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Social and Environmental Characteristics Associated With Older Drivers' Use of Non-driving Transportation Modes

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Abstract

Objective: We examined associations between older drivers' social and environmental characteristics and odds of using non-driving transportation modes. **Methods:** Using 2015 National Health and Aging Trends Study data for community-dwelling drivers (n = 5102), we estimated logistic regression models of associations between social characteristics, environmental characteristics, and odds of using non-driving transportation modes three years later. **Results:** Drivers had 20% increase in odds of getting rides three years later for each additional confidante (adjusted odds ratio [aOR] = 1.20, 95% confidence interval [CI]: 1.11–1.30). Drivers living in more walkable neighborhoods were more likely to walk to get places (National Walkability Index [NWI] score of 18 vs. 2 aOR = 1.71, 95% CI: 1.02–2.90) and take public transit three years later (NWI 18 vs. 2 aOR = 7.47, 95% CI: 1.69–33.0). **Discussion:** Identifying modifiable social and environmental characteristics can inform future interventions supporting older adults' health during the transition to non-driving.

Keywords

transportation, travel behavior, social networks, neighborhoods, driving

Introduction

In the United States, most adults drive a private vehicle as their principal transportation mode (Shen et al., 2017). However, the increasing risk for medical conditions and medication use associated with increasing age can put drivers at a greater risk of adverse driving events (Dickerson et al., 2007). These health-related changes can necessitate a transition to non-driving (Dickerson et al., 2019). Moreover, driving cessation is associated with adverse emotional, social, and functional outcomes including depression and social isolation (Chihuri et al., 2016; Hirai et al., 2020; Qin et al., 2020). Coping factors (e.g., alternative transportation options) may ameliorate adverse health and social outcomes (Choi, et al., 2012b; Turner et al., 2017). Much of the literature on transportation among older adults, however, is cross-sectional or drawn from small, unrepresentative samples (Chudyk et al., 2015; Hahn et al., 2016). The purpose of this study is to explore associations between social and environmental characteristics and older drivers' use of alternative transportation options in the United States. These findings can inform future interventions and policy designed to support older drivers' health and well-being through transitions to non-driving.

Older drivers may use a variety of transportation options, particularly as they reduce driving. Travel behavior depends on an individual's decision-making about the choice set of transportation modes available to them (e.g., driving, walking, and taking public transit) (Domencich & McFadden, 1975; Rasouli & Timmermans, 2014). Social and environmental characteristics influence how older drivers assess whether to use different transportation modes (Hansmann et al., 2023; Ozbilen et al., 2022). We frame our understanding of the relationship between social and

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environmental characteristics and older adults' use of alternative transportation options based on a mobility capital model (Musselwhite & Scott, 2019). In this model, mobility without a car depends on social capital (e.g., friends and family), infrastructure capital (e.g., transportation services), cultural capital (e.g., norms and policies), and individual capital (e.g., abilities and openness to change) (Musselwhite & Scott, 2019). Older drivers may experience gaps in capital—for example, infrastructure gaps such as inadequate pedestrian infrastructure or public transit services. Older drivers then compensate for gaps with other forms of capital, such as getting rides from social network members (Choi, et al., 2012a). When older drivers cannot meet gaps in their mobility capital, they face limited mobility outside their home.

Getting rides from members of one's social network—spouses, adult children, friends, etc.—is important when reducing or stopping driving (Choi, et al., 2012a; Koumoutzis & Vivoda, 2023). The AARP estimates that family and friends provide >1 billion trips per year for adults ages 70 years or older—with adult children acting as drivers in 33% of trips (Feinberg et al., 2011). For social network members, giving rides can require large commitments of time (Koumoutzis et al., 2022), access to a car, money for gas, and geographic proximity to the older adult in question and their destinations. Many older adults ration their requests for rides from their social network to avoid feeling like a burden to others (Meuser et al., 2013). Social capital alone may not be adequate to meet travel needs.

Older adults use other alternative transportation options like walking, public transit, or paratransit service less frequently than getting rides (Kerschner & Silverstein, 2018). However, these options play an important role in meeting the infrastructure and cultural capital needs of older adults who do not drive (Musselwhite & Scott, 2019). Environmental characteristics can impact the likelihood of older adults using these options. Older adults are more likely to walk for transportation if there are shorter distances to travel, greater variety of destinations, green spaces, and crosswalks with countdown timers (Ozbilen et al., 2022). Environmental characteristics are also associated with whether older adults' take public transit. For example, older adults living in areas with cracked or broken sidewalks have lower odds of taking public transit than those who live in areas with continuous sidewalks (Gimie et al., 2022). In general, neighborhood disorder (e.g., abandoned buildings and litter) is associated with older adults engaging in fewer activities outside their homes (Latham & Clarke, 2018).

Older adults' individual characteristics have been associated with using alternative transportation options. With increasing age, older adults are less likely walk or take public transit to get places outside their home (Gimie et al., 2022; Shen et al., 2017). Women stop driving at earlier ages than men and subsequently use alternative transportation options more often than men (Ang et al., 2019; Böcker et al., 2017). Older adults with lower levels of educational attainment make less trips by driving and more by public transit (Bautista-Hernández, 2021). Older adults with lower income use walking and public transit as travel modes more frequently than wealthier older adults (Lehning et al., 2018).

Health and functional status also influence older adults' travel behavior due to increased potential risks of walking or taking public transit (Klicnik & Dogra, 2019). Certain physical, mental, and cognitive deficits may make engaging in some modes of travel more challenging. For example, older adults with dementia may have increased risk for getting lost if walking or taking public transit alone (Kales et al., 2015). Better health and function is associated with increased participation in activities outside one's home, which increases the need to travel around one's community (Nordbakke & Schwanen, 2014).

Understanding the social and environmental characteristics associated with older drivers' use of alternative transportation options over time will help prioritize future interventions and policies designed to support older adults' mobility around their communities, particularly after they stop driving. In this study, we use data from the National Health and Aging Trends Study (NHATS), a nationally representative sample of U.S. older adults. We limit our sample to community-dwelling older drivers and examine associations between their social and environmental characteristics and use of alternative transportation options three years later. We hypothesize the following:

- Older drivers with more social network members who live nearby or in the same household will be more likely to get rides from others to get places outside their home than older drivers with fewer social network members.
- Older drivers who live in neighborhoods with more indicators of walkability and fewer indicators of area disadvantage will be more likely to walk and take public transit to get places than older drivers who live in less walkable, more disadvantaged neighborhoods.

Methods

Data and Sample

We used data from the 2015 wave of the NHATS and follow-up data from 2018 to examine odds of using alternative transportation options after three years. The NHATS is a nationally representative sample of Medicare beneficiaries, ages 65 and older, designed to study trends in late-life functioning (Kasper & Freedman, 2021). Investigators used a stratified three-stage sample design with intentional oversampling of the oldest age group and Black non-Hispanic adults (Montaquila et al., 2012). For these analyses, we used data from the NHATS restricted files to include participant information regarding the geographic area where they lived.

We limited our analytic sample to community-dwelling older adults in the 2015 interview (n = 7070) and further restricted to those who had driven a car in the month prior to the interview (n = 5140) and who did not require a proxy respondent to answer interview questions (n = 5102). At the three-year follow-up, 369 participants had died, 159 participants had moved out of a community setting, and 1011 participants had been lost to follow-up. We excluded participants from our regression analyses if they had died or moved out of the community setting by three-year follow-up for a final analytic sample of 4574 participants.

A local university Institutional Review Board deemed this study exempt from review due to the minimal risks associated with using de-identified, publicly available data and geographic data consistent with the parent study's data use agreement.

Measures

Transportation Options. Our primary outcomes were the use of alternative transportation options to driving in 2018. NHATS participants reported whether they used the following modes of transportation to get places outside their home in the month prior to the interview: getting rides from others, walking, or taking public transit. We treated each of these as binary outcome variables (yes, no).

Social Characteristics. We identified geographically proximate social network members by creating binary variables for living arrangement: living with another household member (yes, no), living with a spouse/partner (yes, no), or living with any of their children (yes, no). We treated each of these as separate explanatory variables to control for participants who account for whether participants were living alone or not as well as who they were living with. NHATS also asks participants to name up to five people they "talked to about important things in the last month," who we refer to as confidantes. We identified geographically proximate confidantes who lived in the same county as the participant but not in the same household, ranging from 0 to 5 confidantes.

Environmental Characteristics. From data gathered in the NHATS 2015 interview, we used participants' Rural Urban Continuum Codes to identify participants living in metropolitan (code = 1–3) or nonmetropolitan areas (code = 4–9). We identified access to walkable streets or public transit using additional data from the National Walkability Index (NWI), which incorporates variables measuring intersection density, proximity to transit stops, and diversity of land use (Thomas & Zeller, 2021). We treated the NWI score as a continuous variable (range = 1–20), with a higher score representing a more walkable neighborhood. We used data from the 2015 Area Deprivation Index (ADI) to reflect neighborhood-level disadvantage. The ADI combines 17 measures of neighborhood disadvantage related to income, employment, education, and housing quality captured at the census block group level (Kind & Buckingham, 2018). A higher ADI percentile represents a more disadvantaged area. We treated the ADI percentile as a continuous variable (range = 1–100).

Geographic data for NHATS participants is available at the census-tract level, but both NWI and ADI represent information for census block groups—a small geographic unit approximating neighborhood boundaries. We estimated population-weighted values for each participant based on NWI and ADI scores for the census block groups in the participant's census tract. We determined population sizes of census block groups from National Historical GIS data from 2015 (Manson et al., 2022). We excluded census block groups if they were missing ADI scores (n = 42 block groups).

Individual Characteristics. We included age (from age 65 in 5-year increments, up to those aged 90 or older), gender (male or female), race/ethnicity (White non-Hispanic, Black non-Hispanic, Hispanic, or other), educational attainment (less than high school diploma, high school diploma/equivalent, or more than high school diploma), and individual income quartile (calculated for all NHATS participants in 2015).

We included covariates to reflect health and functional status in 2015 including self-rated health (poor, fair, good, very good, or excellent), whether the participant had help with 5 instrumental activities of daily living (IADLs; help with all, help with at least one but not all, or help with none), difficulty with vision even with correction (yes or no), risk for depression—identified using Patient-Health Questionnaire-2 (score ranges from 0 to 6, at risk for depression if score >=3, not at risk for depression if score <3) (Löwe et al., 2005), and dementia status (probable dementia, possible dementia, or no dementia). Dementia status in NHATS is determined by self-reported physician diagnosis of Alzheimer's disease, Alzheimer's Disease 8 Dementia Screening Interview, and cognitive testing (Kasper et al., 2013).

We also included participants' driving behavior in 2015 in models. NHATS participants report their driving frequency as every day, most days (5–6 days per week), some days (2–4 days per week), rarely (1 day per week or less), or never in the month prior to their interview. Participants report whether they avoided certain driving behaviors in the month prior to the interview: driving at night, driving alone, driving in bad weather, or driving on highways. We treated number of driving avoidance behaviors as a discrete variable ranging from 0 to 4.

Statistical Analysis

When covariates of interest from the NHATS data were missing due to incomplete response or losses to follow-up, we used multiple imputation to make valid inferences from the available data (Reiter et al., 2006). We created five imputed data sets using a fully conditional specification method—an

approach that involves specifying univariate models for each variable with missing data using logistic regression for binary and ordinal variables and the discriminant function method for nominal categorical variables. The greatest source of missing data was participants who were lost to follow-up by 2018 ($n = 1011$) for reasons other than death or moving out of the community (as these two groups were dropped from the analysis). By using multiple imputation, we attempt to mitigate the risk of bias created by simply excluding missing values in a large cohort study.

We described individual, social, and environmental characteristics of the full sample of participants in 2015. We estimated logistic regression models evaluating the association between each of the four social characteristic variables—living with anyone, living with spouse/partner, living with an adult child, and number of confidantes in 2015—and odds of getting rides from others to get places in 2018, adjusted for the environmental and individual characteristics described above. Next, we evaluated whether associations between NWI and ADI in 2015 and the predicted probability of walking or taking public transit in 2018 were linear. We used Akaike Information Criterion (AIC) to examine whether model fit was superior when using linear, polynomial, or natural cubic spline approaches to continuous variables. Finally, we estimated logistic regression models, adjusted for individual characteristics, evaluating the association between each of these two environmental characteristics—NWI and ADI in 2015—and a) odds of walking and b) odds of taking public transit to get places in 2018. We adjusted these models for the social and individual characteristics described above.

In logistic regression models, we adjusted variance parameters necessitated by the clusters and strata used in the NHATS complex sampling design using a modified balanced repeated replication approach. We used population weights from the 2015 cohort in these analyses. We conducted all analyses using SAS software, Version 9.4 (SAS Institute Inc, 2018).

Results

Sample Characteristics

Table 1 presents weighted characteristics of community-dwelling older adult Medicare enrollees who were current drivers in 2015 (unweighted n = 5,102, weighted = 31,059,767). Most older drivers were between ages 65 and 74 years (63%). Women made up slightly more than half of older drivers (51%). Older drivers were predominantly White, non-Hispanic (85%), while fewer were Black, non-Hispanic (7%) or Hispanic (5%). Most older drivers had earned more than a high school degree (63%) and 26% were in the highest income quartile for the overall NHATS sample.

Most older drivers reported having good, very good, or excellent self-rated health (84%). About half of older drivers got help with at least one IADL (51%), but very few reported getting help with all IADLs (2%). Similarly, it was uncommon for older drivers to have difficulty with their vision even when using corrective lenses (3%) or screen at-risk for depression based on their PHQ-2 questionnaire in 2015 (9%). Most older drivers were classified as having no dementia (92%) and very few as having probable dementia (2%).

Half of older drivers drove every day (50%). On average, older drivers were avoiding few driving behaviors (mean = 0.65). Most older drivers lived with others (72%), and more than half lived with their spouse/partner (63%). Less commonly, older drivers lived with one or more of their children (14%). The average number of older drivers' geographically proximate confidantes was less than one (0.8).

Few older drivers lived in nonmetropolitan areas (19%). Older drivers' average neighborhood NWI score was 8.6 (range from 1 to 20, 20 being the most walkable neighborhoods). Older drivers' average neighborhood ADI percentile was 47.4 (with a range from 1 to 100, 100 being the most disadvantaged neighborhoods).

Social and Environmental Characteristics and Odds of Getting Rides

Our first hypothesis is that older drivers with more social network members who live nearby or in the same household will be more likely to get rides from others to get places outside their home than older drivers with fewer social network members. The first column of results in Table 2, column 1, presents the adjusted odds ratios (aORs) and 95% confidence intervals (CIs) when regressing getting rides from others on living arrangement variables and number of geographically proximate confidantes outside the household. Older drivers living with one or more of their children in 2015 had higher odds of getting a ride from others in 2018 than older drivers who did not live with their children (aOR = 1.28, 95% CI: 1.05–1.56). Older drivers who had more non-household, geographically proximate confidantes also had higher odds of getting a ride from others, with a 20% increase in the odds of getting rides from others with each additional confidante (aOR = 1.20, 95% CI: 1.11–1.30).

While not the focus of this hypothesis, we note that older drivers in nonmetropolitan areas in 2015 were less likely to get rides from others in 2018 compared to older drivers in metropolitan areas (aOR = 0.81, 95% CI: 0.66–0.98). We also identified statistically significant associations between individual characteristics and the odds of getting rides from others. Those with advanced age were more likely to get rides from others (e.g., 90+ years vs. 65–69 years aOR = 2.58, 95% CI: 1.54–4.32). Women were more likely to get rides from others than men (aOR = 2.07, 95% CI: 1.65–2.59). Hispanic older drivers were less likely to get rides from others compared to White, non-Hispanic older drivers (aOR = 0.51, 95% CI: 0.31–0.83). Older drivers with less than high school education were less likely to get rides from others compared

Table 1. Weighted Characteristics (Individual, Social, and Environmental) for Community-Dwelling Older Adult Drivers in 2015.

	Sample *n*	5102		
	Population *n*	31,059,767		
		Sample n	*% (95% CI)*	*Mean (SD)*
Demographics				
Age category group, years				
	65–69	895	34.2 (32.9–35.4)	
	70–74	1435	29.2 (28.0–30.5)	
	75–79	1193	18.8 (17.9–19.8)	
	80–84	874	10.7 (10.0–11.4)	
	85–89	517	5.5 (5.0–6.0)	
	90+	188	1.6 (1.4–1.8)	
		2633	50.9 (49.4–52.5)	
Female				
Race, ethnicity				
	White, non-Hispanic	3892	84.7 (82.9–86.5)	
	Black, non-Hispanic	869	6.9 (6.1–7.8)	
	Hispanic	211	5.1 (3.9–6.3)	
	Other	131	3.2 (2.4–4.1)	
Socioeconomic				
Highest education level				
	Less than high school degree	766	12.1 (10.7–13.5)	
	High school degree or equivalent	1342	24.8 (23.0–26.6)	
	More than high school degree	2994	63.1 (60.6–65.6)	
Household income				
	Q1	1514	24.6 (22.8–26.5)	
	Q2	1377	25.3 (23.4–27.1)	
	Q3	1110	23.9 (22.4–25.4)	
	Q4	1101	26.2 (23.5–28.8)	
Health/function				
Self-rated health				
	Excellent	733	17.3 (15.8–18.8)	
	Very good	1687	34.9 (33.4–36.3)	
	Good	1748	31.5 (29.8–33.1)	
	Fair	777	13.4 (12.2–14.6)	
	Poor	156	3.0 (2.4–3.6)	
Has help with IADLs (e.g., preparing meals)				
	No help with IADLs	2532	47.9 (46.5–49.3)	
	Help with some IADLs	2478	50.6 (49.2–52.0)	
	Help with all IADLs	91	1.5 (1.1–1.9)	
Had difficulty with vision (even with correction)		147	2.6 (2.1–3.2)	
At risk for depression		468	8.8 (7.9–9.8)	
Dementia status				
	No dementia	4569	92.0 (91.2–92.7)	
	Possible dementia	393	6.3 (5.6–6.9)	
	Probable dementia	140	1.8 (1.5–2.1)	
Driving behavior				
Driving frequency				
	Drove rarely	272	4.4 (3.9–5.0)	
	Drove some days	870	14.7 (13.8–15.6)	
	Drove most days	1550	30.7 (29.0–32.3)	
	Drove every day	2410	50.2 (48.5–51.9)	
Number of driving avoidance behaviors (range = 0–4)				0.7 (0.02)
Social networks				
Lived with anyone*		3492	72.4 (70.7–74.1)	
Lived with a spouse or partner		2889	62.7 (61.0–64.4)	
Lived with one or more children		761	14.2 (12.9–15.5)	
Confidantes outside the household (range = 0–5)				
Neighborhoods				0.8 (0.02)
Lived in a nonmetropolitan area		1070	19.0 (11.6–26.4)	
National Walkability Index (range = 1–20)				8.6 (0.2)
Area Deprivation Index (range = 1–100)				47.4 (1.6)

We calculated 95% confidence intervals correcting for the complex survey design and multiple imputation.

Table 2. Odds of Using Transportation Options in 2018 (Adjusted for Social, Environmental, and Individual Characteristics).

			Column 1	Column 2	Column 3
		Outcome	Received a ride in 2018	Walked or used a wheelchair in 2018	Used public transit in 2018
Social networks	Lives with anyone (ref = no)		1.03 (0.76–1.39)	0.91 (0.61–1.37)	0.93 (0.46–1.88)
	Lives with spouse (ref = no)		1.24 (0.96–1.60)	1.20 (0.84–1.73)	0.81 (0.46–1.44)
	Lives with child (ref = no)		**1.28 (1.05–1.56)**	0.81 (0.59–1.11)	0.89 (0.53–1.47)
	Number of non-household confidantes		**1.20 (1.11–1.30)**	1.00 (0.93–1.08)	1.04 (0.87–1.24)
Neighborhood	Nonmetropolitan (ref = metropolitan)		**0.81 (0.66–0.98)**	1.32 (0.93–1.87)	0.52 (0.23–1.15)
	National Walkability Index (ref = 2)				
		6	1.09 (0.81–1.48)	0.90 (0.61–1.33)	2.17 (0.52–9.07)
		12	1.23 (0.87–1.74)	1.26 (0.79–2.02)	**4.17 (1.01–17.3)**
		18	**1.66 (1.07–2.59)**	**1.71 (1.02–2.90)**	**7.47 (1.69–33.0)**
	Area Deprivation Index (ref = 85th percentile)				
		5th	1.05 (0.75–1.47)	**2.03 (1.43–2.90)**	**3.06 (1.72–5.46)**
		25th	1.19 (0.92–1.55)	1.19 (0.86–1.64)	1.40 (0.80–2.44)
		45th	1.08 (0.86–1.37)	1.14 (0.85–1.54)	1.17 (0.70–1.96)
		65th	1.01 (0.82–1.23)	1.21 (0.95–1.53)	0.76 (0.39–1.47)
Driving status in 2015	Number of avoidance behaviors		**1.14 (1.06–1.23)**	**0.91 (0.83–0.99)**	0.97 (0.81–1.17)
	Driving frequency (ref = every day)				
		Rarely	**2.57 (1.73–3.81)**	0.66 (0.44–0.99)	2.43 (0.99–5.95)
		Some days	**1.47 (1.15–1.88)**	0.88 (0.70–1.10)	1.46 (0.87–2.44)
		Most days	**1.47 (1.24–1.75)**	0.98 (0.81–1.19)	**1.54 (1.03–2.33)**
Demographics	Age category (ref = 65–69 years)				
		70–74 years	0.94 (0.75–1.19)	0.89 (0.73–1.08)	0.95 (0.66–1.35)
		75–79 years	1.16 (0.93–1.45)	**0.63 (0.49–0.83)**	0.74 (0.44–1.26)
		80–84 years	**1.61 (1.25–2.09)**	**0.60 (0.47–0.76)**	0.78 (0.45–1.36)
		85–89 years	**2.21 (1.64–3.00)**	**0.49 (0.35–0.69)**	0.49 (0.25–0.98)
		90+ years	**2.58 (1.54–4.32)**	**0.24 (0.13–0.47)**	0.64 (0.20–2.04)
	Gender (ref = men)		**2.07 (1.65–2.59)**	**0.52 (0.43–0.63)**	**0.56 (0.37–0.84)**
	Race (ref = White, non-Hispanic)				
		Black, non-Hispanic	0.85 (0.66–1.10)	0.94 (0.70–1.27)	**2.07 (1.20–3.57)**
		Hispanic	**0.53 (0.34–0.82)**	1.43 (0.91–2.25)	1.76 (0.95–3.25)
		Other	**0.51 (0.31–0.83)**	**1.86 (1.04–3.31)**	1.16 (0.51–2.64)
	Education (ref = more than high school)				
		Less than high school	**0.64 (0.47–0.88)**	0.88 (0.68–1.14)	1.08 (0.55–2.11)
		High school degree or equivalent	0.85 (0.69–1.05)	**0.82 (0.67–1.00)**	0.64 (0.41–1.01)
	Individual income (ref = Q4)				
		Q1	0.79 (0.59–1.07)	0.94 (0.69–1.28)	**0.50 (0.27–0.93)**
		Q2	0.82 (0.65–1.04)	0.86 (0.68–1.09)	**0.44 (0.26–0.77)**
		Q3	0.87 (0.67–1.15)	1.07 (0.85–1.35)	**0.56 (0.35–0.90)**
Health	Self-rated health (ref = excellent)				
		Very good	1.15 (0.92–1.44)	**0.74 (0.56–0.98)**	0.88 (0.58–1.36)
		Good	**1.29 (1.00–1.66)**	**0.55 (0.42–0.72)**	**0.59 (0.36–0.95)**

(continued)

Table 2. (continued)

		Outcome	Column 1 Received a ride in 2018	Column 2 Walked or used a wheelchair in 2018	Column 3 Used public transit in 2018
		Fair	1.33 (0.98–1.82)	**0.40 (0.28–0.58)**	0.71 (0.40–1.26)
		Poor	1.26 (0.80–1.99)	**0.33 (0.17–0.65)**	0.68 (0.20–2.34)
	Help with IADLs (ref = none)				
		Help with some IADLs	1.04 (0.83–1.29)	0.80 (0.62–1.02)	0.76 (0.52–1.11)
		Help with all IADLs	1.02 (0.51–2.07)	0.47 (0.21–1.08)	0.57 (0.10–3.27)
	Difficulty with vision (ref = no)		**1.61 (1.02–2.55)**	1.41 (0.73–2.73)	1.26 (0.48–3.28)
	At risk for depression (ref = no)		1.27 (0.94–1.72)	0.99 (0.74–1.31)	1.29 (0.73–2.29)
	Dementia classification (ref = no dementia)				
		Possible dementia	0.99 (0.72–1.36)	1.14 (0.82–1.57)	0.97 (0.50–1.89)
		Probable dementia	0.76 (0.44–1.32)	1.18 (0.66–2.10)	0.62 (0.03–13.52)
Intercept	Intercept		0.13 (0.05–0.30)	6.77 (3.23–14.18)	0.13 (0.01–1.47)

We adjusted for characteristics above from the 2015 interview. We reported odds ratios with 95% confidence intervals accounting for the NHATS complex survey design and multiple imputation. Odds ratios are statistically significant if they do not cross 1.00, which we identified in bold text in this table.

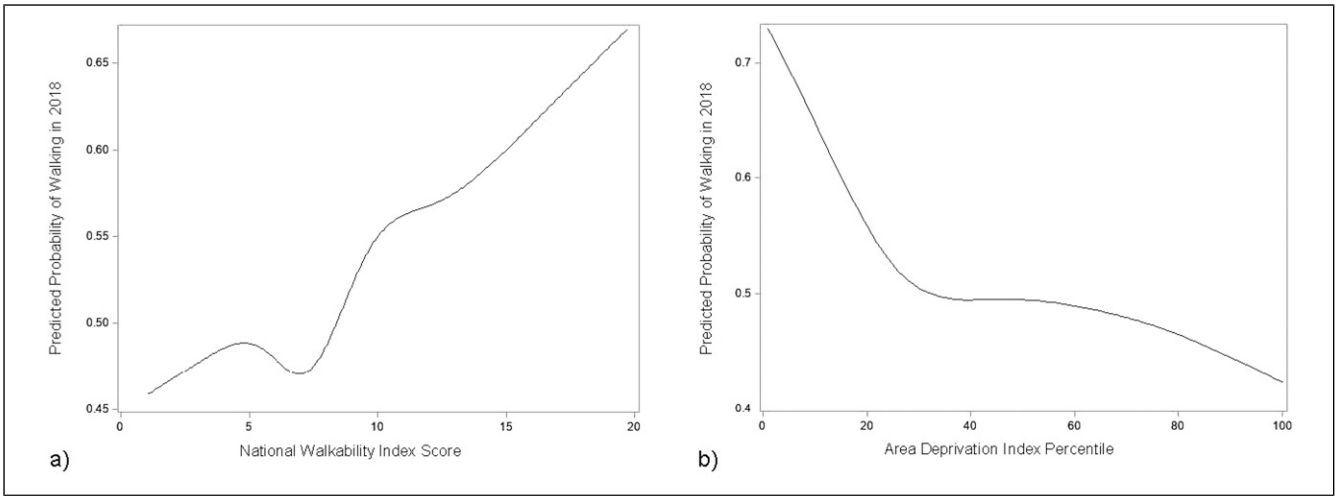

Figure 1. Unadjusted predicted probabilities of walking to get places in 2018. Figure 1(a) reflects predicted probability of walking based on estimated 2015 National Walkability Index score (range = 1–20) and Figure 1(b) reflects predicted probability of walking based on 2015 Area Deprivation Index percentile (range = 1–100).

to those with more than a high school degree (aOR = 0.64, 0.47–0.88). Older drivers who reported difficulty with their vision in 2015 were more likely to get rides from others in 2018 (aOR = 1.61, 95% CI: 1.02–2.55).

Social and Environmental Characteristics and Odds of Walking

We next test our second hypothesis that older drivers who live in neighborhoods with more indicators of walkability and fewer indicators of area disadvantage will be more likely to walk to get places than older drivers who live in less walkable, more disadvantaged neighborhoods. In unadjusted models, the predicted probability of walking to get places in 2018 based on participants' neighborhood characteristics in 2015—NWI score and ADI percentile—was not linear (Figure 1). Based on AIC comparisons, we chose to model NWI and ADI using natural cubic splines with five knots. As shown in Table 2, column 2, older drivers who lived in more walkable neighborhoods in 2015 had greater odds of walking or using a wheelchair to get places outside their home in 2018 than older drivers who lived in less walkable neighborhoods (score of 18 vs. 2 aOR: 1.71, 95% CI: 1.02–2.90). Older drivers who lived in less disadvantaged neighborhoods in 2015 also had greater odds of walking or using a wheelchair to get places (5th vs. 85th percentile aOR = 2.03, 95% CI: 1.43–2.90).

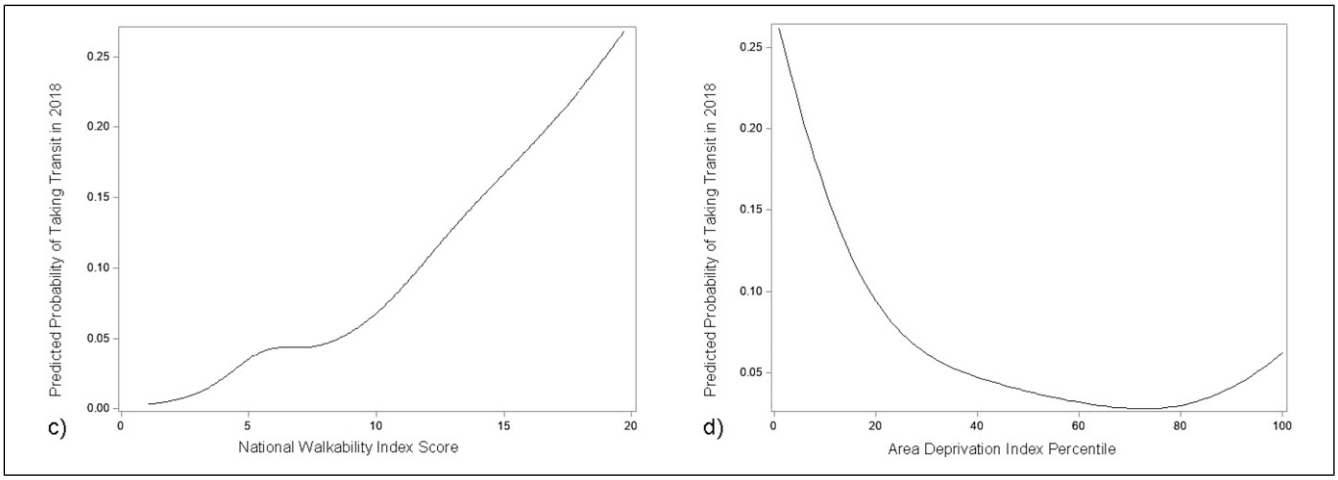

Figure 2. Unadjusted predicted probability of using public transit in 2018. Figure 2(a) reflects predicted probability of using public transit based on estimated 2015 National Walkability Index score (range = 1–20) and Figure 2(b) reflects predicted probability of using public transit based on 2015 Area Deprivation Index percentile (range = 1–100).

While not the focus of our analysis, we also identified statistically significant associations between individual characteristics and the odds of walking to get places. Those with more advanced age were less likely to walk to get places (e.g., 90+ years vs. 65–69 years aOR = 0.52, 95% CI: 0.43–0.63). Women were less likely to walk to get places compared to men (aOR = 0.52, 95% CI: 0.43–0.63). Older drivers with worse self-rated health were less likely to walk to get places (e.g., poor vs. excellent self-rated health aOR = 0.33, 95% CI: 0.17–0.65).

Social and Environmental Characteristics and Odds of Taking Public Transit

Finally, we test our hypothesis that older drivers who live in neighborhoods with more indicators of walkability and fewer indicators of area disadvantage will be more likely to take public transit to get places than older drivers who live in less walkable, more disadvantaged neighborhoods. In unadjusted models, the predicted probability of taking public transit to get places in 2018 based on participants' neighborhood characteristics in 2015—NWI score and ADI percentile—was also not linear (Figure 2). Based on AIC comparisons, we again chose to model NWI and ADI using natural cubic splines with five knots. As shown in Table 2, column 3, older drivers who lived in more walkable neighborhoods in 2015 had greater odds of taking public transit to get places outside their home in 2018 than those who lived in less walkable neighborhoods (score of 18 vs. 2 aOR: 7.47, 95% CI: 1.69–33.0). Older drivers who lived in the least disadvantaged neighborhoods in 2015 also had greater odds of taking public transit to get places (5^{th} vs. 85^{th} percentile aOR = 3.06, 95% CI: 1.72–5.46).

While not the focus of our analysis, we also identified statistically significant associations between individual characteristics and the odds of taking public transit to get places. Women were less likely to take public transit to get places compared to men (aOR = 0.56, 95% CI: 0.37–0.84). Black, non-Hispanic older drivers were more likely to take public transit to get places compared to White, non-Hispanic older drivers (aOR = 2.07, 95% CI: 1.20–3.57).

Discussion

In this study, we hypothesized first that older drivers with more social network members who live nearby or in the same household will be more likely to get rides from others to get places outside their home than older drivers with fewer social network members. Second, we hypothesized that older drivers who live in neighborhoods with more indicators of walkability and fewer indicators of area disadvantage will be more likely to walk and take public transit to get places than older drivers who live in less walkable, more disadvantaged neighborhoods. We used data from the National Health and Aging Trends Study to investigate associations between social and environmental characteristics and older drivers' use of alternative transportation options to driving at three-year follow-up among a nationally representative cohort.

Consistent with our first hypothesis, we found that older drivers' proximity to adult children and non-household confidantes were both associated with the higher odds of getting transportation support after three years. These findings are consistent with the broader literature on driving cessation indicating that social network characteristics are associated with driving behavior outcomes. Older drivers in the Florida Retirement Study were more likely to stop driving if they had received at least some transportation support from friends and neighbors (Choi, et al., 2012a). Confidence in being able to get rides from someone else was also associated with older drivers in Japan being more likely to not renew

their drivers' licenses (Ichikawa et al., 2016). Given the importance of transportation support in the transition to non-driving, our findings add to the existing literature by using longitudinal nationally representative data to identify specific social characteristics associated with a higher odds of getting rides from others over time.

Consistent with our second hypothesis, our results demonstrate associations between greater neighborhood walkability and higher odds of older drivers using walking and public transit as transportation options after three years. However, the association between neighborhood walkability and higher odds of reporting walking at three-year follow-up was relatively weak. While the National Walkability Index (NWI) is associated with higher levels of physical activity for the general population (Watson et al., 2020), older adults may place more value on micro-level sidewalk and intersection characteristics when deciding to walk, and these are not measured in the NWI. Examples include the smoothness of curb cuts—the transition from the sidewalk to the street at an intersection—and where those curb cuts are oriented in relation to the intersection (Gan et al., 2021). Nevertheless, our results show that living in a neighborhood with a higher NWI score was strongly associated with taking public transit to get places, suggesting that proximity and ease of getting to public transit may be important to older drivers' use of this transportation mode.

While not the focus of this study, our findings are consistent with previously identified associations between racial, ethnic, and socioeconomic characteristics and alternative transportation use (Lehning et al., 2018). Future research should investigate causes of these disparities and to what extent race, ethnicity, and socioeconomic status moderate the associations we identified between other social and environmental characteristics and odds of alternative transportation use. Unjust policies of redlining and sequestering of other community resources have created an overlap between racial, ethnic, and socioeconomic disparities with geographic disparities (Bailey et al., 2017). These inequities may further disadvantage racially minoritized older adults due to the neighborhood disadvantage also experienced by their geographically proximate social network.

These findings can help to prioritize efforts to promote mobility capital and wellbeing for older adults as they transition to non-driving by highlighting social and environmental characteristics that may be important to successful coping. Understanding social and environmental contexts can help clinicians tailor their guidance about driving safety and mobility needs for older drivers.

A limitation of this work is that NHATS only provides census tract-level geographic detail about participants, while NWI and Area Deprivation Index (ADI) reflect a smaller geographic level—census block group. Our approach, using population-weighted averages of these variables for census block groups in participant's census tracts, can only provide incomplete information about the associations we investigated. For example, we only identified statistically significant differences in the odds of walking or taking public transit when comparing living in the most advantaged to the most disadvantaged neighborhoods. Future investigation will benefit from opportunities to match neighborhood characteristics to participants' census block groups to estimate the effects of these variables on aging outcomes.

In sum, social network characteristics that reflect geographic proximity and potential emotional support are associated with older adults getting rides from others. Similarly, environmental characteristics that reflect greater walkability and less area-level disadvantage of neighborhoods are associated with higher odds of walking and taking public transit. These social and environmental characteristics may be good indicators of potential alternative transportation options available to adults who are transitioning to non-driving. We call for further research to better understand the influence of social and environmental characteristics on successful maintenance of mobility, health, and quality of life outcomes during and after the transition to non-driving. This in turn is crucial to developing interventions that can help older adults maintain their mobility, health, and quality of life as they transition to non-driving.

Declaration of Conflicting Interests

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