

Supplementary Materials

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Table S1. ADRD Case Definition Using ICD-10 and SNOMED CT Codes

Source: Authors' own analyses.

Code Group	Description
A81	Creutzfeldt-Jakob disease (all variants)
F00	Dementia in Alzheimer's disease
F01	Vascular dementia
F02	Dementia in other diseases classified elsewhere
F03	Unspecified dementia
F04	Amnesic disorder due to known physiological condition
F06	Other mental disorders due to known physiological condition
F07	Personality and behavioral disorders due to known physiological condition
F10.27	Alcohol dependence with alcohol-induced persisting dementia
G10	Huntington's disease
G20	Parkinson's disease
G30	Alzheimer's disease (all types)
G31.0	Frontotemporal dementia
G31.01	Pick's disease
G31.09	Other frontotemporal dementia
G31.1	Senile degeneration of brain, not elsewhere classified
G31.2	Degeneration of nervous system due to alcohol
G31.81	Alpers disease
G31.83	Dementia with Lewy bodies
G31.84	Mild cognitive impairment, so stated
G31.89	Other specified degenerative diseases of nervous system
G31.9	Degenerative disease of nervous system, unspecified
SNOMED CT	Amnesia (52448006), memory impairment (271594007, 75528006, 271618001), Alzheimer's disease (195967001), vascular dementia (230265002), dementia with Lewy bodies (77176002), cognitive disorders
R41	Amnesia and cognitive symptoms (R41.0–R41.9)

Table S2. Coefficients for Block Group Level Model (Sorted by Absolute Value of Feature Coefficients)

Source: Authors' own analyses.

Feature Name	Coefficients
Chronic Disease Burden	0.627
Education And Literacy	0.346
Community Vulnerability	-0.278
Life Expectancy	0.244
Obesity	-0.224
Good Health	-0.201
Education Level	-0.199
Alcohol Abuse	0.160
High Blood Pressure	-0.138
Household Essentials	0.135
Disease Burden	0.126
Equitable Communities	0.114
Chronic Obstructive Pulmonary Disease	-0.097
Literacy	-0.086
Connectivity	0.078
Households Without Vehicles	0.075
Mental Health	-0.040

Table S3. SDOH Feature Values Stratified by Cognitive Impairment Status

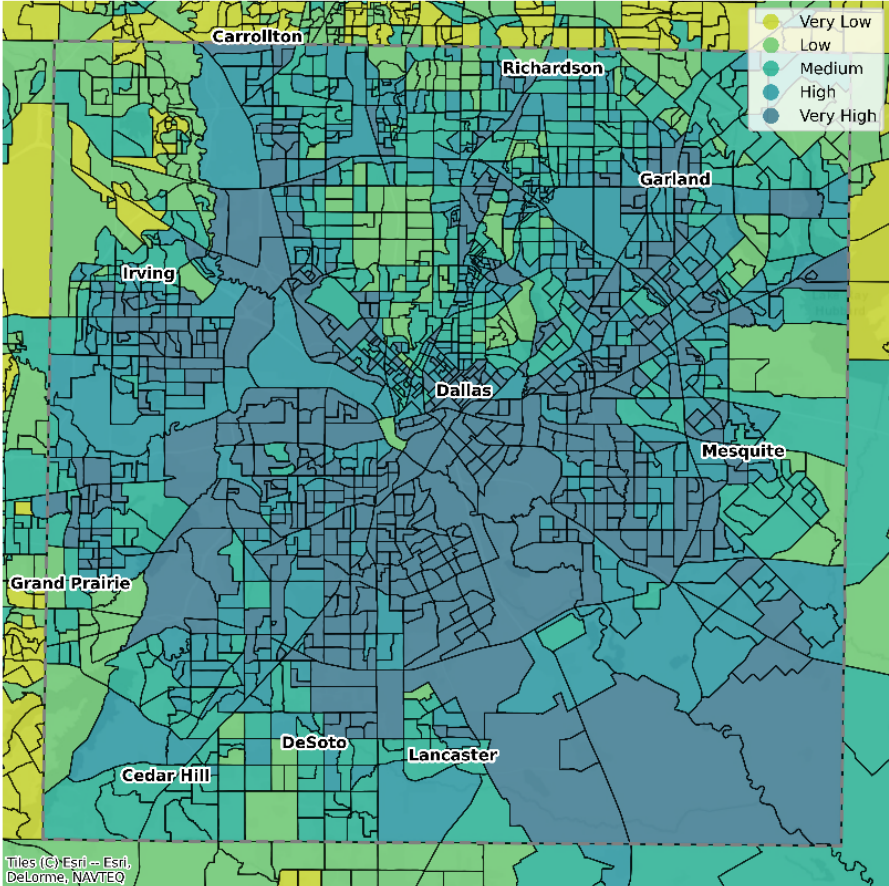
Source: Authors' own analyses.

SDOH Feature	Overall	No Cognitive Impairment	Cognitive Impairment	p-value
Community Vulnerability Index Value	0.55 (0.27)	0.54 (0.27)	0.59 (0.26)	<0.001
Household Essentials Index Value	0.54 (0.27)	0.53 (0.27)	0.58 (0.26)	<0.001
<i>Food Insecurity Index Value</i>	0.53 (0.27)	0.53 (0.27)	0.57 (0.26)	<0.001
<i>Paycheck Predictability Index Value</i>	0.47 (0.27)	0.47 (0.27)	0.49 (0.28)	<0.001
<i>Household Structure Index Value</i>	0.56 (0.27)	0.56 (0.27)	0.58 (0.27)	<0.001
<i>Health Insurance Coverage Index Value</i>	0.61 (0.28)	0.6 (0.29)	0.63 (0.27)	<0.001
<i>Median Household Income Index Value</i>	0.53 (0.27)	0.52 (0.28)	0.57 (0.26)	<0.001
Empowered People Index Value	0.51 (0.26)	0.5 (0.26)	0.55 (0.24)	<0.001
<i>Education Level Index Value</i>	0.6 (0.29)	0.6 (0.29)	0.64 (0.28)	<0.001
<i>Literacy Index Value</i>	0.7 (0.24)	0.69 (0.25)	0.73 (0.2)	<0.001
<i>Education And Literacy Index Value</i>	0.69 (0.26)	0.68 (0.27)	0.73 (0.23)	<0.001
<i>Connectivity Index Value</i>	0.53 (0.29)	0.52 (0.29)	0.57 (0.28)	<0.001
<i>Walk Score Index Value</i>	0.33 (0.25)	0.33 (0.25)	0.31 (0.25)	<0.001
<i>Households Without Vehicles Index Value</i>	0.56 (0.29)	0.56 (0.29)	0.6 (0.29)	<0.001
Equitable Communities Index Value	0.61 (0.24)	0.61 (0.24)	0.64 (0.23)	<0.001
<i>Unemployment Index Value</i>	0.53 (0.26)	0.53 (0.26)	0.54 (0.26)	<0.001
<i>Affordable Housing Index Value</i>	0.58 (0.25)	0.57 (0.26)	0.62 (0.24)	<0.001
<i>Neighborhood Safety Index Value</i>	0.61 (0.26)	0.61 (0.26)	0.65 (0.25)	<0.001
<i>Neighborhood Stability Index Value</i>	0.44 (0.24)	0.44 (0.24)	0.45 (0.24)	<0.001
<i>Clean Air Index Value</i>	0.68 (0.18)	0.68 (0.18)	0.68 (0.18)	0.33

<i>Green Space Access Index Value</i>	0.54 (0.23)	0.54 (0.23)	0.54 (0.23)	<0.001
Good Health Index Value	0.48 (0.25)	0.47 (0.25)	0.52 (0.25)	<0.001
<i>Life Expectancy Index Value</i>	0.57 (0.28)	0.57 (0.28)	0.61 (0.28)	<0.001
<i>Alcohol Abuse Index Value</i>	0.47 (0.27)	0.48 (0.27)	0.45 (0.28)	<0.001
<i>Mental Health Index Value</i>	0.56 (0.3)	0.55 (0.3)	0.59 (0.29)	<0.001
<i>Cancer Index Value</i>	0.34 (0.26)	0.34 (0.26)	0.32 (0.24)	<0.001
<i>Disease Burden Index Value</i>	0.39 (0.22)	0.39 (0.22)	0.41 (0.22)	<0.001
<i>Chronic Disease Burden Index Value</i>	0.48 (0.28)	0.47 (0.28)	0.51 (0.28)	<0.001
<i>Chronic Obstructive Pulmonary Disease Index Value</i>	0.48 (0.26)	0.48 (0.26)	0.52 (0.26)	<0.001
<i>Coronary Heart Disease Index Value</i>	0.43 (0.24)	0.42 (0.23)	0.46 (0.24)	<0.001
<i>Diabetes Index Value</i>	0.51 (0.28)	0.5 (0.28)	0.55 (0.28)	<0.001
<i>Asthma Index Value</i>	0.47 (0.3)	0.47 (0.3)	0.5 (0.31)	<0.001
<i>High Blood Pressure Index Value</i>	0.5 (0.28)	0.49 (0.28)	0.52 (0.29)	<0.001
<i>Obesity Index Value</i>	0.49 (0.28)	0.48 (0.28)	0.52 (0.28)	<0.001

Values shown as mean (standard deviation).

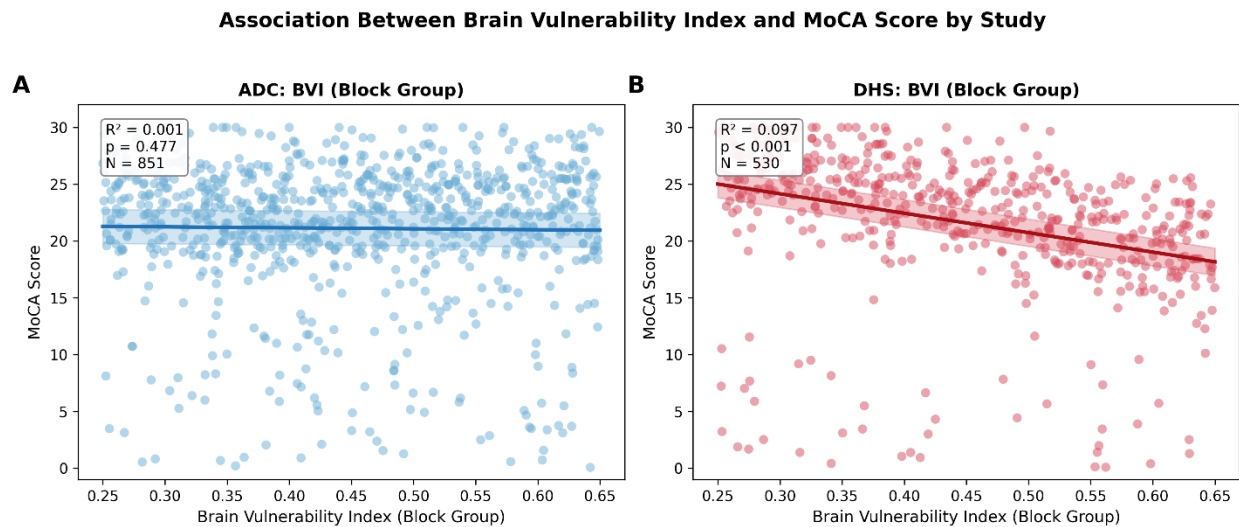
Figure S1. Brain Vulnerability Index (BVI) Across Dallas Metropolitan Area Census Block Groups.



The map presents complementary views of Brain Vulnerability Index, BVI, across the Dallas metropolitan area. The Block group Risk Score map (Figure 1) offers a high-resolution perspective, revealing granular variations in risk within neighborhoods. Central Dallas and adjacent areas show clusters of "High" to "Very High" risk, while outlying regions such as Carrollton and Richardson exhibit predominantly "Low" to "Medium" risk. High-risk zones are concentrated in Dallas, DeSoto, and Lancaster, while suburban areas maintain lower risk profiles. The block group-level map is effective for identifying micro-level disparities and guiding targeted interventions, such as community outreach or localized health services.

Source: Authors' own analyses.

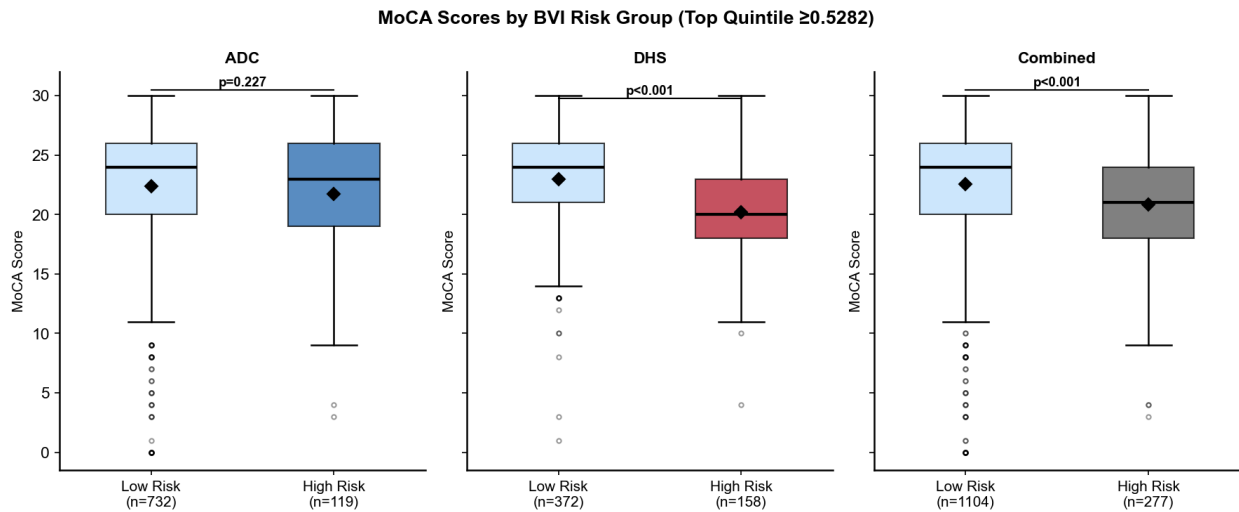
Figure S2: Association Between Brain Vulnerability Index and Cognitive Function by Study



Footnote. Scatter plots show the relationship between the Brain Vulnerability Index (BVI) and Montreal Cognitive Assessment (MoCA) scores. MoCA: range 0-30 points (higher=better cognitive function); Regression lines with 95% confidence bands are shown. R^2 , p-values, and sample sizes are displayed for each panel. The association between BVI and MoCA was significant only in the DHS cohort ($p < 0.001$ for both geographic levels).

Source: Authors' own analyses.

Figure S3. MOCA Scores by BVI Risk Group Using top Quartile Cutoff

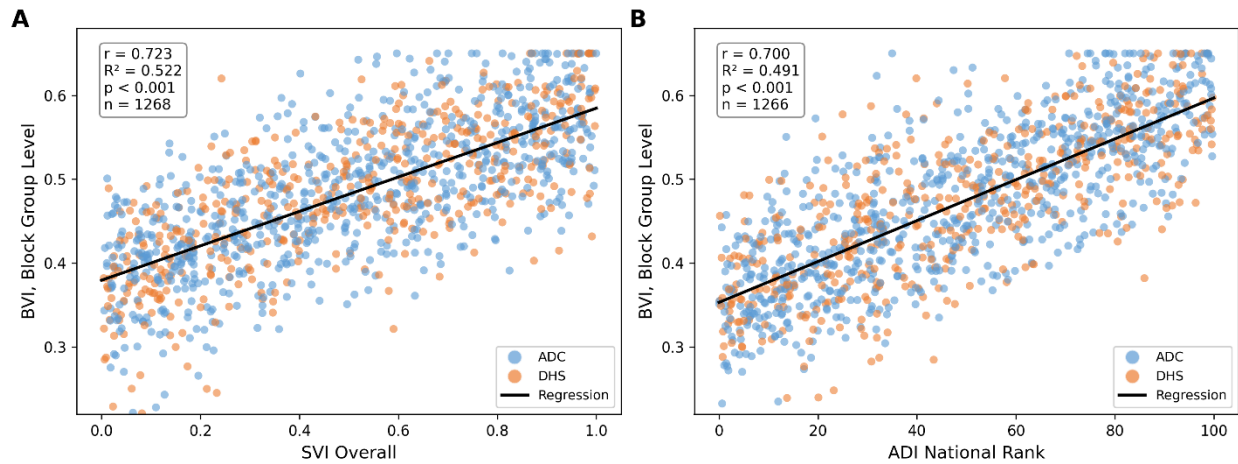


Footnote: Box plots showing the distribution of Montreal Cognitive Assessment (MoCA) scores by Brain Vulnerability Index (BVI) risk group across two independent validation cohorts and the combined sample. Boxes represent the interquartile range (25th–75th percentile), horizontal lines indicate the median, diamond markers indicate the mean, whiskers extend to 1.5 times the interquartile range, and circles represent outliers. The BVI top quintile cutoff (≥ 0.5282) was used to classify participants as high risk or low risk. In the Dallas Heart Study (DHS) and combined analysis, the high-risk group ($n = 158$) had significantly lower MoCA scores compared to the low-risk group. In the Alzheimer's Disease Center (ADC) cohort, the difference was not statistically significant. MoCA: range 0-30 points (higher=better).

Source: Authors' own analyses.

Figure S4. Associations Between Brain Vulnerability Index (BVI) and Established

Associations Between Brain Vulnerability Index (BVI) and Commonly Used Geolocation Indices



Footnote: Scatter plots illustrating the correlation between BVI at the block group level and (A) Social Vulnerability Index (SVI) Overall and (B) Area Deprivation Index (ADI) National Rank. Each point represents an individual participant, with blue circles indicating Alzheimer's Disease Center (ADC) participants and orange circles indicating Dallas Heart Study (DHS) participants. Black lines represent linear regression fits. Abbreviations: BVI, Brain Vulnerability Index; SVI, Social Vulnerability Index; ADI, Area Deprivation Index; ADC, Alzheimer's Disease Center; DHS, Dallas Heart Study.

Source: Authors' own analyses.