs of minority communities.

Enhancing Culturally Sensitive Care and Early Detection

The variations in ADRD prevalence among different groups signal the need for culturally sensitive healthcare approaches. A key implication is the integration of culturally tailored community outreach and awareness programs. Such initiatives should focus on education about ADRD symptoms, risk factors, and the importance of early diagnosis, particularly in communities where awareness is low.

To act on this, healthcare providers and policymakers should collaborate with local community leaders to develop and disseminate educational materials that resonate with the cultural nuances of each community. Training healthcare professionals in cultural competence can also ensure that the symptoms of ADRD are correctly recognized and appropriately managed across diverse populations.

These initiatives could be supported by the Older Americans Act, leveraging Senior Centers as pivotal hubs for disseminating information and providing culturally sensitive ADRD care and support services. This would not only enhance early detection among underserved populations but also align with federal efforts to improve healthcare equity for ADRD patients.

Tailoring Healthcare Access and Quality Interventions

Disparities in healthcare utilization patterns, reflecting ABM’s enabling and need factors, emphasize the need for policies and practices that address these gaps. For instance, interventions could focus on improving access to high-quality care in minority communities, which often face systemic barriers.

Specific strategies might include establishing healthcare facilities in underserved areas, offering transportation services to and from medical appointments, and implementing telemedicine solutions to reach those who cannot easily access traditional care settings. Additionally, incentivizing healthcare providers to work in these underserved areas through loan forgiveness or grant programs could help alleviate provider shortages.

Alleviating the Economic Burden of ADRD Care

This study underscores the financial strain of ADRD care and necessitates a multi-pronged approach to financial relief. Strategies should involve enhancing insurance coverage to include comprehensive ADRD care and expanding financial assistance programs to support families bearing the brunt of care costs.

Policymakers could explore introducing supplementary insurance plans or subsidies specifically designed for ADRD patients. Increasing funding for community-based programs offering respite care and other supportive services can also provide significant relief to families, reducing out-of-pocket expenses and caregiving burdens.

Converting these insights into action requires a collaborative and interdisciplinary approach. Stakeholders from public health, social work, healthcare policy, and medical practice must unite to forge comprehensive, community-centered strategies. These strategies should address the immediate challenges and consider the broader social determinants of health that underlie these disparities. Further research will be vital in monitoring the effectiveness of these interventions and continuously refining our approach to ensuring equitable, high-quality healthcare for all individuals affected by ADRD.

Limitations

The study encapsulates a valuable exploration into the disparities in ADRD prevalence, healthcare utilization, and costs among ethnic and racial groups. It also encounters certain limitations that merit consideration. These limitations stem from the dataset's inherent characteristics and the study design's retrospective nature.

A notable limitation is the potential for recall bias due to the self-reporting nature of the MEPS data. Participants’ recollections of healthcare utilization, expenses, and health status may not always be accurate, leading to discrepancies in the reported data. This self-reporting aspect could particularly affect the precision of the information on healthcare costs and utilization patterns, necessitating a cautious interpretation of the findings derived from these responses.

The retrospective design of this study inherently limits the ability to establish causal relationships between the observed disparities and the healthcare outcomes of interest. While the analysis can highlight significant statistical associations between variables such as race, ethnicity, and socioeconomic factors with ADRD prevalence and healthcare costs, it cannot definitively ascertain causality. This limitation underscores the need for prospective studies to explore these associations further and potentially validate the causal pathways suggested by the findings of this research.

Another critical limitation arises from excluding institutionalized individuals from the MEPS dataset. The survey primarily captures household component data, excluding those in long-term care facilities who might exhibit severe functional impairment. This exclusion likely results in an underestimation of the true healthcare costs and the extent of healthcare utilization associated with ADRD, as individuals with severe conditions who require institutional care are not represented. Consequently, the findings may not fully capture the healthcare needs and challenges this particularly vulnerable segment of the ADRD population faces.

In acknowledging these limitations, this dissertation highlights areas for future research to build upon. Further studies employing datasets that include institutionalized patients, utilizing prospective designs, and exploring mechanisms to mitigate recall bias could provide more comprehensive insights into the disparities in ADRD care. Such research endeavors would contribute to a more nuanced understanding of the factors influencing ADRD prevalence and the healthcare system's response to the needs of individuals with ADRD across diverse communities.

Recommendations for Future Research

The quest for understanding the multifaceted dimensions of ADRD, especially within the context of racial and ethnic disparities, opens up a vast landscape for further investigation. This dissertation unveiled particular layers of this complex issue, shedding light on the prevalence of ADRD, healthcare utilization, and cost disparities among ethnic and racial groups. However, each finding also beckons a more profound exploration to grasp the intricacies and devise effective, equitable solutions. The subsequent recommendations for future research aim to address the limitations encountered in the current study and unearth new perspectives and insights that could significantly contribute to the body of knowledge in this domain. Through a continued scholarly inquiry, we can inch closer to a more inclusive healthcare landscape for individuals afflicted with ADRD across all racial and ethnic backgrounds.

1. Between Groups Analysis: Research into the noted interactions between sex and race, sex and highest degree achieved, race and ethnicity, race and highest degree achieved, and highest degree achieved and poverty category should be explored.

2. Incorporation of Other Relevant Variables: This study was limited to the variables and categories already collected by the MEPS survey. Future studies could incorporate additional variables such as diet, physical activity, employment status, proximity to healthcare facilities, and availability of specialized care or use other datasets with pertinent information not included in MEPS to analyze the disparities comprehensively.
3. Incorporation of Gender Data: To overcome the limitation of gender data inconsistency in the current study, future research should include complete and consistent gender data across all years for a more holistic understanding of racial and ethnic disparities in ADRD-related healthcare.
4. Utilization of Alternative Theoretical Frameworks: While this study utilized ABM, exploring other theoretical frameworks could provide different perspectives and potentially unveil other contributing factors to the racial and ethnic disparities observed in ADRD prevalence, healthcare utilization, and costs.

These recommendations aim to address the identified limitations, expand the scope, and enhance the depth of understanding regarding racial and ethnic disparities in ADRD-related healthcare. Enhancing understanding is crucial for informing policy and practice toward achieving healthcare equity.

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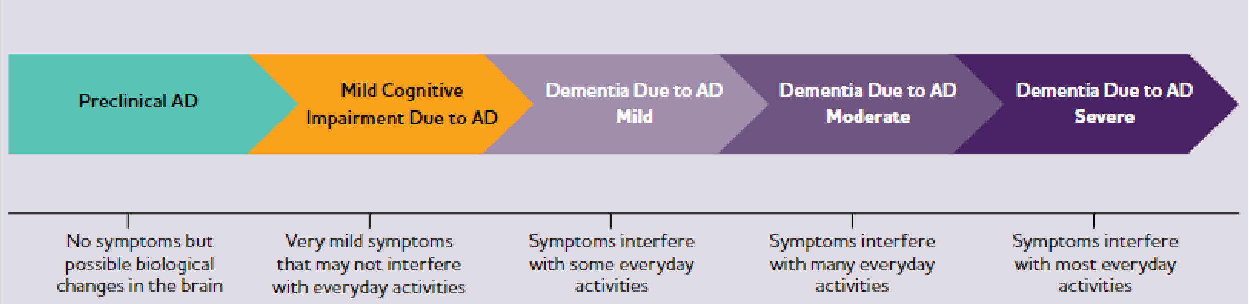
APPENDIX or APPENDICES

Figure 2

Alzheimer's Disease Continuum



Note. Although these arrows are of equal size, the components of the AD continuum are not equal in duration.

Table 1

Demographic and Socioeconomic Characteristics of the sample population

Variables	2016		2017		2018		2019		2020	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Sex										
Male	179,242,664	42.29	177,228,992	43.83	153,678,996	42.72	148,632,813	42.11	152,184,504	42.89
Female	244,611,703	57.71	227,130,002	56.17	206,050,386	57.28	204,311,538	57.89	202,613,750	57.11
Race										
White	367,078,593	86.60	348,753,471	86.25	310,765,998	86.39	302,559,683	85.72	304,840,066	85.92
Black	32,270,636	7.61	30,742,556	7.60	27,768,728	7.72	28,321,991	8.02	28,504,917	8.03
Indigenous and Asian-Pacific	17,329,911	4.09	17,144,518	4.24	14,301,768	3.98	15,424,916	4.37	15,191,725	4.28
Multiple Races Reported	7,175,228	1.69	7,718,448	1.91	6,892,888	1.92	6,637,762	1.88	6,261,548	1.76
Ethnicity										
Hispanic	27,746,769	6.55	26,921,151	6.66	25,635,808	7.13	24,818,714	7.03	26,432,373	7.45
Non-Hispanic	396,107,598	93.45	377,437,844	93.34	334,093,573	92.87	328,125,638	92.97	328,365,881	92.55
Highest Degree Achieved										
Don’t Know/Refused	2,153,063	0.51	2,486,387	0.61	2,072,812	0.58	1,480,911	0.42	1,308,659	0.37
No Degree	70,389,266	16.61	52,898,545	13.08	40,834,031	11.35	39,621,068	11.23	34,712,824	9.78
High School Diploma/GED	193,843,012	45.73	189,137,153	46.77	166,698,433	46.34	165,641,656	46.93	159,139,073	44.85
Bachelor's Degree	67,117,623	15.84	65,763,543	16.26	60,842,197	16.91	61,593,876	17.45	66,536,983	18.75
Master's Degree	45,143,945	10.65	45,043,408	11.14	38,713,917	10.76	38,047,874	10.78	41,572,673	11.72
Doctorate Degree	14,446,243	3.41	11,788,846	2.92	12,324,269	3.43	11,872,977	3.36	13,381,973	3.77
Other Degree	30,761,216	7.26	37,241,113	9.21	38,243,722	10.63	34,685,990	9.83	38,146,069	10.75
ADRD Diagnosis										
Yes	1,651,857	0.39	1,693,967	0.42	1,125,399	0.31	1,267,023	0.36	1,299,307	0.37
No	422,202,510	99.61	402,665,027	99.58	358,603,982	99.69	351,677,329	99.64	353,498,948	99.63
Region										
Northeast	80,859,309	19.08	76,658,982	18.96	67,134,667	18.66	65,053,062	18.43	67,809,038	19.11
Midwest	95,973,701	22.64	87,188,206	21.56	75,344,498	20.94	76,891,361	21.79	78,322,648	22.08
South	154,936,403	36.55	149,590,915	36.99	141,001,175	39.20	133,065,664	37.70	134,342,779	37.86
West	92,084,955	21.73	90,920,891	22.49	76,249,042	21.20	77,934,265	22.08	74,323,789	20.95
Age										
65-69	124,981,871	29.49	117,509,029	29.06	103,073,188	28.65	100,418,442	28.45	99,313,827	27.99
70-74	106,990,556	25.24	104,578,346	25.86	93,897,708	26.10	91,155,564	25.83	93,565,207	26.37
75-79	77,127,239	18.20	76,655,686	18.96	69,620,500	19.35	68,509,245	19.41	69,537,204	19.60
80-84	66,706,446	15.74	54,154,625	13.39	44,667,467	12.42	43,843,272	12.42	46,976,878	13.24
>=85	48,048,254	11.34	51,461,307	12.73	48,470,518	13.47	49,017,828	13.89	45,405,139	12.80
Poverty Category										
Poor/Negative	41,220,862	9.73	36,448,977	9.01	33,767,666	9.39	34,467,570	9.77	30,273,355	8.53
Near Poor	21,448,241	5.06	22,535,960	5.57	16,732,228	4.65	17,026,996	4.82	17,035,894	4.80
Low Income	70,765,153	16.70	63,261,292	15.64	56,409,675	15.68	53,919,629	15.28	56,273,958	15.86
Middle Income	117,643,015	27.76	115,426,528	28.55	100,600,153	27.97	98,350,622	27.87	96,663,447	27.24
High Income	172,777,096	40.76	166,686,237	41.22	152,219,659	42.32	149,179,534	42.27	154,551,599	43.56
Total	423,854,367	100.00	404,358,994	100.00	359,729,381	100.00	352,944,352	100.00	354,798,255	100.00

Note. n = Sample size and % = percent. Poverty Category was computed based on the poverty level percentage with 100% being the poverty line. Poor/Negative represents less than 100%, Near Poor 100-125%, Low Income 125-200%, Middle Income 200-400%, and High income being greater than 400%.

Table 2

Expenditures across the sample population

Variables	2016		2017		2018		2019		2020	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
With ADRD										
Total Healthcare Expenditure	$26,286	$1,662	$23,430	$918	$27,494	$2,879	$24,333	$2,243	$25,260	$2,283
Out Of Pocket Expenditure	$1,942	$167	$3,745	$430	$4,398	$1,947	$3,812	$1,108	$4,584	$1,830
Without ADRD										
Total Healthcare Expenditure	$21,390	$862	$20,580	$701	$21,311	$665	$21,944	$652	$20,332	$654
Out Of Pocket Expenditure	$2,036	$101	$2,156	$133	$2,448	$127	$2,521	$128	$2,492	$224

Note. Amounts were adjusted to 2023 currency based on the GDP price index supplied by the Bureau of Economic Analysis. M = Mean, and SD = standard

Table 3

Income across the sample population

Variables	2016		2017		2018		2019		2020	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
With ADRD										
Total Individual Income	$33,083	$1,786	$26,408	$959	$28,329	$2,158	$27,080	$1,521	$37,808	$4,639
Family Income	$61,671	$3,839	$51,945	$2,439	$63,679	$2,654	$76,212	$4,518	$89,514	$9,642
Family Income as % of Poverty Line	337%	21%	276%	8%	329%	16%	377%	21%	444%	50%
Without ADRD										
Total Individual Income	$44,641	$1,063	$45,789	$1,090	$46,380	$1,050	$46,981	$1,010	$46,502	$945
Family Income	$77,903	$2,060	$77,585	$1,916	$80,445	$1,896	$82,819	$1,976	$80,761	$1,835
Family Income as % of Poverty Line	435%	11%	434%	11%	445%	10%	457%	10%	451%	10%

Note. Amounts were adjusted to 2023 currency based on the GDP price index supplied by the Bureau of Economic Analysis. M = Mean, and SD = standard

Table 4

Medical Visits across the sample population

Variables	2016		2017		2018		2019		2020	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
With ADRD										
Office-Based Provider Visits	12.33	1.16	12.26	0.73	16.04	0.81	10.81	0.62	8.69	0.83
Office-Based Physician Visits	8.60	0.81	6.99	0.62	7.12	0.53	6.79	0.37	5.40	0.56
Outpatient Dept Provider Visits	0.56	0.08	0.53	0.06	0.65	0.04	0.59	0.07	1.41	0.46
Outpatient Dept Physician Visits	0.26	0.04	0.29	0.04	0.41	0.03	0.32	0.05	0.36	0.07
Inpatient Hospital Discharges	0.50	0.07	0.36	0.05	0.20	0.02	0.31	0.03	0.38	0.07
Nights in Hospital for Discharges	2.61	0.42	2.24	0.30	1.01	0.06	1.71	0.21	3.54	0.61
Emergency Room Visits	0.92	0.17	0.63	0.08	0.36	0.03	0.58	0.06	0.59	0.11
Without ADRD										
Office-Based Provider Visits	16.56	0.56	16.05	0.42	17.15	0.40	17.96	0.52	15.11	0.38
Office-Based Physician Visits	9.59	0.27	9.44	0.24	9.68	0.21	9.61	0.23	8.17	0.20
Outpatient Dept Provider Visits	1.82	0.16	1.95	0.16	2.21	0.14	2.52	0.14	2.66	0.16
Outpatient Dept Physician Visits	0.69	0.09	0.73	0.06	0.96	0.07	1.11	0.07	1.09	0.09
Inpatient Hospital Discharges	0.36	0.02	0.34	0.02	0.33	0.02	0.34	0.02	0.27	0.02
Nights in Hospital for Discharges	1.74	0.15	1.78	0.14	1.69	0.15	1.81	0.20	1.51	0.16
Emergency Room Visits	0.50	0.03	0.48	0.02	0.50	0.02	0.55	0.03	0.43	0.02

Note. M = Mean, and SD = standard deviation.

Table 5

Variable Operationalization

Variable	Definition	Operationalized
Sex	Sex at birth	1 Male 2 Female
Race	The Race of the individual	1 White 2 Black 3 Indigenous and Asian-Pacific 4 Multiple Races Reported
Ethnicity	The Ethnicity of the individual	1 Hispanic 2 Non-Hispanic
Highest Degree Achieved	Highest Degree Achieved	1 Don’t Know/Refused 2 No Degree 3 High School Diploma/GED 4 Bachelor's Degree 5 Master's Degree 6 Doctorate Degree 7 Other Degree
ADRD Diagnosis	Medical diagnosis of ADRD to include Vascular Dementia, Dementia in other diseases, Unspecified Dementia, and Alzheimer's Disease	1 Yes 2 No
Region	Individuals residence according to Census data	1 Northeast 2 Midwest 3 South 4 West
Age	Individuals age as of 12/31/**	1 65-69 2 70-74 3 75-79 4 80-84 5 >=85
Family Income as % of Poverty Line	Family Income as continuous % of poverty line	Numerical % of poverty line
Poverty Category	Family Income as a categorical % of poverty line	1 Poor/Negative <100% 2 Near Poor 100-125% 3 Low Income 125-200% 4 Middle Income 200%-400% 5 High Income >400%
Office-Based Provider Visits	Total Office Based Visits (Physician + Non-physician + Unknown)	Provider visits consist of encounters that took place primarily in office-based settings and clinics. These may consist of Physician, non-physician, or unknown provider.
Office-Based Physician Visits	Office Based Visits to Physicians	Physician visits consist of encounters that took place primarily in office-based settings and clinics. These consist of only visits that were performed by a physician.
Outpatient Dept Provider Visits	Total Outpatient Visits (Physician + Non-physician + Unknown)	The total number of reported visits to hospital outpatient departments. These may consist of Physician, non-physician, or unknown provider.

Outpatient Dept Physician Visits	Outpatient Dept Physician Visits	The total number of reported visits to hospital outpatient departments. These consist of only visits that were performed by a physician.
Inpatient Hospital Discharges	Inpatient Hospital Discharges	Total number of inpatient hospital discharges.
Nights in Hospital for Discharges	Nights in Hospital for Discharges	Total number of nights in the hospital.
Emergency Room Visits	Total Emergency Room Visits	The number of all emergency room visits reported.
Total Healthcare Expenditure	Total Healthcare Expenditure	Total expenditure in U.S. dollars.
Out Of Pocket Expenditure	Out Of Pocket Expenditure	Out of pocket expenditure in U.S. dollars.
Total Individual Income	Total Individual Income	Individual income in U.S. dollars.
Family Income	Family Income	Family income in U.S. dollars.

Note. ** represents the two-digit-year that the data was acquired. Amounts were adjusted to 2023 currency based on the GDP price index supplied by the Bureau of Economic Analysis. Age was ran as a continuous variable then manually put into categories.

Table 6

Results From a Factorial Logistic Regression Analysis to Investigate the Differences in Prevalence Rates of ADRD Patients

Variables	2016				2017				2018				2019				2020			
		95% CI				95% CI				95% CI				95% CI				95% CI		
	OR	*LL*	*UL*	*p*	*OR*	*LL*	*UL*	*p*	*OR*	*LL*	*UL*	*p*	*OR*	*LL*	*UL*	*p*	*OR*	*LL*	*UL*	*p*
Sex																				
Male																				
Female	1.36	(0.90,	2.06)	0.139	0.90	(0.59,	1.39)	0.647	1.12	(0.64,	1.93)	0.695	1.05	(0.69,	1.61)	0.808	1.15	(0.74,	1.78)	0.545
Race																				
White																				
Black	1.71	(1.05,	2.77)	0.031	1.42	(0.84,	2.40)	0.192	0.89	(0.33,	2.36)	0.808	1.64	(0.86,	3.13)	0.133	1.36	(0.69,	2.69)	0.369
Indigenous and Asian-Pacific	0.70	(0.30,	1.65)	0.411	0.30	(0.09,	1.00)	0.051	0.45	(0.20,	0.99)	0.046	1.56	(0.68,	3.57)	0.290	2.10	(0.97,	4.57)	0.061
Multiple Races Reported	0.39	(0.09,	1.75)	0.217	0.45	(0.11,	1.91)	0.277	0.30	(0.06,	1.54)	0.149	0.64	(0.14,	2.89)	0.561	0.72	(0.18,	2.94)	0.642
Ethnicity																				
Hispanic	1.18	(0.68,	2.02)	0.557	0.97	(0.53,	1.75)	0.908	1.57	(0.90,	2.72)	0.109	2.38	(1.19,	4.74)	0.014	1.93	(1.19,	3.15)	0.008
Non-Hispanic																				
Highest Degree Achieved																				
Don't Know/Refused	3.46	(1.30,	9.18)	0.013	8.95	(2.95,	27.17)	0.000	7.24	(2.73,	19.24)	<0.001	1.06	(0.15,	7.52)	0.950	<0.001	(<0.001,	<0.001)	<0.001
No Degree	1.83	(1.20,	2.80)	0.006	1.36	(0.79,	2.34)	0.263	1.65	(0.84,	3.25)	0.147	1.44	(0.80,	2.59)	0.219	2.59	(1.56,	4.30)	0.000
HS Diploma/GED																				
Bachelor's Degree	1.33	(0.75,	2.36)	0.326	1.43	(0.81,	2.54)	0.217	0.98	(0.47,	2.03)	0.955	0.72	(0.39,	1.34)	0.300	0.62	(0.30,	1.29)	0.203
Master's Degree	0.61	(0.20,	1.87)	0.384	1.25	(0.54,	2.89)	0.602	0.46	(0.13,	1.62)	0.224	0.92	(0.39,	2.19)	0.851	0.94	(0.46,	1.94)	0.869
Doctorate Degree	0.47	(0.10,	2.17)	0.329	0.80	(0.21,	2.96)	0.731	0.41	(0.09,	2.00)	0.268	0.44	(0.10,	1.94)	0.277	1.21	(0.39,	3.74)	0.745
Other Degree	1.21	(0.50,	2.90)	0.673	1.57	(0.54,	4.53)	0.403	1.62	(0.51,	5.19)	0.411	0.51	(0.19,	1.38)	0.184	0.32	(0.14,	0.73)	0.007
Poverty Category																				
Poor/Negative	1.25	(0.70,	2.24)	0.457	1.11	(0.59,	2.09)	0.742	1.06	(0.51,	2.18)	0.879	0.74	(0.33,	1.64)	0.449	0.70	(0.31,	1.60)	0.400
Near Poor	1.03	(0.43,	2.48)	0.944	1.42	(0.64,	3.17)	0.390	0.50	(0.17,	1.48)	0.207	0.64	(0.24,	1.71)	0.366	1.04	(0.40,	2.70)	0.941
Low Income	0.98	(0.54,	1.78)	0.951	1.19	(0.68,	2.08)	0.532	0.82	(0.41,	1.65)	0.575	1.41	(0.79,	2.52)	0.243	1.08	(0.55,	2.10)	0.826
Middle Income																				
High Income	0.89	(0.00,	0.00)	0.703	0.41	(0.20,	0.83)	0.013	0.65	(0.29,	1.43)	0.277	0.85	(0.47,	1.53)	0.584	1.31	(0.77,	2.23)	0.310

Note. CI = confidence interval, OR = odds ratio, LL = lower limit, and UL = upper limit. The Wald Chi-Square Test was used to denote statistical significance for the factorial logistic regression test. The p-values were as follows for 2016-2020 respectively 0.003, <0.001, <0.001, 0.002, and <0.001.

Table 7

Results From a MANOVA Analysis to Investigate the Differences in Healthcare Utilization Patterns for ADRD Patient

Variables	With ADRD		Without ADRD			Hispanic		Non-Hispanic		
	M	*SD*	*M*	*SD*	*p*	*M*	*SD*	*M*	*SD*	*p*
2016										
Office-Based Provider Visits	12.33	1.83	16.56	0.56	0.011	13.17	1.18	16.78	0.60	<0.001
Office-Based Physician Visits	8.60	1.19	9.59	0.27	0.241	8.73	0.79	9.64	0.29	<0.001
Outpatient Dept Provider Visits	0.56	0.11	1.82	0.16	0.003	0.65	0.18	1.89	0.17	<0.001
Outpatient Dept Physician Visits	0.26	0.06	0.69	0.09	0.083	0.40	0.16	0.71	0.10	<0.001
Inpatient Hospital Discharges	0.50	0.09	0.36	0.02	0.023	0.28	0.04	0.36	0.02	<0.001
Nights in Hospital for Discharges	2.61	0.53	1.74	0.15	0.060	1.76	0.44	1.74	0.16	0.823
Emergency Room Visits	0.92	0.21	0.50	0.03	<0.001	0.37	0.05	0.51	0.03	<0.001
2017										
Office-Based Provider Visits	12.26	2.47	16.05	0.42	0.006	12.89	1.10	16.26	0.45	<0.001
Office-Based Physician Visits	6.99	1.10	9.44	0.25	0.002	9.30	0.68	9.44	0.26	0.492
Outpatient Dept Provider Visits	0.53	0.11	1.95	0.16	0.002	1.47	0.45	1.98	0.17	<0.001
Outpatient Dept Physician Visits	0.29	0.08	0.73	0.00	0.044	0.56	0.13	0.74	0.00	0.002
Inpatient Hospital Discharges	0.36	0.08	0.34	0.02	0.849	0.23	0.04	0.35	0.02	<0.001
Nights in Hospital for Discharges	2.24	0.63	1.78	0.14	0.404	1.20	0.33	1.82	0.15	<0.001
Emergency Room Visits	0.63	0.12	0.48	0.02	0.058	0.49	0.07	0.48	0.03	0.894
2018										
Office-Based Provider Visits	16.05	2.77	17.15	0.40	0.552	14.51	1.24	17.35	0.42	<0.001
Office-Based Physician Visits	7.12	0.71	9.68	0.21	0.009	9.74	0.77	9.67	0.23	0.714
Outpatient Dept Provider Visits	0.65	0.19	2.21	0.14	0.006	0.78	0.12	2.32	0.15	<0.001
Outpatient Dept Physician Visits	0.41	0.16	0.96	0.07	0.048	0.49	0.09	1.00	0.07	<0.001
Inpatient Hospital Discharges	0.20	0.05	0.33	0.02	0.089	0.27	0.04	0.34	0.02	<0.001
Nights in Hospital for Discharges	1.01	0.34	1.69	0.15	0.324	1.38	0.30	1.71	0.16	0.029
Emergency Room Visits	0.36	0.09	0.50	0.02	0.144	0.50	0.07	0.50	0.02	0.836
2019										
Office-Based Provider Visits	10.81	1.63	17.96	0.52	0.000	12.72	0.60	18.33	0.55	<0.001
Office-Based Physician Visits	6.79	0.72	9.61	0.23	0.001	8.70	0.49	9.67	0.24	<0.001
Outpatient Dept Provider Visits	0.59	0.15	2.52	0.14	0.000	0.85	0.21	2.64	0.15	<0.001
Outpatient Dept Physician Visits	0.32	0.10	1.11	0.07	0.004	0.43	0.09	1.16	0.07	<0.001
Inpatient Hospital Discharges	0.31	0.06	0.34	0.02	0.630	0.24	0.04	0.35	0.02	<0.001
Nights in Hospital for Discharges	1.71	0.48	1.81	0.20	0.892	1.53	0.46	1.83	0.21	0.060
Emergency Room Visits	0.58	0.09	0.55	0.03	0.797	0.42	0.05	0.56	0.03	<0.001
2020										
Office-Based Provider Visits	8.69	0.94	15.11	0.38	<0.001	10.82	0.79	15.43	0.40	<0.001
Office-Based Physician Visits	5.40	0.64	8.17	0.20	0.000	6.31	0.48	8.31	0.21	<0.001
Outpatient Dept Provider Visits	1.41	0.53	2.66	0.16	0.037	2.11	0.61	2.70	0.18	<0.001
Outpatient Dept Physician Visits	0.36	0.11	1.09	0.09	0.023	1.01	0.27	1.09	0.09	0.254
Inpatient Hospital Discharges	0.38	0.08	0.27	0.02	0.105	0.17	0.02	0.28	0.02	<0.001
Nights in Hospital for Discharges	3.54	1.29	1.51	0.16	0.000	0.90	0.16	1.57	0.17	<0.001
Emergency Room Visits	0.59	0.11	0.43	0.02	0.053	0.31	0.04	0.44	0.02	<0.001

Note. M = mean, and SD = standard deviation. For model significance, both the F-statistic and p-value were used.

Table 8

Results From a MANOVA Analysis to Investigate the Differences in Healthcare Utilization Patterns for ADRD Patients (cont.)

Variables	White		Black		IAP		MRR		White vs Black	White vs IAP	White vs MRR	Black vs IAP	Black vs MRR	IAP vs MRR
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*p*	*p*	*p*	*p*	*p*	*p*
2016														
Office-Based Provider Visits	17.25	0.60	13.03	0.78	10.06	0.58	12.25	0.66	0.019	<0.001	0.008	0.101	0.812	0.274
Office-Based Physician Visits	9.76	0.28	9.21	0.48	7.10	0.53	8.30	0.45	0.727	<0.001	0.381	0.206	0.768	0.501
Outpatient Dept Provider Visits	1.91	0.19	1.32	0.23	0.69	0.04	1.71	0.15	0.056	<0.001	0.648	0.032	0.397	0.008
Outpatient Dept Physician Visits	0.72	0.10	0.60	0.15	0.34	0.03	0.45	0.15	0.515	0.003	0.190	0.135	0.505	0.576
Inpatient Hospital Discharges	0.36	0.02	0.40	0.04	0.18	0.02	0.49	0.10	0.505	0.002	0.454	0.003	0.608	0.087
Nights in Hospital for Discharges	1.64	0.16	3.22	0.75	0.85	0.28	2.20	0.14	0.054	0.021	0.495	0.006	0.350	0.129
Emergency Room Visits	0.48	0.03	0.60	0.05	0.51	0.04	1.06	0.26	0.100	0.835	0.148	0.575	0.258	0.215
2017														
Office-Based Provider Visits	16.61	0.45	12.48	1.10	11.01	0.71	15.29	1.11	0.003	<0.001	0.515	0.383	0.236	0.050
Office-Based Physician Visits	9.70	0.27	7.98	0.30	7.21	0.50	7.91	0.34	0.011	0.000	0.079	0.388	0.949	0.554
Outpatient Dept Provider Visits	2.01	0.18	1.50	0.14	1.26	0.10	2.34	0.52	0.166	0.060	0.717	0.611	0.376	0.259
Outpatient Dept Physician Visits	0.73	0.07	0.70	0.09	0.69	0.07	0.63	0.05	0.787	0.841	0.682	0.967	0.808	0.866
Inpatient Hospital Discharges	0.35	0.02	0.33	0.04	0.30	0.04	0.25	0.02	0.723	0.648	0.237	0.788	0.401	0.720
Nights in Hospital for Discharges	1.72	0.15	2.57	0.29	1.45	0.13	1.97	0.08	0.158	0.728	0.817	0.236	0.617	0.689
Emergency Room Visits	0.49	0.03	0.56	0.04	0.31	0.04	0.40	0.03	0.333	0.072	0.314	0.034	0.138	0.472
2018														
Office-Based Provider Visits	17.46	0.41	14.73	1.70	14.32	0.85	18.78	2.24	0.126	0.475	0.672	0.930	0.240	0.400
Office-Based Physician Visits	9.80	0.22	9.34	1.11	7.04	0.38	10.77	1.95	0.689	<0.001	0.655	0.073	0.557	0.099
Outpatient Dept Provider Visits	2.26	0.16	2.03	0.30	1.19	0.11	2.48	0.11	0.556	0.001	0.776	0.088	0.579	0.116
Outpatient Dept Physician Visits	0.96	0.07	1.03	0.27	0.70	0.08	1.38	0.11	0.795	0.151	0.474	0.303	0.580	0.265
Inpatient Hospital Discharges	0.35	0.02	0.28	0.04	0.16	0.03	0.24	0.02	0.132	<0.001	0.260	0.041	0.736	0.406
Nights in Hospital for Discharges	1.77	0.16	1.39	0.30	0.61	0.09	1.29	0.14	0.253	<0.001	0.418	0.025	0.876	0.241
Emergency Room Visits	0.51	0.02	0.53	0.07	0.32	0.07	0.33	0.03	0.793	0.028	0.050	0.053	0.093	0.950
2019														
Office-Based Provider Visits	18.29	0.54	14.24	1.31	19.54	3.91	14.05	1.09	0.004	0.758	0.035	0.210	0.934	0.206
Office-Based Physician Visits	9.80	0.25	8.57	0.60	8.53	0.75	7.63	0.59	0.067	0.145	0.115	0.968	0.532	0.560
Outpatient Dept Provider Visits	2.60	0.15	2.16	0.27	1.41	0.17	2.80	0.29	0.252	0.000	0.802	0.125	0.475	0.106
Outpatient Dept Physician Visits	1.12	0.07	1.09	0.14	0.67	0.13	1.58	0.17	0.884	0.008	0.252	0.179	0.283	0.033
Inpatient Hospital Discharges	0.34	0.02	0.38	0.04	0.22	0.05	0.44	0.09	0.435	0.027	0.411	0.020	0.629	0.061
Nights in Hospital for Discharges	1.75	0.23	1.90	0.21	2.11	0.66	3.18	1.07	0.689	0.619	0.247	0.767	0.295	0.417
Emergency Room Visits	0.56	0.03	0.54	0.06	0.51	0.13	0.58	0.09	0.825	0.734	0.858	0.816	0.786	0.697
2020														
Office-Based Provider Visits	15.75	0.42	11.48	1.06	9.52	0.71	12.73	1.32	0.001	<0.001	0.153	0.146	0.576	0.147
Office-Based Physician Visits	8.40	0.23	7.21	0.51	5.54	0.36	6.98	0.73	0.044	<0.001	0.137	0.017	0.816	0.166
Outpatient Dept Provider Visits	2.79	0.18	1.71	0.28	1.50	0.20	2.90	0.32	0.001	0.000	0.893	0.607	0.157	0.110
Outpatient Dept Physician Visits	1.11	0.10	0.86	0.18	0.96	0.15	1.19	0.26	0.243	0.531	0.791	0.745	0.360	0.571
Inpatient Hospital Discharges	0.28	0.02	0.28	0.04	0.16	0.03	0.21	0.05	0.969	0.003	0.355	0.032	0.413	0.548
Nights in Hospital for Discharges	1.45	0.17	2.23	0.74	1.51	0.62	1.80	0.81	0.317	0.933	0.697	0.470	0.713	0.798
Emergency Room Visits	0.42	0.02	0.55	0.09	0.27	0.04	0.44	0.08	0.191	0.006	0.851	0.010	0.434	0.134

Note. M = mean, SD = standard deviation, IAP = Indigenous and Asian-Pacific, and MRR = Multiple Races Reported. For model significance, both the F-statistic and p-value were used. Tukey's was then ran post-hoc to determine specific significant groups.

Table 9

Results From a MANOVA Analysis to Investigate the Differences in Healthcare Expenditure Patterns for ADRD Patients

Variables	With ADRD		Without ADRD			Hispanic		Non-Hispanic		
	M	*SD*	*M*	*SD*	*p*	*M*	*SD*	*M*	*SD*	*p*
2016										
Total Healthcare Expenditure	$26,286	$2,714	$21,390	$863	0.054	$18,473	$1,698	$21,614	$913	<0.001
Out Of Pocket Expenditure	$1,942	$376	$2,036	$101	0.794	$957	$126	$2,112	$109	<0.001
Total Individual Income	$33,083	$2,736	$44,641	$1,065	0.001	$26,530	$1,705	$45,861	$1,120	<0.001
Family Income	$61,671	$5,379	$77,903	$2,060	0.009	$50,726	$2,980	$79,739	$2,169	<0.001
Family Income as % of Poverty Line	337%	29%	435%	11%	0.003	261%	15%	446%	11%	<0.001
2017										
Total Healthcare Expenditure	$23,430	$2,771	$20,580	$705	0.268	$17,039	$1,500	$20,846	$749	<0.001
Out Of Pocket Expenditure	$3,745	$925	$2,156	$133	0.001	$930	$110	$2,251	$144	<0.001
Total Individual Income	$26,408	$2,295	$45,789	$1,091	<0.001	$28,253	$1,770	$46,953	$1,149	<0.001
Family Income	$51,945	$4,522	$77,585	$1,919	<0.001	$56,229	$3,395	$78,993	$2,012	<0.001
Family Income as % of Poverty Line	276%	22%	434%	11%	<0.001	283%	15%	444%	11%	<0.001
2018										
Total Healthcare Expenditure	$27,494	$4,482	$21,311	$665	0.035	$23,371	$2,808	$21,174	$681	0.001
Out Of Pocket Expenditure	$4,398	$1,973	$2,448	$127	0.001	$1,312	$181	$2,542	$138	<0.001
Total Individual Income	$28,329	$2,761	$46,380	$1,050	<0.001	$27,079	$2,170	$47,800	$1,061	<0.001
Family Income	$63,679	$5,725	$80,445	$1,896	0.013	$52,173	$3,295	$82,557	$1,940	<0.001
Family Income as % of Poverty Line	329%	29%	445%	10%	0.001	273%	18%	458%	10%	<0.001
2019										
Total Healthcare Expenditure	$24,333	$2,892	$21,944	$652	0.370	$19,071	$1,743	$22,171	$675	<0.001
Out Of Pocket Expenditure	$3,812	$1,138	$2,521	$128	0.036	$1,361	$263	$2,614	$135	<0.001
Total Individual Income	$27,080	$2,697	$46,981	$1,010	<0.001	$22,685	$1,527	$48,742	$1,066	<0.001
Family Income	$76,212	$7,592	$82,819	$1,976	0.335	$49,384	$3,382	$85,323	$2,080	<0.001
Family Income as % of Poverty Line	377%	38%	457%	10%	0.027	250%	17%	472%	11%	<0.001
2020										
Total Healthcare Expenditure	$25,260	$3,303	$20,332	$654	0.109	$18,116	$1,816	$20,530	$691	0.001
Out Of Pocket Expenditure	$4,584	$1,836	$2,492	$224	0.021	$935	$104	$2,625	$246	<0.001
Total Individual Income	$37,808	$5,466	$46,502	$945	0.023	$26,097	$1,750	$48,111	$997	<0.001
Family Income	$89,514	$11,514	$80,761	$1,835	0.167	$57,155	$4,087	$82,696	$1,952	<0.001
Family Income as % of Poverty Line	444%	58%	451%	10%	0.818	283%	18%	465%	10%	<0.001

Note. M = mean, and SD = standard deviation. For model significance, both the F-statistic and p-value were used.

Table 10

Results From a MANOVA Analysis to Investigate the Differences in Healthcare Expenditure Patterns for ADRD Patients (cont.)

Variables	White		Black		IAP		MRR		White vs Black	White vs IAP	White vs MRR	Black vs IAP	Black vs MRR	IAP vs MRR
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*p*	*p*	*p*	*p*	*p*	*p*
2016														
Total Healthcare Expenditure	$21,677	$968	$21,551	$1,623	$14,466	$999	$23,809	$1,810	0.953	0.001	0.641	0.005	0.637	0.065
Out Of Pocket Expenditure	$2,186	$115	$1,097	$107	$934	$107	$1,270	$206	<0.001	<0.001	0.021	0.360	0.592	0.304
Total Individual Income	$46,507	$1,184	$30,634	$1,840	$33,060	$2,450	$37,468	$3,780	<0.001	0.000	0.090	0.538	0.215	0.480
Family Income	$80,074	$2,259	$54,419	$2,591	$77,540	$4,636	$69,613	$7,782	<0.001	0.744	0.367	0.003	0.198	0.539
Family Income as % of Poverty Line	451%	12%	290%	14%	371%	24%	366%	43%	<0.001	0.028	0.150	0.026	0.202	0.937
2017														
Total Healthcare Expenditure	$20,059	$585	$22,326	$1,875	$27,823	$1,877	$21,727	$1,340	0.352	0.477	0.665	0.622	0.894	0.596
Out Of Pocket Expenditure	$2,289	$153	$1,403	$116	$1,088	$150	$1,883	$535	<0.001	<0.001	0.505	0.177	0.429	0.203
Total Individual Income	$47,484	$1,200	$32,336	$1,371	$37,846	$1,819	$36,174	$674	<0.001	0.007	0.012	0.147	0.405	0.758
Family Income	$79,721	$2,135	$52,639	$2,074	$83,305	$3,258	$62,069	$2,630	<0.001	0.660	0.027	<0.001	0.247	0.033
Family Income as % of Poverty Line	450%	12%	289%	12%	399%	15%	341%	10%	<0.001	0.142	0.008	0.001	0.207	0.233
2018														
Total Healthcare Expenditure	$21,783	$723	$21,777	$3,021	$11,830	$877	$18,843	$1,352	0.999	<0.001	0.354	0.004	0.497	0.036
Out Of Pocket Expenditure	$2,613	$147	$1,631	$131	$1,212	$175	$1,175	$156	0.001	<0.001	<0.001	0.196	0.139	0.890
Total Individual Income	$48,428	$1,201	$30,206	$1,695	$32,333	$3,358	$45,417	$1,778	<0.001	<0.001	0.610	0.603	0.014	0.050
Family Income	$83,016	$2,131	$50,772	$3,026	$85,896	$7,068	$70,000	$3,017	<0.001	0.756	0.159	0.000	0.049	0.213
Family Income as % of Poverty Line	463%	11%	282%	16%	386%	29%	409%	17%	<0.001	0.032	0.308	0.005	0.023	0.702
2019														
Total Healthcare Expenditure	$21,872	$708	$23,223	$1,657	$20,899	$2,355	$22,666	$1,884	0.480	0.731	0.842	0.465	0.896	0.706
Out Of Pocket Expenditure	$2,633	$147	$1,387	$138	$2,731	$699	$2,004	$197	<0.001	0.907	0.081	0.103	0.082	0.395
Total Individual Income	$48,905	$1,112	$35,488	$1,842	$34,046	$2,844	$34,561	$2,532	<0.001	<0.001	0.000	0.685	0.825	0.914
Family Income	$84,932	$2,254	$58,355	$2,968	$95,790	$9,349	$59,498	$4,852	<0.001	0.305	0.001	0.001	0.887	0.005
Family Income as % of Poverty Line	473%	12%	323%	16%	420%	27%	337%	25%	<0.001	0.127	0.001	0.008	0.738	0.096
2020														
Total Healthcare Expenditure	$20,230	$694	$21,214	$2,932	$18,258	$1,814	$27,320	$5,063	0.749	0.393	0.317	0.431	0.457	0.211
Out Of Pocket Expenditure	$2,627	$231	$1,284	$166	$2,588	$1,293	$1,621	$118	<0.001	0.976	0.035	0.338	0.415	0.503
Total Individual Income	$48,264	$1,042	$32,817	$1,742	$38,067	$2,800	$41,723	$2,526	<0.001	0.004	0.163	0.163	0.094	0.513
Family Income	$83,342	$1,975	$53,292	$2,860	$86,325	$8,396	$68,488	$5,326	<0.001	0.733	0.089	0.000	0.097	0.135
Family Income as % of Poverty Line	468%	11%	304%	16%	419%	28%	387%	22%	<0.001	0.133	0.081	0.001	0.080	0.538

Note. M = mean, SD = standard deviation, IAP = Indigenous and Asian-Pacific, and MRR = Multiple Races Reported. For model significance, both the F-statistic and p-value were used. Tukey's was then ran post-hoc to determine specific significant groups.