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The Association Between Socioeconomic Factors, Race, and Usage of a Specialty Memory Clinic

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Abstract

Background and Objectives: The capacity of specialty memory clinics in the United States is very limited. If lower socioeconomic status or minoritized racial group is associated with reduced use of memory clinics, this could exacerbate healthcare disparities, especially if more effective treatments for Alzheimer disease become available. We aimed to understand how use of a memory clinic is associated with neighborhood-level measures of socioeconomic factors and the intersectionality of race.

Methods: We conducted an observational cross-sectional study utilizing electronic health record data to compare the neighborhood advantage of patients seen at the Washington University Memory Diagnostic Center to the catchment area using a Geographical Information System. Further, we compared the severity of dementia at the initial visit between patients who self-identified as Black or White. We used a multinomial logistic regression model to assess the Clinical Dementia Rating® (CDR®) at the initial visit and t-tests to compare neighborhood characteristics including the Area Deprivation Index (ADI) to the catchment area.

Results: 4,824 patients seen at the memory clinic between 2008-2018 were included in this study (mean age 72.7 [standard deviation 11.0] years, 2,712 [56%] female, 543 [11%] Black). Most of the memory clinic patients lived in more advantaged neighborhoods within the overall catchment area. The percentage of patients self-identifying as Black (11%) was lower than the average percentage of Black individuals by Census tract in the catchment area (16%) ($p < 0.001$). Black patients lived in less advantaged neighborhoods, and Black patients were more likely than White patients to have moderate or severe dementia at their initial visit (odds ratio, 1.59 [95% confidence interval, 1.11 – 2.25]).

Discussion: This study demonstrates that patients living in less affluent neighborhoods were less likely to be seen in one large memory clinic. Black patients were under-represented in the clinic, and Black patients had more severe dementia at their initial visit. These findings suggest that patients with a lower socioeconomic status and who identify as Black are less likely to be seen in memory clinics, which are likely to be a major point of access for any new Alzheimer disease treatments that may become available.

Introduction

Many older adults have concerns about their memory and thinking. An evaluation by a memory specialist can help diagnose the etiology of cognitive impairment, guide treatment, and lead to referrals for resources.¹ A comprehensive evaluation is usually necessary to sort among the many causes of cognitive impairment, including sleep disorders, mood disorders, medication side effects, and neurodegenerative diseases such as Alzheimer disease (AD).² However, there are relatively few specialty memory clinics, a referral from a primary care provider and insurance are typically required, there are often long wait times for an initial visit, and clinics may require that a support person accompany the patient.³ The limited availability and obstacles to accessing and using memory clinics may result in disparities in care.

The literature suggests that patients with lower socioeconomic status and who identify with minoritized racial and ethnic groups may be less likely to be seen in memory clinics. Access to and use of health care services is associated with neighborhood-level measures of socioeconomic factors such as the area deprivation index (ADI).^{4,5} Studies suggest that minoritized racial and ethnic groups have reduced access to and usage of specialty medical care⁶⁻⁸ and may present for care at more severe stages of the disease.⁸⁻¹¹ Importantly, minoritized groups and patients living in more disadvantaged neighborhoods have a higher risk of dementia^{12,13} and may have more rapid progression of dementia.¹⁴ If groups at higher risk of dementia are less likely to be seen in memory clinics, this could exacerbate existing healthcare disparities. Further, since research studies and clinical trials often recruit participants from memory clinics, reduced use of these clinics by underserved groups could impede efforts to make research studies and clinical trials more inclusive, less biased, and more generalizable. A lower number of individuals in minoritized groups seen in memory clinics could be a contributing factor to the disproportionately low representation of these groups in AD clinical trials.¹⁵ Importantly, it seems increasingly likely that new, more effective AD treatments may become available for clinical use,¹⁶ and that memory clinics will be a major provider of these treatments. Therefore, if patients with lower

socioeconomic status or minoritized groups are less likely to be seen in memory clinics, distribution of new AD treatments will be less equitable.

This study aimed to identify potential socioeconomic and racial disparities in the patients seen at a large specialty memory clinic in St. Louis, Missouri. Information on clinic patients was extracted from the electronic health record (EHR) and compared to information on the clinic's catchment area. In addition, the characteristics of patients self-identifying as Black and White were compared.

Methods

Standard Protocol Approvals, Registrations, and Patient Consents

This study was approved by the Washington University in St. Louis Institutional Review Board (201905161). Participant consent was not required because data was anonymized.

Data Sources

EHR data, neighborhood indicator data, and cartographic boundary shapefiles for Missouri and Illinois¹⁷ were merged for this analysis. The catchment area was defined as the geographical area within a 100-mile radius of the clinic where most of the clinic patients lived. Structured EHR data, including patient addresses, self-reported race, biological sex, insurance information, completed labs and procedures, diagnoses, and unstructured clinical notes were extracted from outpatient records stored in the Allscripts (Chicago, IL) TouchWorks database. Patient self-reported race and ethnicity was collected either verbally or on paper forms provided to the patient. Responses were then recorded in the EHR system by providers or clinic staff. The options provided on the forms and in the EHR interface changed several times over the timeframe of our dataset, however, a free-response field was consistently available. Unique responses observed for our cohort can be found in the eMethods. Patients who were evaluated by memory specialists at the Washington University Memory Diagnostic Center between 2008-2018 were eligible for inclusion (eFigure 1). Patients who were missing data on variables critical to this analysis (sex, race, ethnicity, or address) or who lived outside the catchment area were excluded.

Additionally, only patients who self-identified as non-Hispanic White or Black were included due to the small sample sizes of other groups. Full inclusion and exclusion criteria can be seen in eTable 1.

Dementia evaluation

The Washington University Memory Diagnostic Center required patients to have insurance (either private or public) and bring a support person to their visit who knew them well and could provide a history. Patients presenting to the clinic underwent a comprehensive history and neurological examination. At each visit, memory specialists assessed the presence and severity of dementia with the Clinical Dementia Rating® (CDR®).¹⁸ 0 denotes normal cognition, 0.5 very mild dementia, 1 mild dementia, 2 moderate dementia, and 3 severe dementia. The CDR evaluates for intra-individual changes in memory, thinking, and function relative to previous abilities and habits. Memory specialists derived and discretely recorded the CDR in their notes, which were extracted from structured EHR data and unstructured clinical notes using commercially-available text-mining software, Linguamatics (Cambridge, UK) I2E (v5.6).^{19, 20} The global CDR from new patient visits was used to indicate dementia severity at the initial presentation.

Diagnoses

Primary memory-related diagnoses and comorbid conditions were based on ICD-9/ICD-10 codes in the structured diagnosis data. ICD-10 codes for all diagnoses were linked to the Phecode Map 1.2 with ICD-10 codes from PheWAS Resources to establish disease phenotypes (eFigure 2).²¹ Disease phenotypes were aggregated across the patient population to determine the most common memory-related diagnoses and comorbid conditions.

Neighborhood Indicators

Neighborhood indicators included the 2015 area deprivation index (ADI) (census block level),^{22, 23} 2010 social vulnerability index (SVI) and percent of the population aged 65 and older [census tract (CT) level],²⁴ and a collection of 2010 and 2012 American Community Survey 5-year estimates extracted from publicly available census data [percent of the population below the federal poverty level (FPL) (county level),²⁵ household median income (HHMI; CT level),²⁶ percent of the population with at

least a high school degree (CT level),²⁷ percent of the population with at least a bachelor's degree (CT level),²⁷ the percent of the population that is White or Black (CT level)²⁸, and the percent of the aging population with health insurance (CT level)²⁹⁻³¹]. These indicators were linked to patients by county, ZIP Code, or CT.

Statistical Analysis

Summary statistics were calculated for the entire cohort and the cohort stratified by race and sex. Two-sided two sample t-tests for the difference in means were used to compare continuous variables across groups, and Chi-squared tests were used to compare categorical features across groups. A Mantel-Haenszel Test was used to compare the distribution of initial CDR across groups. In addition, diagnoses were stratified by race and sex and odds ratios and 95% confidence intervals (OR, 95% CI) were calculated. A workflow diagram can be seen in eFigure 3.

A multinomial logistic regression model was used to model the CDR at the initial visit as a function of race, sex, age, and ADI. Logistic regression was used to compare patients initially presenting with early dementia (CDR of 0.5 or 1) to patients initially presenting with moderate to severe dementia (CDR of 2 or 3). Poisson regression was used to model factors associated with the count of memory clinic patients in each Census tract. More details regarding the statistical analyses are found in the eMethods.

GIS Analysis

A Geographic Information Systems (GIS) approach was used to visualize the spatial distribution of memory clinic patients living in the catchment area. The catchment area was defined as a 100-mile radius of the memory clinic. Patients living outside of the catchment area or patients with addresses unsuitable for geocoding (e.g., rural route or PO boxes) were excluded from these analyses. Geocoded addresses were used to determine patients' CT, ZIP Codes, and counties.

ZIP code summaries of patient counts were used to show the spatial distribution of memory clinic patients. Two-sided one sample t-tests were used to compare the proportion of memory clinic patients identifying as Black to the average proportion of the population that is Black by CT, and to compare the

distribution of memory clinic patient neighborhood features to the catchment area using the catchment area mean neighborhood indicator as the null hypothesis. More details regarding the GIS analyses are found in the eMethods.

Data Availability

Anonymized data not published within this article will be made available by request from any qualified investigator.

Results

Participants

Data were obtained for 6,171 patients who were seen for outpatient care at the Washington University Memory Diagnostic Center between 2008-2018 (eTable 2). Patients living more than 100 miles from the memory clinic were excluded to facilitate comparisons within the catchment area, leaving 5,289 patients (85.7%) (eTable 3). Of the patients living in the catchment area, 4,824 met all additional inclusion criteria (eFigure 1), representing 78% of the total cohort. In the final study cohort, 56% of patients were female, 11% were Black, and the age at the first visit was 72.7 years (11.0 years) [mean (standard deviation)] (Table 1). The most common group of memory diagnoses as documented by ICD-10 codes were AD (37%), memory loss (35%), and dementia (20%); common comorbid conditions included major depressive disorder (17%), hypertension (15%) and diabetes (6%) (Table 1, eFigure 2).

Association with neighborhood advantage

By mapping ADI and SVI onto patient addresses, we found that memory clinic patients were more likely to reside in more advantaged neighborhoods with lower ADI and SVI compared to the 100-mile catchment area at-large ($p < 0.001$ for both) (Table 2, Figure 1). Further, memory clinic patients were more likely to reside in neighborhoods with higher HHMI and education levels compared to the catchment area population ($p < 0.001$ for both). Memory clinic patients also resided in areas with a slightly lower percentage of Black individuals (14% versus 16% for the catchment area, $p < 0.001$), and a higher

percentage of individuals older than 65 years (16% versus 14%, $p < 0.001$). The number of memory clinic patients by Census tract remained associated with the percent of Black patients even after adjusting for the percent of individuals older than age 65 years, the total tract population, and the distance from the tract to the Memory Diagnostic Center ($p < 0.001$, eTable 4). Notably, there was relatively little variation in the percent of the population older than 65 years across the catchment area (eFigure 4). The percentage of memory clinic patients self-identifying as Black (11%) was lower than the average percentage of Black individuals in the catchment area by census tract (16%) ($p < 0.001$).

There were significant differences in the characteristics of Black and White patients evaluated in the memory clinic (Table 3). Black memory clinic patients were more likely to be diagnosed with diabetes (OR, 3.08 [95% CI, 2.56 – 4.44]) and hypertension (OR, 2.93 [95% CI, 2.38 – 3.58]) compared to White patients. Black patients lived in more disadvantaged neighborhoods than White patients with regards to all measures studied: ADI, SVI, percent below the federal poverty level, HHMI, and education level ($p < 0.001$ for all). There was no difference in the type of insurance provider (e.g., public or private insurance) for Black and White patients (Table 3).

We next evaluated for differences between male and female patients (eTable 5). Male patients were slightly younger (72.1 years (10.9 years) versus 73.3 years (11.0 years) for women), more likely to be White (OR, 1.66 [95% CI, 1.38 – 2.00]), more likely to have private insurance ($p = 0.04$), more likely to have diabetes (OR, 1.31 [95% CI, 1.03 – 1.66]), more likely to have hypertension (OR, 1.30 [95% CI, 1.10 – 1.52]), and less likely to have AD (OR, 0.76 [95% CI, 0.68-0.86]). Based on ADI and HHMI, female patients lived in slightly more disadvantaged neighborhoods, although there was no significant difference in other neighborhood indicators.

Dementia severity at initial visit

The first available CDR was recorded in structured EHR data or unstructured clinical notes for 3,674 of the included participants (76%). This extraction method performed well evaluated against a gold standard annotation by two memory specialists (F1 score: 0.99). The first available CDR from a note or structured EHR data was labeled as the new patient visit (initial visit) for 74% of patients, as an

established patient visit for 9% of patients, and was unlabeled for 17% of patients (eTable 6). At their new patient visit, 20% of patients did not have significant cognitive impairment (CDR 0), 48% had very mild dementia (CDR 0.5), 21% had mild dementia (CDR 1), and 11% had moderate or severe dementia (CDR 2 or 3, respectively) (Table 1).

Factors associated with dementia severity at the initial evaluation were examined using individuals with a CDR available from their new patient visit (eTable 7). There was no difference between male and female patients in dementia severity at the initial evaluation. However, Black patients were more likely to have more advanced dementia at their initial presentation compared to White patients (Figure 2, Mantel-Haenszel test: $p < 0.001$). At their initial visit, 40% of Black patients and 31% of White patients had mild dementia or worse (CDR 1 or greater) and 16% of Black patients and 10% of White patients had moderate or severe dementia (CDR 2 or 3, respectively) (Table 3). Black patients had higher odds of presenting with moderate to severe dementia (CDR 2 or 3) than mild dementia (CDR 0.5 or 1) at their initial evaluation as compared to White patients (OR, 1.59 [95% CI, 1.11 – 2.25]), even after adjusting for age, sex, and ADI (Table 4). Similar trends were present when each CDR level was evaluated (eTable 8).

Discussion

The main objective of this study was to evaluate for potential socioeconomic and racial disparities in patients seen at a large specialty memory clinic in metropolitan St. Louis compared to the clinic catchment area. By comparing neighborhood-level measures of the memory clinic patients with the characteristics of the catchment area, this study found that patients were more likely to reside in relatively advantaged areas of the St. Louis region. Additionally, this study found under-representation of Black patients in the clinic, and that Black patients were more likely than White patients to have advanced dementia at their initial evaluation. These differences suggest inequities that could affect dementia diagnosis, care, caregiving resources, access to clinical trial participation, and emerging therapies.

If more effective AD treatments become available, it seems likely that underserved groups, such as patients living in less affluent areas as well as minoritized groups, would have reduced access because they may be less likely to be seen in memory clinics that will serve as a major access point for these treatments. Underserved groups have often had reduced access to appropriate treatments, such as those for diabetes and cardiovascular disease.^{32,33} It is also important to note that new AD treatments are likely to only be indicated in patients with early dementia.¹⁶ Because Black patients are more likely to present with more advanced dementia, they may be less likely to be eligible for new AD treatments at the time of their initial clinic visit. Delays in diagnosis may further worsen if demand for memory care substantially increases, as may occur if an effective treatment becomes widely available.³⁴ Disparities may be further exacerbated if there is increased demand for memory care by more advantaged groups, which may strain already limited resources and further delay care to disadvantaged groups.

A major limitation of the study is that only a single large memory clinic was studied. It is therefore unknown whether similar disparities exist at other memory clinics. Additionally, although the Washington University Memory Diagnostic Center is the largest memory clinic in the region, patients could also receive high quality care from other centers. For this reason, we may be overestimating the effect of neighborhood affluence on memory care. Since we do not have data on the care these patients may receive, we cannot make assumptions regarding the quality of the care. However, it is likely that patients who are not treated at the memory clinic in this study would have less access to specialty memory care services such as AD biomarker testing, which would be required for initiation of new AD treatments.³⁵

Certain limitations of the EHR data used in this study should be noted. Some patient addresses were unsuitable for geocoding, which led to missing data, and it is possible that data was not missing at random. Patient addresses were extracted at a single point in time, and some patients may move between neighborhoods. Neighborhood indicators, especially at larger areas like the tract or county, may not accurately represent the conditions for individuals. Multiple measures were included to demonstrate consistency of results. ICD codes were used for the diagnosis, but these codes are used primarily for

billing purposes and may not provide a precise diagnosis. Therefore, ICD codes were grouped based on Phecode phenotypes to draw conclusions regarding common diagnoses. The dementia severity at the initial visit was not available for a significant number of patients, and it is possible that data was not missing at random.

The results of this study are unsurprising given the history of structural and institutionalized racism in the United States and the resultant self-propagating cycles that enforce and maintain disparities in accessing healthcare.³⁶ The St. Louis region, like many other metropolitan areas, also has a history of redlining, which can worsen health disparities.³⁷ Like many major cities, the areas most populated by the Black community have fewer health care facilities and lack adequate public transportation. The intersection of these structural and systematic barriers perpetuates distrust in the healthcare system, which could potentially result in Black patients delaying presentation for care until their condition is more advanced. However, there are many factors that may impact the severity of a patient's dementia when referred to the specialty memory clinic that are not recorded in the EHR. These may include patient and provider beliefs about normal aging and dementia, potential effectiveness of available treatments, and the value and safety of clinical research. Future work could collect these measures through a survey or qualitative approach and assess their impact on the severity of dementia at the initial visit.

Although this study demonstrates that socioeconomic and racial disparities exist in the patients who are seen at the Washington University Memory Diagnostic Center compared to the catchment area, it is important to note that these disparities are not due to the choices of individual clinicians, who see all patients who are scheduled. Instead, these disparities reflect access to primary care and the choices of primary care physicians (to refer to the memory clinic or not), healthcare systems (to accept appointments only for patients with insurance), provider groups (to require a support person), and the choices of patients that may be affected by well-justified mistrust of the medical system. Therefore, reducing these disparities may require outreach to patients and primary care providers, as well as structural changes in healthcare systems and provider groups. Currently there are no clinicians practicing in the Washington University Memory Diagnostic Center who are Black, and some patients prefer a clinician who shares

lived experiences, including identifying with the same racial or ethnic group.³⁸⁻⁴⁰ Outreach, structural changes, and recruiting a diverse workforce require meaningful effort, and empiric data suggesting the need for these initiatives may increase the likelihood of support.

Many clinicians at the Washington University Memory Diagnostic Center are engaged in research at the Knight Alzheimer Disease Research Center (ADRC). For two decades the African American Advisory Board of the Knight ADRC has worked to increase the participation of Black patients in Alzheimer's research, promote inclusive research practices, and increase the diversity of physicians in the department.⁴¹ More recently, the Knight ADRC created the Health Disparities and Equity Core to center diversity, equity, and inclusion in all aspects of the Knight ADRC's functions.⁴² The efforts of the Knight ADRC to promote diversity, equity, and inclusion have now been extended to clinical care through this and other work.⁴³ The first step is the ability to measure disparities in care, and the EHR can enable continuous monitoring of healthcare disparities and evaluation of the effectiveness of any initiatives to reduce disparities. Such initiatives may include increased outreach to less affluent neighborhoods with a higher frequency of individuals from minoritized groups, reducing requirements for scheduling an initial appointment, and hiring clinicians who represent minoritized groups. At a time when memory care may be undergoing a major transformation, this study provides additional motivation for addressing disparities that are likely to affect patient care and demonstrates that the EHR may provide a powerful tool to monitor and potentially reduce disparities in memory care.

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Tables And Figures

Table 1. Characteristics of patients included in the study (N = 4,824).

Variable	N (%), Mean (SD), or Median (IQR)
Patient characteristics	
Age (years) ^a	72.7 (11.0)
Race and Ethnicity ^b	
Black or African American	543 (11%)
Non-Hispanic White	4,281 (89%)
Sex ^b	
Female	2,712 (56%)
Male	2,110 (44%)
Global CDR at initial visit (N = 2,736, 57%)	
0, no significant dementia	556 (20%)
0.5, very mild dementia	1315 (48%)
1, mild dementia	575 (21%)
2, moderate dementia	244 (9%)
3, severe dementia	46 (2%)
Insurance Provider ^b	
Public	3603 (75%)
Private	1206 (25%)
Other	15 (0.31%)
Characteristics of patient's neighborhood	
Area Deprivation Index ^c	41.50 (24.00, 64.00)
Social Vulnerability Index ^c	0.30 (0.12, 0.51)
Percent below federal poverty level (N = 4,393, 87%) ^a	13.3 (5.7)
Household median income ^a	\$66,700 (\$29,000)
Educational level ^a	
High School or Higher	91% (7%)
Bachelors or Higher	38% (21%)
Racial composition ^a	
Black	14% (25%)
White	82% (24%)
Common memory diagnoses*^b	
Alzheimer Disease	1795 (37%)
Memory Loss	1689 (35%)
Dementias	956 (20%)
Common comorbid conditions*^b	
Major Depressive Disorder	809 (17%)
Hypertension	715 (15%)
Diabetes	288 (6%)

Abbreviations: SD, standard deviation; IQR, interquartile range; CDR, Clinical Dementia Rating. *See eFigure 2 for ICD codes. ^a Mean (SD). ^b N (%). ^c Median (IQR).

Table 2. Neighborhood indicator summary measures of locations in which Washington University Memory Diagnostic Center patients reside compared to the surrounding 100-mile catchment area (N = 4,824).

Measure	Locations in which memory clinic patients live Mean (SD)	Catchment area Mean (SD)	T-value	P-value
Area Deprivation Index	44.75 (26.0)	64.6 (24.1)	t = -63.05	p < 0.001
Social Vulnerability Index	0.35 (0.26)	0.47 (0.28)	t = -30.98	p < 0.001
Household Median Income	\$66,700 (\$29,000)	\$50,900 (\$22,000)	t = 37.89	p < 0.001
Education level				
High School or Higher	91% (7%)	86% (8%)	t = 43.49	p < 0.001
Bachelors or Higher	38% (21%)	24 (17%)	t = 45.18	p < 0.001
Racial composition				
Black	14% (25%)	16% (28%)	t = -6.82	p < 0.001
White	82% (24%)	81% (28%)	t = 2.96	0.003
Percent of population 65 years or older	16% (5%)	14% (5%)	t = 16.44	p < 0.001
Health Insurance				
All Insurance Types	99% (1%)	99% (2%)	t = -0.09	p = 0.93
Private Insurance	71% (11%)	68% (14%)	t = 138	p < 0.001
Public Insurance	97% (3%)	98% (3%)	t = -6.60	p < 0.001

Abbreviations: SD, standard deviation.

Table 3. Racial differences in patient characteristics (N = 4,824).

	Black Patients N = 543 (11%)	Non-Hispanic White Patients N = 4281 (89%)	Unadjusted Odds Ratio (95% CI) or P-value
Patient characteristics			
Age (years, mean ± SD) ^a	73.0 ± 12.0 years	72.7 ± 10.9 years	p = 0.67
Female ^b	363 (67%)	2349 (55%)	1.66 (1.38, 2.00)
Global CDR at initial visit (N = 2,736, n, %) ^b	Observations = 310	Observations = 2426	
0, no significant dementia	54 (17%)	502 (21%)	Mantel-Haenszel Test M ² = 13.61 r = -0.071 p < 0.001
0.5, very mild dementia	131 (42%)	1184 (49%)	
1, mild dementia	75 (24%)	500 (21%)	
2, moderate dementia	41 (13%)	203 (8%)	
3, severe dementia	9 (3%)	37 (2%)	
Insurance Provider ^b			χ ² (df=2) = 5.33 p = 0.07
Public	424 (78%)	3179 (74%)	
Private	116 (21%)	1090 (25%)	
Other	3 (0.4%)	12 (0.2%)	
Neighborhood characteristics of patients			
Area Deprivation Index ^c	71.0 (40.0, 91.0)	40.0 (23.0, 60.0)	p < 0.001
Social Vulnerability Index ^c	0.60 (0.37, 0.86)	0.28 (0.12, 0.47)	p < 0.001
Percent below federal poverty level ^a	16% (8%)	13 (5%)	p < 0.001
Household Median Income ^a	\$49,600 (\$25,500)	\$68,900 (\$28,800)	p < 0.001
Education level ^a			
High School or higher	86% (10%)	91% (7%)	p < 0.001
Bachelors or higher	29% (20%)	39 (21%)	p < 0.001
Common memory diagnoses*^b			
Alzheimer Disease	211 (39%)	1584 (37%)	1.08 (0.90, 1.30)
Memory Loss	201 (37%)	1488 (35%)	1.10 (0.92, 1.33)
Dementias	123 (22%)	833 (19%)	1.21 (0.97, 1.50)
Common comorbid conditions*^b			
Major Depressive Disorder	68 (13%)	741 (17%)	0.68 (0.52, 0.89)
Hypertension	164 (30%)	551 (13%)	2.93 (2.38, 3.58)
Diabetes	80 (15%)	208 (5%)	3.08 (2.56, 4.44)

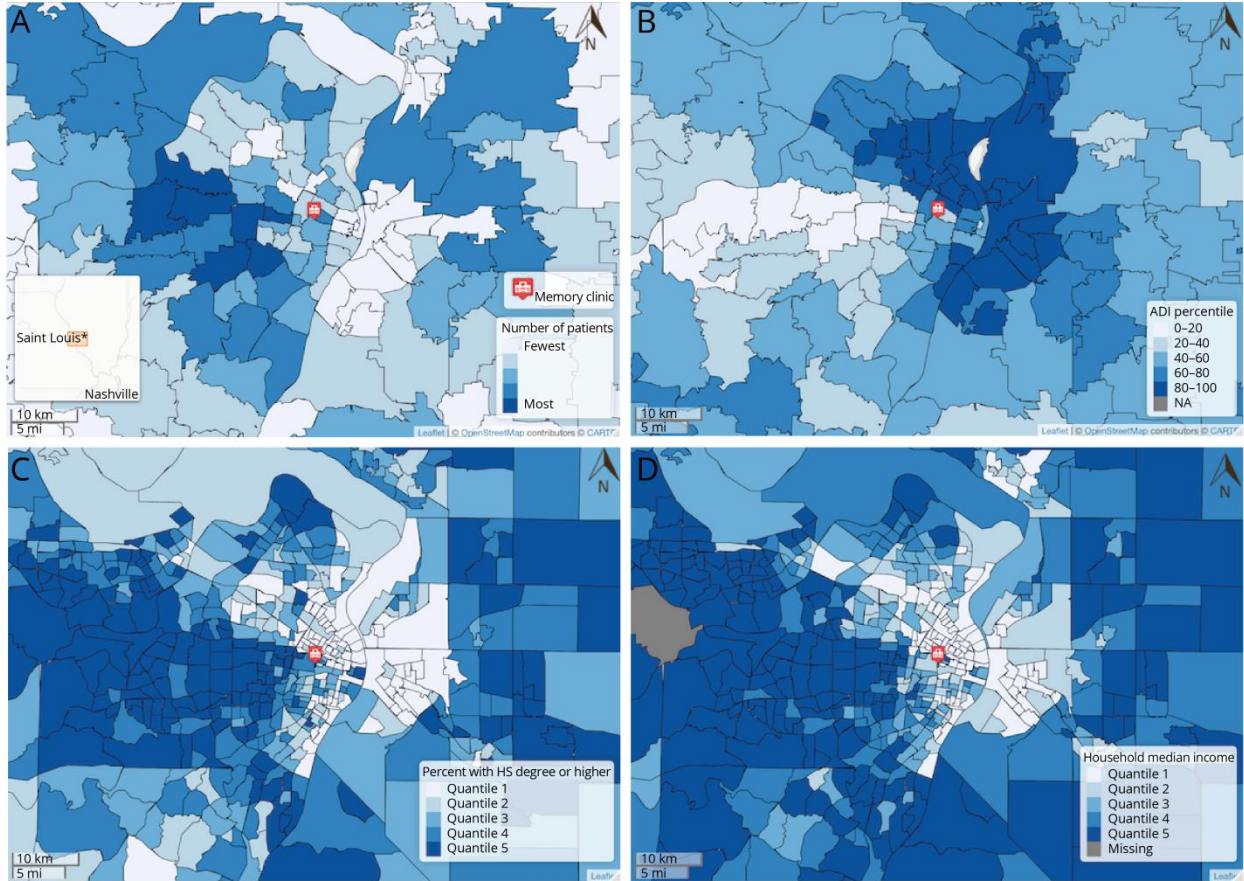
Abbreviations: CI, confidence interval; SD, standard deviation; CDR, Clinical Dementia Rating; IQR, interquartile range. *See eFigure 2 for ICD codes. ^a Mean (SD). ^b N (%). ^c Median (IQR).

Table 4. Factors associated with more advanced dementia at the initial presentation (N = 2,180). A logistic regression model of either early (Clinical Dementia Rating (CDR) 0.5 or 1.0) or more advanced dementia (CDR 2 or 3) was evaluated as a function of race (Black or White, White was reference), sex (male or female, female was reference), age, and Area Deprivation Index. Individuals rated CDR 0 were excluded from this analysis.

Factor	Odds Ratio	P-value
Race: Black	1.59 (1.11, 2.25)	0.01
Sex: Male	1.01 (0.78, 1.30)	0.97
Age	1.03 (1.02, 1.05)	$p < 0.001$
Area Deprivation Index	1.00 (1.00, 1.01)	0.22

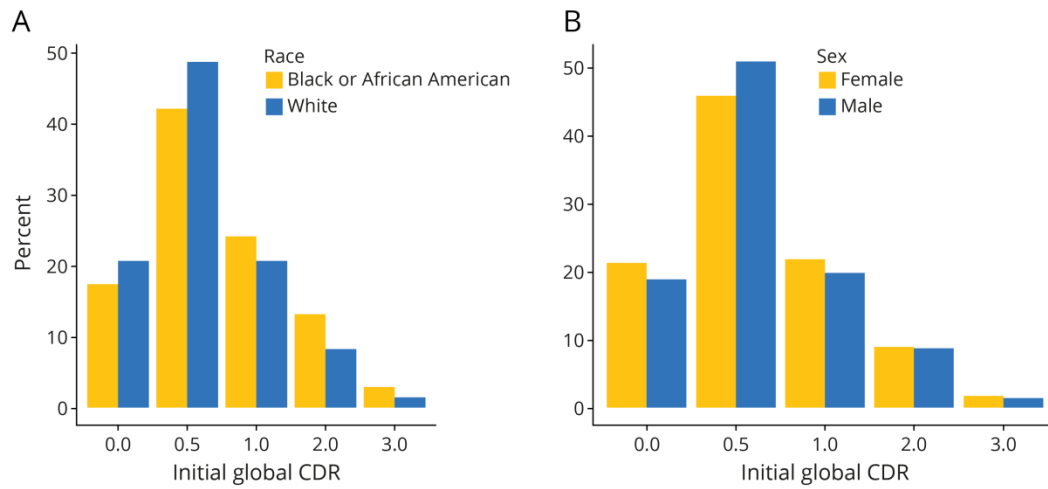
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Figure 1. Map of the Washington University memory clinic catchment area. The memory clinic patient population is concentrated in areas of relative neighborhood advantage. A: Memory clinic patient count by ZIP code. B: Area Deprivation Index (ADI) by ZIP code. C: Percent of population with at least a high school (HS) degree by Census Tract (CT). D: Household Median Income (HHMI) by CT.



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Figure 2. Bar Chart of Initial Global Clinical Dementia Rating (CDR) ($N = 2,736$). Left: CDR stratified by race. Right: CDR stratified by sex.



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