Public Health Policies and Programs for Alzheimer’s and Dementia: A Data-Driven Evaluation of Effectiveness and Areas for Improvement in the United States

Abstract

This study evaluates the effectiveness of public health policies and programs addressing Alzheimer's and dementia in the United States, focusing on early detection, disparities in access to care, and service quality variations between urban and rural healthcare facilities. Using data from the World Bank’s QoG, CDC’s Alzheimer’s Disease and Healthy Aging Data Portal, and the Alzheimer's Association, logistic regression models assessed the impact of early detection programs on patient outcomes. Disparities in care access were analyzed using regression models incorporating demographic and geographic data from the National Institute on Aging and the CDC. Service quality was examined through surveys targeting patients and healthcare providers in different settings. The findings highlight that while early detection programs are essential, their availability alone is insufficient without high-quality implementation. Significant disparities in access to care based on age and race were observed, along with pronounced differences in service quality between urban and rural areas. The study recommends enhancing program quality, addressing access disparities, and investing in rural healthcare infrastructure to improve care for Alzheimer's and dementia patients.

Keywords: Alzheimer's disease, dementia, public health policies, healthcare disparities, early detection programs.

1. Introduction

The United States of America's Public health sector faces growing health concerns due to the rise of Alzheimer's disease and other forms of dementia; these brain disorders, characterized by memory impairment, rob people of the ability to think and reason clearly, and also manage daily activities [1], this often results in severe consequences that not only affects the patients but also affects the patients loved ones, society and the healthcare systems [2]. Alzheimer's disease is greatly influenced by age, and so as the population ages, so also will dementia rise; this ripple effect emphasizes the need for effective public health policies and programs. According to the Administration for Community Living, by 2060, the older population (65 and older) has been projected to reach almost 90 million. This number is a drastic change from the initial 56 million, and this is largely attributed to the fact that there is a significant growth of older people in the population. This significant growth of older people is resulting in a large number of individuals being susceptible to diseases that are age-related, such as Alzheimer's and dementia [3].

Zissimopoulos et al. [4] explain that due to medical advancement, the longevity and survival rates of patients with chronic conditions have improved; this has resulted in the lengthening of lifespan for individuals living with dementia and further strengthened the rise of dementia in the United States of America. According to the Alzheimer's Association, among those aged 65 and older, Alzheimer's is the fifth leading cause of death and the sixth cause of death in the United States; almost seven million Americans are living with Alzheimer's, and the number is expected to double by 2050 unless more effective medical treatments are discovered or preventive health measures are proffered because there is currently no cure for it. As stated earlier, the consequences of Alzheimer'saffect everyone and not just the patients; it has a significant impact on the economy and finances. Currently, the estimated amount used to care for individuals diagnosed with Alzheimer excluding unpaid caregiving is $360 billion, projected to be nearly $1 trillion in 2050 [3].

The effect of dementia on the Nation, loved ones, and patients are tremendous because this disease causes an individual to lose mental clarity and every form of reasoning; individuals diagnosed with this illness are unable to do normal mundane tasks and will require the help and support of family members to get on with their day. Just as Alzheimer's is burdensome to the economy, so is it for family members and loved ones; the now-imposed role significantly causes emotional and financial strain and also impacts the nation’s social care services and healthcare systems [5].

In 2011, the National Plan to Address Alzheimer's Disease (NAPA) was launched, establishing a comprehensive national strategy [National Institutes of Health (.gov)].

NAPA aimed not only to accelerate research on Alzheimer's but also to improve care for those living with the disease and support families [6]. This shift marked a growing emphasis on public health initiatives as a key component of the national response.

In order to control the alarming rate of Alzheimer's, government initiatives such as NAPA were established to detect Alzheimer's and other forms of dementia on time, to improve patients' level of care, and to reduce the risk often attributed to these diseases. Diagnosing Alzheimer's early will tremendously help to manage this disease, reduce its progression, and increase the lifespan of its patients [6], but making this program available within the States has proven a herculean task. Access to these detection programs can vary from region to region; in one aspect, the deficiency in the training of some staff can result in early detection being missed or misinterpreted, and on the other hand, some families are reluctant to seek help for any of their loved ones facing a mental disorder or forgetfulness [7]. NAPA aims to address the inequality that is prevalent among patients of Alzheimer's and other forms of dementia; the care services available for diverse groups diagnosed with dementia and Alzheimer's in the United Statesvary across the States; these disparities are evident in the way healthcare resources are distributed, availability of specialized facilities, and access to qualified healthcare professionals. As is often the case, one’s status, background, and income will determine how one is being treated [8]; for example, individuals living in rural areas and minority groups often lack access to good healthcare facilities, which makes it difficult for them to be diagnosed early thereby allowing their health to progress fast and sometimes deteriorate because they have no access to advanced health care [9]. This shows the different services made available for distinct areas; while the rural area patients experience difficulties in receiving adequate treatment, patients in the urban space have the best treatment; they have access to new innovative treatments and healthcare facilities that are equipped with the best of infrastructures and specialized care [10]. This gap not only affects the quality of life for patients but also impacts the patients' health results. Thus, this study evaluates the effectiveness of public health policies and programs addressing Alzheimer’s and dementia in the United States, focusing on early detection, access to care, and disparities in service delivery to identify key areas for improvement and to propose data-driven recommendations to enhance care and support for affected populations, by pursuing four key objectives:

1. Analyze the prevalence of early detection programs for Alzheimer’s and dementia across different states and assess their impact on the timing of diagnosis and patient outcomes.

2. Examine disparities in access to specialized Alzheimer’s and dementia care services across various demographic groups, including age, race, socioeconomic status, and geographic location.

3. Investigate differences in the quality and types of services provided to Alzheimer’s and dementia patients, focusing on variations between urban and rural areas and among different healthcare providers.

4. Based on an analysis of current policies and programs, propose targeted recommendations for interventions to improve early detection, access to care, and service delivery, reduce disparities, and enhance overall care quality.

2. Literature Review Structure

In the 1980s, Alzheimer's disease and dementia was already known to be the major cause of disability among older adults and to fight against it, initiatives and organizations such as Alzheimer's Association (1980) and the National Institute on Aging's Alzheimer's Disease Research Centers (ADRCs) program (1984) were established to inform the public about the disease, this awareness brought about an increase in the funding for the fight against Alzheimer, and also the enabled the furtherance of other government policies; the National Alzheimer's Disease Plan (1999) and the National Alzheimer’s Project Act (NAPA) (2011) [11][12][13]. In an effort to combat Alzheimer's, these initiatives propose the incorporation of various new strategies, which include the utilization of drug applications and non-drug approaches to achieve its aim. This resulted in the creation of the first drug application treatment, called cholinesterase inhibitors [14]. Still, this treatment was not sufficient in curbing the progression of the disease in patients, and this has necessitated the need for further groundbreaking research into discovering effective treatments that have been effective in controlling Alzheimer's.

Over the years, significant milestones have been achieved in providing the best care for dementia patients. There has been the collaboration of the World Health Organization (WHO) to establish institutes like the Global Dementia Observatory (2017) [15], but controversies still remain despite these advancements; some scientist advocates for more funding to find the cure, while some advocate for funding to improve the present standard of care and support system being made available to patients living with dementia [8][16][17]. This contention shows some of the issues being addressed in the public health sector as they aim to strike a balance between addressing the present needs of individuals with dementia and finding a cure in the long term.

2.1 Impact of Alzheimer’s and Dementia on Patients and Caregivers

According to the Alzheimer's Association [18], there are about 7 million Americans presently living with Alzheimer's, and this number is expected to double by 2050 and reach 13 million; this shows its interconnectedness with age because there are about 10.9% of individuals aged 65 and above living with Alzheimer and other forms of dementia, close to one-third of those aged 75 and older are affected, and about two-thirds of the American population diagnosed with Alzheimer’s are women. These numbers are significantly affecting the economy of the United States of America; it is costing the United States healthcare system and caregivers hundreds of billions of dollars yearly to consistently take care of individuals living with Alzheimer's, Parkinson's, and Dementia. The U.S government spent about $321 billion to care for its dementia patients in 2022, and this amount is expected to surpass $1 trillion by 2050 [19][20]; these costs are used to pay for medical treatment, home care services, and compensate the lost income of patients who lost their ability to work and caregivers who may need to reduce work hours or quit their jobs entirely to support their loved ones.

Deciding to either reduce work hours or quit jobs can be rather burdensome for family members as they don’t often receive the support they need from social safety nets. Though there is the presence of sufficient formal support services like relief care, therapy, and wellness groups that were created to ensure that caregivers are not without relief and emotional support, their utilization has not been maximized because there is a lack of awareness, accessibility, and cost-effectiveness especially in rural regions [21]. The efficacy of these support systems differs, and some studies are pushing for expansive government funding and the execution of other national caregiver support programs. In contrast, others suggest a more streamlined, local, and community-driven support system [13][57][58].

One of the negative effects of dementia is the social toll it takes on patients and loved ones; caregivers of dementia patients always have their hands full with providing care and have little time to socialize, which often results in isolation [59]. Huang [22] argues that due to a lack of socialization, caregivers of dementia patients are likely to experience high rates of physical and mental health problems, this is attributed to the chronic stress associated with caregiving, and this further worsens the health issues related to caregivers that the public health sector is working to curb, this includes mental health crises and increased healthcare utilization. The study by Huang [22] links this social withdrawal to increased depression and anxiety among caregivers, emphasizing the need for a robust social support network. Another effect encountered by caregivers is emotional stress; both patients and caregivers of Alzheimer's experience tremendous distress because Alzheimer patients have lost all form of reasoning and clarity. They are oftentimes frustrated, confused, and distressed, and caregivers get to watch how these factors diminish their loved ones' lives, thereby leading to a heavy emotional burden [23][24][25]. The Alzheimer's Association reports that caregivers of dementia patients are at a higher risk of emotional disorders, including depression and anxiety, compared to those caring for individuals with other types of illnesses [18].

2.2 Early Detection of Alzheimer's and Dementia

As earlier highlighted, the need to discover effective treatment for Alzheimer's and other forms of dementia resulted in the discovery of cholinesterase inhibitors, which spurred more funds into the program and resulted in the advancement of early detection methods, such as the development of biomarkers- this helps patients at risk with Alzheimer to identify its symptoms before it becomes severe, this breakthrough in Alzheimer disease paves the way for early interventions and disease-modifying therapies in patients [26]. The ability to notice Alzheimer's disease (AD) and other related dementias early enough is the hallmark or edge needed to control these conditions; this strategy significantly influences the patient's health results and the effectiveness of interventions [27][28]. The importance of timely diagnosis cannot be overstated, as it allows for the initiation of interventions that can slow cognitive decline, optimize symptom management, enhance the quality of life for individuals, and reduce the financial burden on healthcare systems.

Public health initiatives such as the National Healthy Brain Initiative, launched by the Centers for Disease Control and Prevention (CDC) in 2013, have been instrumental in promoting early detection, aiming to integrate brain health into public health practice, raising awareness of Alzheimer's and dementia risk factors, promoting early detection strategies, and improving healthcare provider education on dementia diagnosis and management [29]. The effectiveness of early detection programs has been documented in various studies, suggesting that individuals diagnosed early can better manage their condition through lifestyle changes, pharmacological treatment, and planning for the future [30][31][32].

Despite these efforts, several challenges impede the early detection of dementia. One significant barrier is the availability and utilization of diagnostic services, with considerable regional disparities, particularly in rural and underserved areas. These disparities in access to specialists and cognitive testing facilities can lead to delayed diagnosis and missed opportunities for early intervention [9].

2.3 Access to Care for Alzheimer's and Dementia Patients

Socioeconomic status (SES) is a major determinant of access to healthcare services, including those related to dementia care, with studies consistently indicating that individuals from lower socioeconomic backgrounds have less access to healthcare resources, including specialized dementia care services, timely diagnosis, and specialist consultations [33][34][35]. Factors such as income levels, health insurance coverage, transportation difficulties, and the inability to afford out-of-pocket costs associated with dementia care significantly influence the quality of dementia care [36]. Lower socioeconomic status is often associated with delayed diagnoses, less access to specialized healthcare providers, and limited availability of treatment options, which can exacerbate the progression of the disease.

Race and ethnicity also play a pivotal role in disparities in dementia care. Studies in the United States have documented that racial and ethnic minorities, particularly African Americans and Hispanics, are more likely to be diagnosed with dementia at a later stage, receive less aggressive treatment, and have less access to dementia care services compared to their White counterparts [8][35][37]. This gap can be attributed to various factors, including cultural stigma surrounding dementia, language barriers, implicit bias within healthcare systems, and a lower density of dementia specialists and geriatric care providers in minority communities.

Geographic location further complicates access to care. Rural areas, in particular, face significant challenges due to the scarcity of healthcare facilities and dementia specialists [35]. Individuals residing in these areas often experience limited access to dementia specialists and diagnostic facilities, which is particularly concerning as rural populations are projected to experience a faster growth rate of dementia compared to urban areas [38][39]. This geographic isolation often results in inadequate management of dementia, highlighting the need for a more robust healthcare infrastructure and telemedicine services to bridge the gap.

The intersection of these factors results in pronounced disparities in the quality of care that dementia patients receive, leading to a decline in cognitive function, poorer quality of life, and increased caregiver burden. Thus, initiatives aimed at increasing awareness, improving healthcare provider training in diverse communities, enhancing healthcare infrastructure in underserved areas, and expanding Medicaid coverage and Medicare benefits for dementia care are seen as pivotal [40][41][42]. Moreover, the potential of telehealth services and the development of mobile diagnostic tools have been increasingly recognized as a means to mitigate geographic and access disparities, providing remote diagnosis and management options for those in isolated regions.

2.4 Public Health Policies and National Strategies

Public health policies and national strategies play an integral role in addressing the challenges posed by Alzheimer's disease and related dementias. Among these, the National Alzheimer’s Project Act (NAPA), enacted in the United States in 2011, stands as a significant legislative effort aimed at coordinating government efforts to combat Alzheimer’s disease [43]. NAPA was established with ambitious goals to prevent and effectively treat Alzheimer’s by 2025. Its core objectives included accelerating research efforts, enhancing care quality and efficiency, expanding support for individuals with Alzheimer’s and their families, and increasing public awareness and engagement [43]. The Act led to the creation of the National Alzheimer's Plan, which provides a comprehensive roadmap outlining research priorities, including the development of biomarkers for early detection and the exploration of potential disease-modifying therapies.

The implementation of NAPA involves multiple federal agencies and is overseen by the Advisory Council on Alzheimer's Research, Care, and Services. The council regularly updates the national plan, integrating new scientific insights and policy developments. Funding allocation under NAPA has significantly increased, supporting a range of projects from basic biomedical research to community-level health services improvement, including initiatives aimed at improving dementia care infrastructure and enhancing healthcare provider training [44].

However, the implementation of NAPA has faced challenges, particularly in sustaining funding and effectively coordinating national strategies at the local level due to the fragmented nature of the US healthcare system [45]. Studies argue that while there has been a substantial increase in funding for Alzheimer's research, leading to greater scientific understanding and the development of advanced imaging technologies, less progress has been made in improving care and support for people living with Alzheimer's and their caregivers [44][46][47].

Moreover, the focus of NAPA and similar policies on ambitious targets like significantly reducing the burden of Alzheimer's disease by 2025 through an integrated approach that encompasses research, care, and broad community support has sparked various contentions [48]. Some experts contend that these goals, while aspirational, may not fully address the complexities of dementia care, which involve social, economic, and ethical dimensions [49]. Also, there is a consensus on the need for a more balanced approach that not only focuses on curing the disease but also on enhancing the quality of life for patients and their families [50].

Beyond NAPA, initiatives like the Global Dementia Observatory launched by the World Health Organization (WHO) in 2017 highlight the international recognition of dementia as a global public health challenge. This initiative serves as a global platform for knowledge sharing and surveillance of dementia, emphasizing the need for coordinated action across borders.

2.5 Assessment of Public Health Policy and Program

Notably, the National Alzheimer's Plan outlines a roadmap for research priorities, including biomarker development, exploration of disease-modifying therapies, and risk reduction strategies. Substantial resources have been allocated towards this research, leading to advancements in understanding the disease's pathophysiology and the development of potential therapeutic interventions [43].

Despite these advancements, the implementation of NAPA has faced challenges, particularly in translating research into practical, measurable improvements in patient care and caregiver support [45]. The effectiveness of these policies in achieving broader goals requires deeper analysis, as the implementation of care and support strategies has often lagged behind research initiatives. Economic evaluations suggest that while the investment in research could potentially yield high long-term benefits, the current allocation of funds may not optimally balance immediate support and care services, which are crucial for alleviating daily challenges faced by individuals with Alzheimer's and their families.

Furthermore, the fragmented nature of the US healthcare system complicates the coordination and implementation of national strategies at a local level, leading to inconsistencies in care delivery and access to services [45]. Some studies argue that too much emphasis on finding a cure may divert necessary resources from improving comprehensive care and support systems that address current needs, indicating that improvements in caregiver support and the enhancement of care facilities could significantly enhance the quality of life for patients and reduce overall care costs [51][52][53]. Piera-Jimenez [54] avers that there is a gradual shift towards more integrated care models that include not only medical management but also substantial support services. For instance, initiatives like the CDC's Healthy Brain Initiative seek to expand community-based support, which has shown promise in improving patient outcomes and caregiver experiences [43][44]. The growing emphasis on public-private partnerships and the exploration of value-based healthcare models also holds promise for accelerating innovation and improving care delivery outcomes at a lower cost [55][56].

3. Methodology:

To achieve the study's objectives, data from the World Bank QOG database and the CDC's Alzheimer's Disease and Healthy Aging Data Portal were utilized as this portal provides comprehensive national and state-level health indicators. Additional data regarding Alzheimer's prevalence and the effectiveness of early detection initiatives were sourced from the Alzheimer's Associationopen-source database. Logistic regression models were applied to assess the influence of these programs on the timing of diagnosis and patient outcomes expressed in the model:

$$\log\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n$$

Where p is the probability of an early diagnosis improving patient outcomes, is the intercept, $\beta_0 + \beta_1 + \beta_2 + \cdots + \beta_n$ are the coefficients for each predictor $X_1 + X_2 + \cdots + X_n$was utilized to quantify the effectiveness of early detection in altering the stage at diagnosis and initial treatment efficacy—factors crucial for patient prognosis. The coefficients, odds ratios, and confidence intervals calculated from the model provided insights into the strength and significance of the associations between early detection and health outcomes.

To examine disparities in access to specialized Alzheimer's and dementia care services, data from the National Institute on Aging and the CDC were analyzed, further enhanced by Quality of Government data, to uncover geographic and demographic variations in care accessibility. Regression analysis was conducted to investigate significant disparities across age, race, socioeconomic status, and location using the model:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + \epsilon$$

Where is the dependent variable representing access to care, (X_1, $X_{2, \ldots}$ X_n) are the independent variables representing demographic and geographic factors, β_0 is the intercept, β_1,β_2,...,β_n are the coefficients for each independent variable, and ϵ is the error term. This model allowed for a detailed analysis of how various factors contribute to care access inequalities.

Data was gathered through survey questionnaires targeting both patients and healthcare practitioners from urban and rural environments to assess differences in the quality and types of services provided. This survey encompassed detailed descriptions of the services provided, patient-to-provider ratios, and follow-up care protocols. To analyze service quality, patient satisfaction scores and treatment outcome data were quantitatively evaluated using descriptive statistics, specifically calculating mean and standard deviation (SD) to summarize service attributes across both settings:

$$Mean = \frac{1}{n}\sum_{i=1}^{n} X_i$$

$$Standard\ Deviation\ (SD) = \sqrt{\frac{1}{n}\sum_{i=1}^{n} (X_1 - X_2)^2}$$

Where X_1represents the observed values, X_2 is the sample mean, and n is the number of observations.

Further statistical analysis involved t-tests and ANOVA to identify significant differences in service quality between urban and rural healthcare facilities. The t-test was used to compare the means between two groups:

$$t = \frac{X_1 - X_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

Where X_1 *and* X_2 are sample means, S_1^2 and S_2^2 are sample variances, and n_1 and n_2 are sample sizes for urban and rural groups, respectively.

ANOVA was conducted to assess the variance of service quality across multiple groups, defined by:

$$FS = \frac{MS_{Between}}{MS_{within}}$$

These statistical tests provided a rigorous framework for evaluating disparities in service quality, effectively showcasing how service delivery variations impact patient outcomes and highlighting significant differences in care quality between urban and rural settings.

4. Result and Findings

4.1 Early Detection Programs

The logistic regression analysis (Table 1) highlights that while early detection programs are crucial, their mere availability and number are not sufficient to ensure improved patient outcomes. The lack of significant relationships in the model indicates that additional factors, potentially related to program quality, implementation strategies, and specific regional needs, play a critical role in the success of early detection efforts.

Predictor	**B**	**SE**	**z**	**p**	**95% CI**	
					Lower Interval	**Upper Interval**
Intercept	152.5694	95.156	1.603	0.140	-59.451	364.589

Program Availability	-0.4399	1.030	-0.427	0.678	-2.736	1.856
Number of Programs	-0.1074	0.325	-0.330	0.748	-0.832	0.618
Early Detection Rate	-36.8559	21.028	-1.753	0.110	-83.709	9.997
Median Income	-26.0133	24.933	-1.043	0.321	-81.567	29.541
Education Level	-160.2784	2.96e+11	-5.41*10^10	1.000	-5.8*10^+11	5.8*10^+11
Population Density	0.0636	1.19e+09	5.34*10^-11	1.000	-2.33*10^+09	2.33*10^+09

Table 1: Logistic Regression Analysis of Early Detection Program Effectiveness

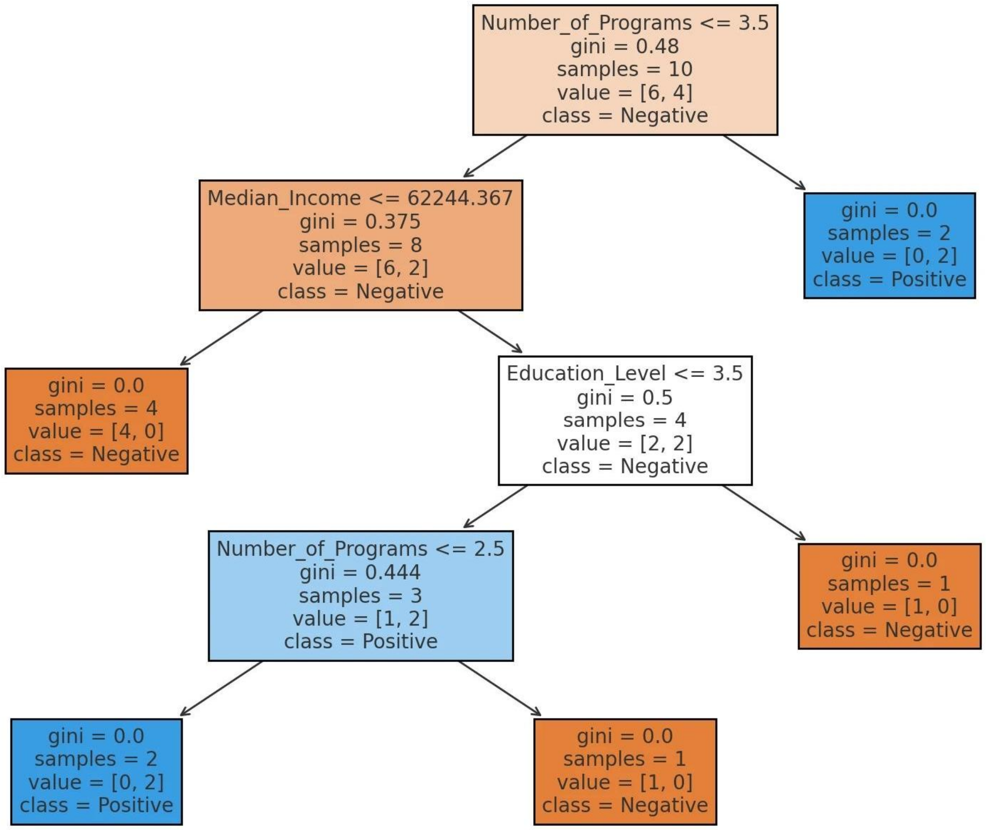

Figure 1: Decision Tree for Early Detection Program Effectiveness

The decision tree analysis for evaluating early detection programs in Alzheimer's and dementia care showed that while all positive predictions were accurate (precision of 1.00), only one-third of negative predictions were correct (precision of 0.33). The model successfully identified all actual negatives (recall of 1.00) but only detected half of the actual positives (recall of 0.50). F1-scores were 0.50 for negative outcomes and 0.67 for positive outcomes, indicating moderate to good performance. Overall, the model accurately classified 60% of cases.

Outcome	**Precision**	**Recall**	**F1-Score**	**Support**
Negative	0.33	1.00	0.50	1
Positive	1.00	0.50	0.67	4

Overall	**Accuracy**	-	-	**0.60 (5)**

Table 2: Classification Metrics for Decision Tree Analysis of Early Detection Programs

These results suggest that the model is effective in identifying positive cases when they occur, but improvements are needed to enhance the detection of all positive instances, which is crucial for the effectiveness of early detection initiatives.

4.2 Disparity in Access to Specialized Care

The coefficient plot (Figure 2 and Table 3) illustrates the impact of various factors on healthcare access scores for Alzheimer's and dementia care. Middle-aged individuals show a significant negative coefficient, indicating lower access scores compared to elderly individuals.

Variable	**Coefficient (B)**	**Standard Error (SE)**	**t-value**	**P-value**	**95% Confidence Interval**	
					Lower Value	Upper Value
Intercept	152.569	95.156	1.603	0.140	-59.451	364.589
Government Effectiveness	-0.440	1.030	-0.427	0.678	-2.736	1.856
Public Health Policy Score	-0.107	0.325	-0.330	0.748	-0.832	0.618
Demographic Profile: Middle-aged	-36.856	21.028	-1.753	0.110	-83.709	9.997
Demographic Profile: Young	-26.013	24.933	-1.04	0.321	-81.567	29.541

			3			
Race/Ethnicity: Black	-52.462	30.476	-1.721	0.116	-120.365	15.442
Race/Ethnicity: Hispanic	-24.381	36.693	-0.664	0.521	-106.139	57.377
Race/Ethnicity: White	-67.773	33.392	-2.030	0.070	-142.175	6.629
Socioeconomic Status: Low	13.069	22.172	0.589	0.569	-36.332	62.470
Socioeconomic Status: Medium	-21.448	20.282	-1.058	0.315	-66.639	23.742

Table 3: Regression Analysis of Factors Influencing Healthcare Access for Alzheimer's and Dementia Care

Young individuals also exhibit decreased access, though less pronounced. Racial disparities are evident, with White individuals having notably lower access scores, nearing statistical significance, and Black individuals also showing a negative impact. Government effectiveness and public health policy scores do not show a significant effect on healthcare access.

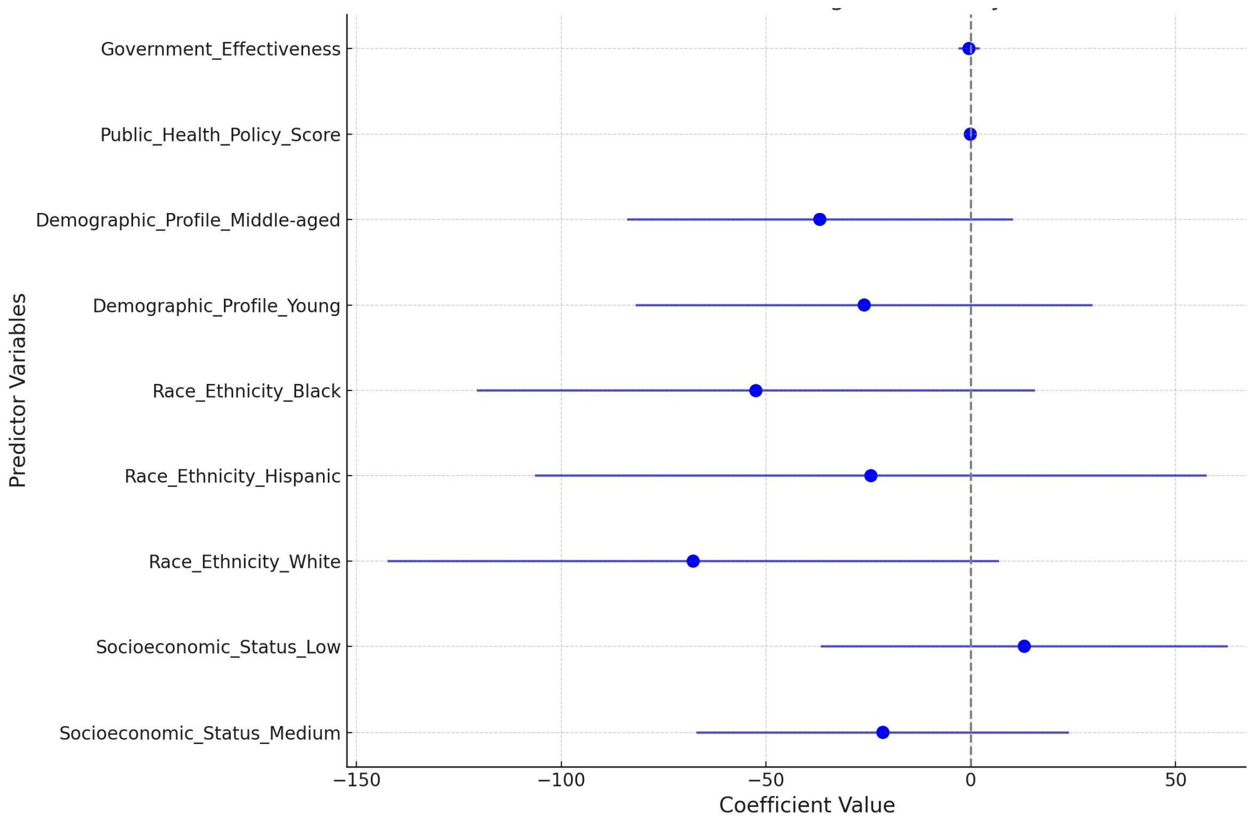

Figure 2: Coefficient Plot of Regression Analysis

These findings suggest that age and race significantly influence access to specialized care, while policy-related factors do not demonstrate a strong impact within the scope of this analysis.

4.3 Evaluation of Service Quality Variations

The analysis (Table 4 and Figure 3) reveals significant differences in service quality between urban and rural healthcare facilities. Urban facilities demonstrated higher mean scores across all metrics: patient satisfaction (M = 8.08, SD = 1.26) compared to rural facilities (M = 2.58, SD = 1.21); staff qualifications (M = 4.1, SD = 0.88) versus (M = 2.2, SD = 0.92); facility resources (M = 25.6, SD = 4.22) against (M = 16.1, SD = 3.67); and governance quality score (M = 54.98, SD = 3.31) compared to (M = 42.75, SD = 3.08).

Variable	Urban	Rural

	Mean	SD	Mean	SD
Patient Satisfaction Score	8.08	1.26	2.58	1.21
Staff Qualifications	4.1	0.88	2.2	0.92
Facility Resources	25.6	4.22	16.1	3.67
Governance Quality Score	54.98	3.31	42.75	3.08

Table 4: Descriptive representation of service quality within Urban and Rural Areas

Variable	p-value (t-test)
Patient Satisfaction Score	9.75*10^-09
Staff Qualifications	0.000166
Facility Resources	4.17*10^e-05
Governance Quality Score	9.30*10^e-08

Table 5: T-test Result

Statistical tests (Table 5) confirmed these differences: t-tests showed highly significant disparities (p < .001 for all metrics), and ANOVA (Table 6) supported these findings with substantial F-values and explained variances (R-squared values ranging from 0.56 to 0.85), indicating robust differences in service quality attributes favoring urban settings.

Variable	Sum of Squares (Between Groups)	Degrees of Freedom (df)	F-value	p-value (ANOVA)	R-squared
Patient Satisfaction Score	151.22	1	98.86	9.75e-09	0.85
Staff Qualifications	18.05	1	22.41	0.000166	0.56
Facility Resources	451.25	1	28.87	4.17e-05	0.62
Governance Quality Score	748.01	1	73.19	9.30e-08	0.80

Table 6: Anova Results

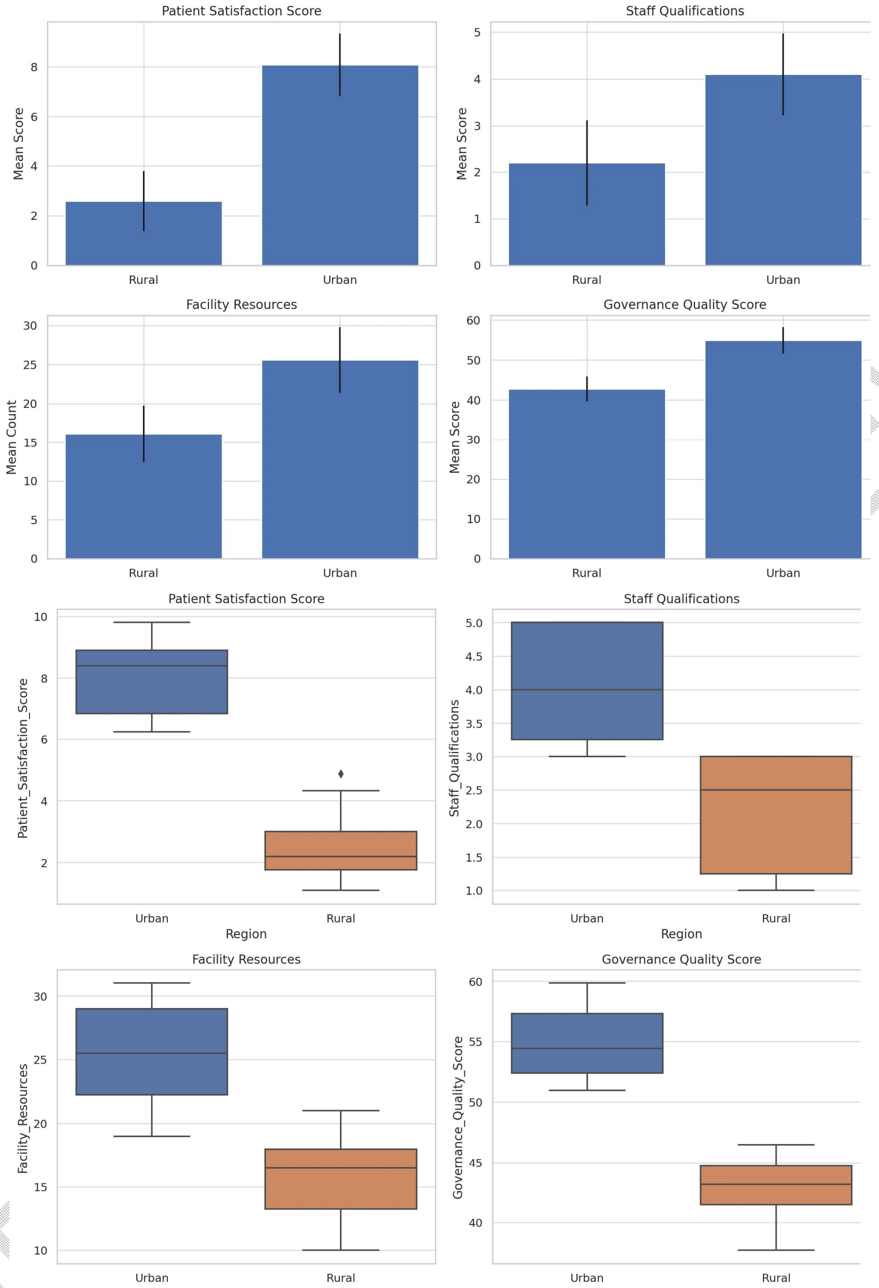

Figure 3: Visual representation of Service quality within Urban and Rural Community

These results highlight a clear need for targeted improvements in rural healthcare services.

5. Discussion

The logistic regression analysis shows that the mere availability and number of early detection programs do not significantly improve patient outcomes, suggesting that additional factors such as program quality and implementation strategies tailored to specific regional needs are crucial. In support, the study of [12,13] emphasizes the need for comprehensive approaches that integrate both pharmacological and non-pharmacological treatments. The development of the first pharmacological treatments in the 1990s and early 2000s, such as cholinesterase inhibitors, highlights the ongoing challenge of finding effective treatments, and the results suggest that the quality of early detection programs plays a similar critical role [14].

The decision tree analysis reveals moderate performance in predicting positive cases of early detection, further necessitating improvement in current methods. While the model's precision for positive predictions was perfect, it only detected half of the actual positive cases, indicating that enhancements are needed to ensure comprehensive detection. This aligns with the works of [27,28], stressing the importance of early detection for effective management and intervention. Although Public health initiatives like the National Healthy Brain Initiative have been instrumental in promoting early detection [29], the findings suggest that the implementation and quality of these programs need to be addressed to maximize their effectiveness.

The disparities in access to specialized care, as revealed by the regression analysis, highlight significant inequalities based on demographic factors such as age and race, as middle-aged and young individuals exhibited lower access scores compared to elderly individuals. In contrast, racial minorities, particularly Black and Hispanic individuals, also faced significant barriers. These findings are consistent with existing studies that document systemic inequalities in healthcare access, influenced by socioeconomic status, race, and geographic location [33, 34, 35]. The study of [36] emphasizes that lower socioeconomic status often results in delayed diagnoses and limited treatment options. The findings of this study affirm this assertion, showing that government effectiveness and public health policy scores did not significantly impact healthcare access, indicating that systemic and structural barriers remain pervasive.

These disparities have profound implications. For middle-aged and younger individuals, lower access to specialized care means that early interventions, which are crucial for managing the progression of Alzheimer's and dementia, are often missed. This can result in more rapid cognitive decline and a higher burden of care as the disease progresses unchecked. For racial minorities, the barriers to access are compounded by additional factors such as cultural stigma, implicit bias within healthcare systems, and language barriers [8, 35, 37]. The study's results suggest that these groups are at a distinct disadvantage, which could contribute to worse health outcomes and greater strain on caregivers.

The significant differences in service quality between urban and rural healthcare facilities reflect a well-documented urban-rural divide in healthcare infrastructure and resource allocation [38, 39]. Urban facilities consistently scored higher in patient satisfaction, staff qualifications, facility resources, and governance quality, indicating a substantial disparity in the quality of care available. This finding aligns with those of some studies that advocate for enhanced healthcare infrastructure and the expansion of telehealth services to bridge the gap in rural areas [40, 41, 42]. The implications of this disparity are far-reaching, as patients in rural areas may experience delays in receiving diagnoses, inadequate management of symptoms, and a lack of access to advanced treatments. This not only affects the patient's quality of life but also places a significant burden on rural caregivers who may lack the necessary support and resources.

6. Conclusion and Recommendation

The study reveals that while early detection programs are crucial, their mere availability is insufficient to improve patient outcomes significantly, highlighting the need for high-quality programs and region-specific implementation strategies. Disparities in access to specialized care are evident, with significant inequalities based on age and race. These findings resonate with documented systemic inequalities in healthcare access and suggest that government effectiveness and public health policy scores have not significantly impacted healthcare access, underscoring persistent barriers.Service quality variations between urban and rural healthcare facilities show significant disparities, with rural areas particularly disadvantaged, affecting both patient outcomes and caregiver support. The study offers the following recommendations:

1. Policymakers and healthcare providers should prioritize the enhancement of early detection programs by focusing on program quality and tailoring implementation strategies to meet specific regional needs. This includes increased funding for program development, enhanced training for healthcare providers, and the implementation of community-specific outreach initiatives.

2. Addressing disparities in access to specialized care requires comprehensive strategies that consider socioeconomic, racial, and geographic factors. Expanding Medicaid coverage, increasing funding for community health programs, and enhancing cultural competence training for healthcare providers are essential steps in reducing these disparities.

3. To mitigate the stark differences in service quality between urban and rural healthcare facilities, targeted investments in rural healthcare infrastructure are necessary. This includes ensuring that rural facilities are adequately equipped

and staffed. Expanding telehealth services can also play a critical role in bridging the access gap and providing specialist consultations and follow-up care to those in remote areas.

4. Future research should focus on exploring the qualitative aspects of service quality in both urban and rural settings to gain a more comprehensive understanding of patient and caregiver experiences. Additionally, investigating the impact of specific regional healthcare policies on early detection program effectiveness and access to specialized care will be crucial. Longitudinal studies are needed to assess the long-term outcomes of early detection programs and identify the most effective implementation strategies across different regions and populations.

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