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Research Report

Social Determinants of Health, Risk and Resilience against Alzheimer's Disease and Related Dementias: The Healthy Brain Initiative

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Abstract.
Background: Few studies have investigated associations between perceived social determinants of health (SDOH) and Alzheimer's disease and related dementia (ADRD) biomarkers or between SDOH and resilience against ADRD.
Objective: To examine associations between perceived and objective SDOH and ADRD-related outcomes.
Methods: We used cross-sectional data on ≥ 50-year-olds without dementia in the Healthy Brain Initiative (n = 162). Questionnaires captured trust in neighbors and indices of perceived neighborhood greenspace access, time spent in neighborhood greenspaces, and interpersonal discrimination. Residential addresses were linked to 2021 Area Deprivation Index scores. The Vulnerability Index (VI) is based on 12 dementia risk factors (e.g., age, race/ethnicity, diabetes) and Resilience Index (RI) is based on 6 protective factors (e.g., diet, mindfulness, physical activity). Cognitive measured included number symbol coding task and Montreal Cognitive Assessment. Biomarkers included $A\beta_{42/40}$ and pTau-217/npTau-217, hippocampal and white matter hyperintensity volume, lipoprotein A, and high-sensitivity c-reactive protein.
Results: Perceived greater access to greenspaces (estimate = 2.83, 95% CI = 1.40–4.26) and greater time in neighborhood greenspaces were associated with greater RI scores (estimate = 2.30, 95% CI = 1.24–3.35). Reporting greater discrimination (estimate = 0.10, 95% CI = 0.04–0.16) and living in higher deprivation neighborhoods were associated with greater VI scores (estimate = 0.017, 95% CI = 0.003–0.032). Greater discrimination was associated with greater white matter hyperintensity volume (estimate = 0.27, 95% CI = 0.04–0.51).
Conclusions: Perceived greenspace access and time spent in greenspaces were associated with resilience against ADRD, and interpersonal discrimination was associated with vulnerability to ADRD. Future work needs to validate perceived SDOH measures, examine associations in racially/ethnic diverse populations, and investigate longitudinal associations between SDOH and ADRD-related biomarkers.

Keywords: Alzheimer's disease, biomarkers, built environment, dementia, green space, neighborhood resilience, social determinants of health, socioeconomic status, structural determinants of health

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INTRODUCTION

Risk factors for Alzheimer's disease and related dementias (ADRD) include age, genetics (e.g., apolipoprotein E genotype), and low education [1, 2], whereas factors protective against ADRD include physical activity, healthful diets, greater education, occupational complexity, and participation in cognitive and social leisure activities [1, 3]. Social determinants of health (SDOH), which broadly encompass healthcare access and quality, educational access and quality, social and community context, neighborhood and built environment, and economic stability [4, 5] are upstream factors that significantly influence risk for and protection against ADRD.

Evidence for associations between SDOH and ADRD outcomes is rapidly growing, particularly for studies on neighborhood-level greenspaces, socioeconomic status (NSES), and social environments (e.g., social cohesion), as well as interpersonal discrimination/racism [4, 6–9]. Greater access to greenspaces (natural vegetation including parks and gardens) has been associated with better mental and physical health [10–12] and greater physical activity [7, 13, 14]. In turn, greater greenspace access has been associated with lower ADRD risk, slower cognitive decline, and less brain atrophy and white matter damage in numerous studies of older adults [4, 7, 15–17].

Living in socioeconomically deprived areas increases risk of cardiovascular diseases, stress, diabetes, and unhealthy lifestyle behaviors-all ADRD risk factors [18–20]. Residents of deprived neighborhoods have greater ADRD risk and poorer cognitive functioning and brain imaging outcomes [18, 21–23]. SDOH include social environments and interpersonal relationships within communities [6], and studies show that greater neighborhood social cohesion is associated with better cognitive functioning [24, 25]. Lastly, the stress of interpersonal discrimination has been associated with worse cognitive functioning [9, 26–29]. Older Black and Hispanic adults exposed to chronic stress, systemic racism, and discrimination have shown higher levels of psychological stress, greater mental health burden, and greater inflammation, increasing their vulnerability to ADRD [30–33].

The extant literature is limited regarding studies on self-reported measures of neighborhood greenspaces and associations between SDOH and ADRD biomarkers. Self-reported greenspace measures have been associated with ADRD risk factors/outcomes in preliminary studies and are thought to tap into different constructs (e.g., perceptions) than objective measures (e.g., percentage park space). ADRD biomarkers provide the earliest signs of risk of developing disease among asymptomatic individuals and thus are well suited for research aimed at prevention. To address these scientific gaps, we used data from the Healthy Brain Initiative to explore associations between self-reported measures of neighborhood greenspace, discrimination, and trust in neighbors, as well as an objective measure of NSES, with measures of resilience and ADRD vulnerability including plasma, magnetic resonance imaging (MRI), and inflammation biomarkers.

METHODS

Sample

The Health Brain Initiative (HBI) is an observational cohort study that since 2022 has been enrolling South Florida participants who are ≥ 50 years old, have no, subjective, or mild cognitive impairment (Clinical Dementia Rating (CDR) ≤ 1), have a study partner, and can undergo MRI. Excluded individuals have significant illnesses that affect participation in brain imaging or that may produce unreliable cognitive measures (e.g., metastatic cancer, unstable diabetes, etc.). HBI is approved by University of Miami's Institutional Review Board and participants provided informed consent. HBI protocol details are elsewhere [34].

Social determinants of health measures

Questions on neighborhood greenspace access, time spent in neighborhood greenspaces, and trust in neighbors are asked on a 7-point scale (1 = strongly disagree to 7 = strongly agree). The neighborhood greenspace access index is comprised of 3 questions on whether the neighborhood has i) many shade trees, ii) a lot of green space, or iii) a park within walking distance of home (range = 3–21; higher scores = greater access). The time spent in neighborhood greenspaces index is calculated from 3 questions on whether the participant spends a lot of time i) relaxing, ii) exercising, or iii) socializing in parks, gardens, and other greenspaces in the neighborhood (range = 3–21; higher scores = greater time spent in greenspaces). Cronbach's alpha measures of internal consistency were 0.82 for the time spent in neighborhood greenspace index and 0.60 for the neighborhood greenspace access index. Partici-

pants are also asked a single question about whether "Most people in [their] neighborhood can be trusted," (adapted from Health & Retirement Study question [35]), from which we derived a measure of trust in neighbors (low = values of 1–3, versus moderate-high = values of 4–7).

The Intersectional Discrimination Index [36] was calculated from 9 questions assessed on a 5-point scale (1 = strongly disagree to 5 = strongly agree) on lifelong experiences related to how others perceive them (e.g., skin color, nationality, gender) (range = 9 to 45; higher score = greater discrimination). Participants are asked, for example, the degree to which they feel that health care providers might treat them poorly; they might have difficulty finding/keeping jobs; and they might be harassed by police/security.

Area deprivation index (ADI) values (2021) were linked to participants' residential addresses. ADI was constructed from 17 US Census measures at the block group level (e.g., median family income, median gross rent, percentage of families in poverty) (range = 1–100; higher scores = greater deprivation), with detailed methods provided elsewhere [37]. ADI has been associated with numerous ADRD-related outcomes including cognitive decline and AD neuropathology [21, 22].

Outcomes measures

Components of the Brain Health Platform [38] include the Resilience Index (RI), Vulnerability Index (VI), and Number Symbol Coding Task (NSCT). The RI and VI have been validated and shown to predict cognitive impairment in prior studies (AUC For RI: 0.84; AUC for VI = 0.84). The RI consists of 6 measures [39]. The Cognitive Reserve Unit Scale (CRUS) is calculated based on education and occupation (range = 0–66). The Quick Physical Activity Rating (QPAR) measures intensity, frequency, and duration of 10 activity categories (e.g., sitting, light/moderate/strenuous activities) (range = 0–153). The Cognitive & Leisure Activity Scale (CLAS) measures frequency of 15 activities (e.g., volunteering, socializing, chess) (range = 0–80). The Applied Mindfulness Process Scale (AMPS) measures decentering and positive and negative emotional regulation (range = 0–60). The Mediterranean-DASH Intervention for Neurodegenerative Delay Diet (MIND) assesses 15 diet components (e.g., berries, nuts) (range = 0–15). Lastly, the Social Engagement Score assesses social activities, socialization, and engagement (range = 1–4). Total RI scores are calculated by summing the subcomponent scores (range = 1–378; higher scores = greater resilience against dementia). VI is composed of 12 risk factors for dementia: age, biological sex, race and ethnicity, education, frailty (Fried Frailty Index ≥ 2), obesity ($>30\,kg/m^2$), depression (Hospital Anxiety and Depression Scale ≥ 8), and self-reported comorbidities (hypercholesterolemia, diabetes, hypertension, heart disease, stroke) [40] (range = 2–20; higher scores = greater vulnerability to dementia). Other factors such as smoking, alcohol use, and traumatic brain injury were evaluated for inclusion but did not significantly contribute to the predictive model and thus were excluded from the final set of factors used to derive the VI.

We included two brief, validated measures assessing executive function and global cognitive function, which were available for the majority of HBI participants (other cognitive test scores/cognitive domains were available for a smaller subset). The Montreal Cognitive Assessment (MoCA) ranges from 0 to 30, with higher scores indicating better global cognition [41, 42]. NCST has been shown to discriminate between those with and without cognitive impairment (range = 0–70; higher scores = better executive function) [43].

HBI's blood collection and MRI scan protocols are elsewhere [34]. Blood specimens are shipped to C2N laboratories, which employs mass spectrometry to calculate plasma AD biomarkers including $A\beta_{42/40}$ and pTau-217/npTau-217. Blood-based measures of inflammation and cardiovascular disease risk, specifically lipoprotein A (lp(A)) (optimal: 0 to < 75 nmol/L; moderate: 75–125 nmol/L: high risk:>125 nmol/L) and high-sensitivity c-reactive protein (CRP) (optimal: 0 to < 1 mg/L, moderate risk: 1–3 mg/L, high risk:>3), were derived by Cleveland HeartLab. MRI (i.e., T1, FLAIR) are uploaded to Combinostics, an FDA-cleared MRI pipeline that provides quantitative measures of total hippocampal and white matter hyperintensity (WMH) volumes (mL). These biomarkers for AD neuropathology, inflammation, and brain volume were chosen because they are risk factors for cognitive impairment and dementia [33, 44–46].

Statistical analyses

Descriptive statistics (e.g., mean) describe sample demographics and neighborhood and ADRD measures. Multivariable linear regression models tested associations between the five social determinants

(e.g., neighborhood greenspace access index, time spent in neighborhood greenspaces index, etc.) and the ADRD-related outcomes (e.g., RI, VI, etc.). Models for RI and the biomarker outcomes *a priori* controlled for age, gender, race, ethnicity, education, and presence of cognitive impairment (Clinical Dementia Rating = 0.5 or 1 versus 0), and models for VI *a priori* controlled for cognitive impairment (other important covariates already included in VI calculation). VI and RI models additionally controlled for living situation when doing so changed the regression estimate by more than 10%. We restricted to individuals with no impairment (CDR = 0; $n = 97$) when examining plasma biomarkers to assess whether SDOH were associated with lower plasma $A\beta_{42/40}$ and higher pTau-217/npTau-217 ratios among asymptomatic individuals (i.e., greater chance of being preclinical AD).

RESULTS

Table 1 provides sample demographics ($n = 162$). Participants were on average 68.2 years old (range = 45–88) with 16.5 years of education (range = 4–20). Sixty-five percent were women; 34% lived alone; 9% were Black, 2% Asian, 87% White, and 1% two or more racial groups; and 11% were Hispanic. Thirty-seven percent had some cognitive impairment (CDR = 0.5 or 1 versus 0). Table 1 provides means and SDs for the SDOH and ADRD outcomes and the number of participants missing each measure.

Table 1
Participant Characteristics

Baseline visit characteristics[a]	Statistic
Sample size, n	162
Age, mean (SD)	68.2 (10.7)
Gender, n (%)	
Male	57 (35.2%)
Female	105 (64.8%)
Racial group, n (%)	
White	139 (87.4%)
Black/African American	15 (9.4%)
Asian	3 (1.9%)
Two or more racial groups	2 (1.3%)
Hispanic ethnicity, n (%)	17 (10.6%)
Living situation, n (%)	
Lives alone	54 (33.5%)
Lives with spouse, partner, or other	107 (66.5%)
Years of education, mean (SD)	16.5 (3.4)
Cognitively impaired (CDR 0.5 or 1 versus 0), n (%)	57 (37.0%)
High sensitivity C-reactive protein (hs-CRP, mg/L), mean (SD)	2.22 (2.49)
Lipoprotein A, (lp(A), nmol//L), mean (SD)	71.56 (86.44)
Vulnerability Index[b], mean (SD)	6.6 (2.3)
Resilience Index[b], mean (SD)	175.3 (31.8)
Number symbol coding task (NSCT), mean (SD)	42.3 (43.0)
Montreal Cognitive Assessment (MoCA), mean (SD)	25.4 (3.0)
Plasma $A\beta_{42/40}$, mean (SD)	0.10 (0.04)
Plasma pTau-217/npTau-217 (%), mean (SD)	1.14 (0.81)
Hippocampal volume (mL), mean (SD)	7.15 (0.95)
White matter hyperintensity volume (mL), mean (SD)	3.98 (6.57)
Area deprivation Index[b], mean (SD)	32.7 (26.2)
Interpersonal discrimination index[b], mean (SD)	5.3 (6.8)
Neighborhood greenspace access index[b], mean (SD)	15.8 (4.1)
Time spent in neighborhood greenspaces index[b], mean (SD)	10.6 (5.4)
Low trust in neighbors (versus moderate/high), n (%)	25 (15.5%)

SD, standard deviation; ADI, Area deprivation index; CDR, Clinical Dementia Rating. [a]Missing data (no missing data if not indicated): racial group, $n = 3$; Hispanic ethnicity, $n = 2$; living situation, $n = 1$; education, $n = 1$; $A\beta_{42/40}$, $n = 42$; pTau-217/npTau-217, $n = 43$; hippocampal volume, $n = 57$; white matter hyperintensity volume, $n = 58$; Greenspace access index, $n = 51$; Time in greenspace index, $n = 40$; Discrimination index, $n = 45$; ADI, $n = 17$; Area deprivation index, $n = 17$; MoCA, $n = 4$; hs-CRP, $n = 68$; lp(A), $n = 69$. [b]Range in scores: Resilience index: 1–378 (higher = more resilient); Vulnerability index: 2–20 (higher = more vulnerable); ADI: 1–100 (higher = more deprived); discrimination: 9–40 (higher = more); greenspace access: 3–21 (higher = greater access); time in greenspaces: 3–21 (higher = greater time).

Table 2
Associations between social determinants and resilience, vulnerability and cognition

Measure	Outcome	Estimate[a,b]	95% CI	*p*
Neighborhood greenspace access index	Resilience index	**2.83**	**1.40, 4.26**	**0.0002**
	Vulnerability index	0.01	–0.10, 0.12	0.87
	Number symbol coding task	0.40	–0.02, 0.82	0.06
	Montreal cognitive assessment	0.06[c]	–0.08, 0.20	0.41
Time spent in neighborhood greenspaces index	Resilience index	**2.30**	**1.24, 3.35**	**<0.0001**
	Vulnerability index	–0.01	–0.08, 0.07	0.87
	Number symbol coding task	0.23	–0.08, 0.54	0.15
	Montreal cognitive assessment	–0.03[c]	–0.14, 0.06	0.48
Low trust in neighbors	Resilience index	–4.01[c]	–18.31, 10.28	0.58
	Vulnerability index	0.55	–0.42, 1.52	0.26
	Number symbol coding task	–0.59	–4.64, 3.46	0.77
	Montreal cognitive assessment	–0.46	–1.79, 0.87	0.49
Interpersonal discrimination index	Resilience index	–0.34	–1.32, 0.64	0.49
	Vulnerability index	**0.10**	**0.04, 0.16**	**0.001**
	Number symbol coding task	–0.04	–0.31, 0.24	0.79
	Montreal cognitive assessment	0.00[c]	–0.08, 0.09	0.94
Area deprivation index (ADI)	Resilience index	–0.16	–0.38, 0.05	0.13
	Vulnerability index	**0.017**	**0.003, 0.032**	**0.02**
	Number symbol coding task	0.04	–0.03, 0.10	0.25
	Montreal cognitive assessment	0.01[c]	–0.01, 0.03	0.44

[a]All models for vulnerability index *a priori* controlled presence of cognitive impairment (Clinical Dementia Rating = 0.5 or 1 versus 0). [b]All models for resilience index *a priori* controlled for participant's age, gender, race, ethnicity, education (years), and presence of cognitive impairment (Clinical Dementia Rating = 0.5 or 1 versus 0). [c]Models additional controlled for living situation because found to be an additional confounder (changed estimate by > 10%).

Table 2 provides adjusted associations between the SDOH and RI and VI. Perceiving greater greenspace access (i.e., neighborhood greenspace access index score) and greater time spent in neighborhood greenspaces were associated with greater RI scores (estimates = 2.83, 95% CI = 1.40–4.26, and = 2.30, 95% CI = 1.24–3.35, respectively). Reporting greater interpersonal discrimination and living in higher ADI neighborhoods were associated with greater VI scores (estimates = 0.10, 95% CI = 0.04–0.16, and 0.017, 95% CI = 0.003–0.032, respectively). No associations were observed with the cognitive measures.

Table 3 provides adjusted associations between SDOH and the biomarkers. Greater discrimination was associated with greater WMH volumes (estimate = 0.273; 95% CI = 0.035–0.511). No other associations at $p < 0.05$ were observed with the biomarker outcomes.

DISCUSSION

Among individuals with no/mild cognitive impairment, (a) perceived better neighborhood greenspace access and more time spent in neighborhood greenspaces were associated with greater RI scores; (b) greater discrimination and living in more deprived neighborhoods were associated with greater VI scores; and (c) greater discrimination was associated with more WMH. Overall, this suggests that individual- and neighborhood-level SDOH in later life are associated with vulnerability to and resilience against ADRD.

Beneficial associations between neighborhood greenspace access and lower ADRD risk and better cognitive function have been demonstrated in a growing number of studies of older adults [4, 7, 15, 10, 47–49]. Objective measures of greenspace exposure throughout the life course have been associated with slower cognitive decline in older age [4, 49–51]. Furthermore, beneficial associations between objective greenspace measures and cognitive and brain health have been observed in middle-aged adults [52]. For instance, in a cohort of middle-aged women in the US, cross-sectional associations were observed between greener neighborhoods (i.e., normalized difference vegetation index (NDVI) measure) and better global cognition and psychomotor speed/attention [52]. In addition, greater neighborhood greenness was cross-sectionally associated with better global cognition and verbal fluency and greater cortical thickness in both brain hemispheres in a study of middle-aged Bulgarians [53]. Lastly, in a cohort of middle- to older-age individuals without cognitive impairment, greater neighborhood greenness measured via the NDVI was associated with greater cortical thickness

Table 3
Adjusted associations between social determinants of health and biomarker outcomes

Measure[a]	Continuous biomarker outcome	Estimate	95% CI	*p*
Neighborhood greenspace access index	Plasma $A\beta_{42/40}$[b]	0.0002	–0.0004, 0.0009	0.45
	Plasma pTau-217/npTau-217 (%)[b]	–0.02	–0.06, 0.02	0.33
	Hippocampal volume	0.009	–0.033, 0.051	0.68
	WMH volume	–0.154	–0.428, 0.120	0.27
	High sensitivity CRP	0.01	–0.13, 0.15	0.89
	Lipoprotein A	3.58	–0.85, 8.01	0.11
Time spent in neighborhood greenspaces index	Plasma $A\beta_{42/40}$[b]	–0.0001	–0.0006, 0.0005	0.63
	Plasma pTau-217/npTau-217 (%)[b]	–0.01	–0.04, 0.02	0.64
	Hippocampal volume	0.005	–0.027, 0.037	0.75
	WMH volume	0.031	–0.233, 0.296	0.82
	High sensitivity CRP	0.04	–0.07, 0.15	0.45
	Lipoprotein A	3.41	–0.18, 7.00	0.06
Low trust in neighbors	Plasma $A\beta_{42/40}$[b]	0.0022	–0.0049, 0.0093	0.53
	Plasma pTau-217/npTau-217 (%)[b]	–0.04	–0.52, 0.44	0.87
	Hippocampal volume	–0.055	–0.476, 0.587	0.84
	WMH volume	0.107	–4.316, 4.528	0.96
	High sensitivity CRP	–0.57	–2.30, 1.17	0.52
	Lipoprotein A	–4.68	–62.99, 53.63	0.87
Interpersonal discrimination index	Plasma $A\beta_{42/40}$[b]	0.0002	–0.0002, 0.0006	0.50
	Plasma pTau-217/npTau-217 (%)[b]	–0.01	–0.04, 0.02	0.58
	Hippocampal volume	–0.019	–0.047, 0.009	0.17
	WMH volume	**0.273**	**0.035, 0.511**	**0.02**
	High sensitivity CRP	0.01	–0.07, 0.10	0.74
	Lipoprotein A	0.46	–2.53, 3.45	0.76
Area deprivation index (ADI)	Plasma $A\beta_{42/40}$[b]	–0.0000	–0.0001, 0.0001	0.95
	Plasma pTau-217/npTau-217 (%)[b]	0.00	–0.00, 0.01	0.30
	Hippocampal volume	0.002	–0.006, 0.010	0.62
	WMH volume	0.039	–0.025, 0.104	0.23
	High sensitivity CRP	–0.004	–0.026, 0.018	0.72
	Lipoprotein A	0.07	–0.69, 0.83	0.85

Ci, confidence interval; WMH, white matter hyperintensity; CRP, C-reactive protein; [a]Models controlled for participant's age, gender, race, ethnicity, education (years), and presence of cognitive impairment (Clinical Dementia Rating = 0.5 or 1 versus 0); [b]Restricted to individuals with no cognitive impairment (global Clinical Dementia Rating = 0), $n = 97$.

in Alzheimer's disease regions of interest as measured via MRI [54]. Overall, prior studies, which have been discussed in greater detail in various literature reviews [4, 7, 10], suggest that access to greenspaces across the lifespan is protective against ADRD, indicating a possible intervention target to prevent disease or slow age of onset through the population-level promotion of social and physical activity and mental health.

A few studies have examined perceptions of greenspaces in relation to ADRD outcomes. Satisfaction with surrounding greenspaces was not associated with subjective cognitive decline in a Korean study of ≥ 18-year-olds [55]. Perceived lack of neighborhood parks/playgrounds was associated with worse scores on a composite measure of global cognition in ≥ 45-year-olds of the Reasons for Geographic and Racial Differences in Stroke (REGARDS) cohort [56]. Lastly, self-reported natural environment visits and time spent visiting natural environments were not associated with a measure of visual attention/executive processing in ≥ 18-year-olds in the PHENOTYPE cohort in Spain, the Netherlands, and UK [57]. Researchers increasingly recognize the importance of perceptions of neighborhood environments (compared to objective measures) on ADRD risk factors/behaviors such as physical activity in the neighborhood. Our study adds to the literature by focusing on perceived access to and time spent in neighborhoods greenspaces in later life and their associations with greater resilience against ADRD.

Individuals reporting greater lifetime discrimination had greater vulnerability to developing ADRD and greater white matter damage as measured via WMH volume. Lifelong challenges and chronic stress associated with frequent macro- and microaggressions and discrimination in housing, education and job opportunities can lead to increased overall risk in developing ADRD [26]. Regardless of SES, Black individuals exhibit higher allosteric load and inflammation, cumulative damage done to the body

when it is exposed to chronic stress [30, 58]. Similar chronic stressors extend to historically disadvantaged groups including women, immigrants/non-English speakers, and the LGBTQIA community. Chronic stress is known to impact cardiovascular and cerebrovascular health (e.g., white matter damage measured via MRI), and through these mechanisms, may hasten the age of onset of dementia or ADRD symptoms.

This study has limitations. We found no associations between SDOH and the plasma AD biomarkers or inflammation biomarkers, which may be a result of limited statistical power due to the smaller sample size with these biomarker measures. We performed complete case analyses (participants missing data were dropped from analyses), and thus, we consider this study preliminary. While we included measures of executive function and global cognition, future work would benefit from examining associations with specific cognitive domains such as episodic memory (often affected first in Alzheimer's disease) and other domains associated with brain aging and other ADRD diagnoses (e.g., language). Findings must be replicated and expanded upon once additional participants and longitudinal measures are added to the HBI cohort, as well as in other racially/ethnically, geographically, and socioeconomically diverse cohorts (e.g., our sample was highly educated, which may have biased results and limits generalizability). As the cohort grows, we can address whether SDOH are associated with longitudinal change in biomarkers and incident cognitive impairment due to different ADRD etiologies. The discrimination index was not designed to measure subdomains of discrimination (e.g., racial), which could be explored in future ADRD studies that have access to such measures. Available measures of neighborhood environment were limited and could be expanded upon in future iterations of the annual HBI assessments to improve internal consistency of the neighborhood greenspace access index and to include additional qualities of neighborhood greenspaces (e.g., recreational spaces, gardens). Lastly, the neighborhood greenspace indices will need to be validated against objective measures of greenspace access and time spent in greenspace.

Our study contributes significantly to the burgeoning literature on this topic by emphasizing the importance of perceptions of built and social environments on ADRD risk and resilience. Subsequent work needs to elucidate underlying mechanisms relating SDOH to ADRD-related outcomes, to demonstrate life course and longitudinal associations that will support causality in observed associations, and to investigate associations within historically disadvantaged and minoritized populations, which would benefit the most from any interventions to improve social and built environments for brain health promotion across the life course.

AUTHOR CONTRIBUTIONS

Lilah Besser (Conceptualization; Data curation; Formal analysis; Methodology; Project administration; Writing – original draft; Writing – review & editing); Kyle Edwards (Writing – original draft); Nina-Simone Lobban (Writing – original draft; Writing – review & editing); Magdalena Tolea (Writing – original draft; Writing – review & editing); James E. Galvin (Writing – original draft; Writing – review & editing).

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CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

DATA AVAILABILITY

The data supporting the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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