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Biopsychosocial Risk Factors for Driving Cessation: Findings From the Health and Retirement Study

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Abstract

Objective: This study aims to identify social, psychological, and biomedical risk factors for current and future driving cessation in older adults. **Method:** Data from six waves (1998-2008) of the Health and Retirement Study (HRS) were pooled. Participants aged 65 and above were included in the study (*N* = 17,349). **Results:** Multivariate logistic regression models to identify risk factors for current and future driving cessation were consistent (age, gender, education, race, marital status, income, cognitive function, limits in activities of daily living and instrumental activities of daily living, vision, health, diabetes, stroke, arthritis, and hip fracture). Only one variable, falls, was associated with future driving cessation (odds ratio [OR] = 0.92; confidence interval [CI] = [0.85, 1.0]), but not current driving cessation. **Discussion:** Older age, female gender, and minority race were risk factors for current and future cessation. Adults with arthritis were more likely to keep driving compared with those without arthritis.

Keywords

older adults, older drivers, driving cessation, transportation

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Introduction

The population of drivers is aging. During a recent 10-year period (2001-2010), the number of older licensed drivers increased by 22% and now exceeds 34 million drivers age 65 and older National Highway Traffic Safety Administration (NHTSA; 2012). In 2010, older drivers accounted for 16% of all licensed drivers in the United States (NHTSA, 2012). The trend is expected to continue and, in fact, accelerate as the baby boom cohort enters late life (McGuckin & Lynott, 2012). A large influx of older drivers is not necessarily a troubling development, because by many metrics older drivers are among the safest drivers on the road (Dugan, 2006; Insurance Institute for Highway Safety, 2012). However, with increasing age the risk for impairments that impact critical driving skills increases due to changes related to normal aging as well as changes related to age-associated disease (Insurance Institute for Highway Safety, 2012).

Driving is the preferred means of travel for most Americans, especially older adults (Rosenbloom & Herbel, 2009). More than 75% of older adults currently live in suburban or rural areas (Rosenbloom & Herbel, 2009). This is important because many communities lack viable alternative transportation options for people who do not drive. Thus, driving cessation is an unwanted and distressing transition for many older drivers. The consequences of driving cessation can be grim, including decreased out-of-home activity levels (Marottoli et al., 2000), increased social isolation, depressive symptoms (Fonda, Wallace, & Herzog, 2001; Marottoli et al., 1997; Ragland, Satariano, & MacLeod, 2005), health declines (Edwards, Lunsman, Perkins, Rebok, & Roth, 2009), and mortality (Edwards, Perkins, Ross, & Reynolds, 2009).

Researchers have identified a number of risk factors associated with older adult driving cessation, notably related to sensory perception and cognition. Safe driving requires speedy and accurate reactions to sensory stimuli. Older drivers with dual sensory impairment are at greater crash risk than those with a visual acuity or hearing deficit alone (Green, McGwin, & Owsley, 2013). However, research consistently demonstrates that older White and Black adults with poor visual ability have increased risks of driving cessation (Forrest, Bunker, Songer, Cohen, & Cauley, 1997; Owsley, Stalvey, Wells, & Sloane, 1999). A study of factors influencing driving status in an older Latino population found that those who gave up driving had more severe visual impairment compared with those who kept driving (Segal-Gidan, Varma, Salazar, & Mack, 2010). Specific vision issues such as macular degeneration and retinal hemorrhage have also been associated with cessation (Campbell, Bush, & Hale, 1993).

Safe driving also requires the ability to make rapid, sound decisions. Thus, in addition to vision, cognition is a strongly related to driving status. Lower or declining cognitive function, a psychological risk factor, is consistently associated with driving cessation (Brayne et al., 2000; Carr, Shead, & Storandt, 2005; Edwards, Ross, Ackerman, et al., 2008; Segal-Gidan et al., 2010). In fact, cognitive speed of processing predicted driving cessation above and beyond demographic and physical functioning variables in a study of Maryland drivers over a 10-year period (Edwards, Bart, O'Connor, & Cissell, 2009).

Biomedical risk factors for driving cessation include: Parkinson's disease, stroke, and syncope (Campbell et al., 1993), as well as cardiovascular disease, diabetes, and fractures (Forrest et al., 1997). In addition, poor self-reported health status and physical health declines were risks for cessation (Edwards et al., 2009; Sims, Ahmed, Sawyer, & Allman, 2007). Functional impairments such as activities of daily living (ADL) or instrumental activities of daily living (IADL) limitations were significantly associated with driving cessation (MacLeod, Geyer, Satariano, & Ragland, 2004; Campbell et al., 1993; Carr, Flood, Steger-May, Schechtman, & Binder, 2006).

In addition to biomedical and psychological risk factors, a number of sociodemographic factors have been studied. Driving cessation is strongly associated with increasing age (Adler & Rottunda, 2006; Choi & Mezuk, 2012; Dellinger, Sehgal, Sleet, & Barrett-Connor, 2001; Edwards et al., 2008) and gender. Research has consistently demonstrated that older men are less likely than older women to cease driving (Choi, Mezuk, Lohman, Edwards, & Rebok, 2012; Foley, Heimovitz, Guralnik, & Brock, 2002; Kington, Reuben, Rogowski, & Lillard, 1994). In a longitudinal investigation of gender and racial differences in driving cessation Choi and colleagues (2012) found that women and racial minorities were more likely to cease driving compared with men or non-Hispanic Whites. Socioeconomic status influences driving status, too. Few financial resources were associated with increased cessation risk (Adler & Rottunda, 2006).

However, existing research on older driver safety tends to have limitations that temper the interpretation or the generalizability of findings. For example, some cessation research has relied on samples drawn from a single state that contains excellent data on driver attitudes and behavior, but may have a limited array of related variables, lacks geographic variability, may have only a few years of follow-up data, and may rely on an analytic sample of less than 2,000 persons. Numerous important studies on driving cessation have analyzed data collected as part of the Advanced Cognitive Training for Independent and Vital Elderly (ACTIVE) study, a six-site clinical trial that started recruitment in 1998. However, the ACTIVE study is not nationally representative and longitudinal analyses are based on samples of less than 1,000 adults. Data from the Fatal Accident Reporting System (FARS) have been used to identify risk factors for driving outcomes. However, FARS is limited to accidents involving a fatality (w/in 30 days of the crash) and has only limited predictors available related to the vehicle, driver, and environment. Because a fatal crash outcome is a relatively rare event, FARS does not have information about the more frequent and minor outcomes that are perhaps more relevant in terms of prevention or policy. Finally, research using simulators or instrumented vehicles may collect the most objective driving performance data, but due to cost and very specialized equipment, rely on small nonrepresentative samples. Thus, the overall impact of these important studies remains somewhat modest.

In contrast, the Health and Retirement Study (HRS) is a nationally representative sample with excellent driving, biomedical, psychological, social, and demographic variables and has not been extensively utilized in senior transportation studies. Thus, we used a biopsychosocial model to examine a broad range of risk factors for current and imminent (2 years) future driving cessation from six waves (1998-2008) of the HRS.

Method

Data

This study pooled data from six waves (1998, 2000, 2002, 2004, 2006, and 2008) of the HRS. The HRS is a nationally representative longitudinal panel survey of community dwelling middle-aged and older individuals in the United States. The biannual survey, which began in 1992 collects data on demographic characteristics, work history, retirement, household income as well as wealth, physician diagnosed health conditions, and driving status (Juster & Suzman, 1995). Detailed information about the HRS is available online at http://hrsonline.isr.umich.edu.

Sample Selection

Participants aged 65 or above who had complete data on the driving questions of the survey were included in the analytic sample ($N = 17{,}349$).

Measurements

Dependent variable. *Current driving* status was determined by response to the question "are you able to drive?" coded "1" for yes, and "0" for other. This variable has been used in a number of studies (Choi & Mezuk, 2012; Freund & Szinovacz, 2002; Kim & Richardson, 2006). To investigate changes in driving in the near term (within 2 years), we created the second dependent variable, *Future Driving* status. Future driving was the subject's response to that exact question at the next wave of data collection (e.g., "lagged" from data of the previous wave).

Independent variables. Independent variables representing biomedical, psychological, and social risk factors were considered. The biomedical variables include participants' physical limitations and chronic health conditions. ADL difficulty was a count (0-6) of difficulty in performing the following activities: dressing, walking across a room, bathing, eating, getting in/out bed, and toileting. IADL difficulty was a count (0-5) of difficulty performing the following activities: cooking, shopping for groceries, making a call, taking medicine, and managing money.

Participants were asked whether a physician diagnosed chronic health conditions including: high blood pressure, diabetes, cancer, lung diseases, heart diseases, stroke, and arthritis (coded as "1" for having the condition and "0" for no). Self-report of a fall or hip fracture was coded as "1" for yes and "0" for no. Vision was measured by using self-rated eyesight based on responses to the question: "Is your eyesight excellent, very good, good, fair, or poor?" A set of categorical dummy variables was constructed. A binary variable was coded as "excellent," "good," and "fair/poor." For cognitive functioning, the HRS cognition score is summary of three tests (a count [0~35] of words memory test, 7 minus series, and Telephone Interview of Cognitive Status [TICS]). TICS has been widely used as a measure of cognitive function and as a screener for cognitive impairment and dementia (Espeland et al., 2011).

Age was measured in number of years. Gender was assessed with a binary variable: male (1) and female (0). Race was specified with a binary variable: coded as "1" for non-Hispanic Whites and "0" for otherwise. Marital status was also specified with categorical dummy variables: "married," "separated/divorced," "widowed," and "never married." Education (0-17) was a continuous variable measured by years of schooling. Household income was specified with categorical dummy variables corresponding to quartiles of the distribution of annual household income for all HRS households. The household income variable employed contains imputed values for participants with missing data that were assigned by the HRS.

Statistical Analysis

First we calculated the means and standard deviations for each variable. Then, we used a multivariate logistic regression method to estimate the effects on driving status, controlling for demographic characteristics. We also performed the Variance Inflation Factor (VIF) test for a multicollinearity problem. The mean score of VIF test (1.35 for current driving model and 1.34 for future driving model) indicated that multicollinearity was not an issue in the model. We compared risk factors for current driving cessation and future cessation. The future driving status was determined by the response on the next wave of data from the individual. To adjust for the repeated observations in the pooled data set, we adjusted standard errors for covariance between the repeated observations by using a robust option in STATA. We used weighted data at the sample mean for the analysis. Sensitivity analyses were conducted to examine and compare current status and future status model fit.

Results

Descriptive Statistics

Table 1 shows the descriptive statistics of the sample. The average age of participants was approximately 75 years (SD = 7.16) and most were non-Hispanic Whites (79%). Approximately 80% reported they were still driving. Overall, there were more females (56%) than males (44%). The majority of participants were married (59%). In terms of physical function, participants had low levels of physical limitations of both ADLs (0.44 out of 6) and IADLs (0.35 out of 5). Table 2 shows the proportion of drivers and nondrivers and the percentage of drivers who transitioned from driving to nondriving for each wave.

Table 3 presents the multivariate logistic regression results of current driving and future driving models. The models for current and future driving had similar results. The odds of current and future driving are decreased by approximately 22% and 22% with each unit increase in ADL difficulties (odds ratio [OR] = 0.78; confidence interval [CI] = [0.74, 0.81], OR = 0.78; CI = [0.74, 0.82], $p < .001$, respectively). Similarly, the odds of current and future driving status are decreased by approximately 54% and 51% with each unit increase in IADL difficulties (OR = 0.46; CI = [0.43, 0.48], OR = 0.49; CI = [0.45, 0.52], $p < .001$, respectively). Compared with participants who reported having good eyesight, the odds of current and future driving status were 44% (OR = 0.56; CI = [0.51, 0.61], $p < .001$) and 43% (OR = 0.57; CI = [0.52, 0.63], $p < .001$) less for participants who reported having poor/fair eyesight and 20% (OR = 1.20; CI = [1.10, 1.31], $p < .001$) and 18% (OR = 1.18; CI = [1.09, 1.29], $p < .001$) more for participants who reported having very good/excellent eyesight.

Table 1. Descriptive Characteristics of the Sample (*N* = 17,349).

Variables	*M*	*SD*
Dependent		
Currently driving	80%	0.40
Independent		
Sociodemographics		
Age	75.10	7.16
Male	44%	
Education	11.93	3.37
Non-Hispanic Whites	79%	
Marital status		
Married	59%	
Divorced/separated	9%	
Widow	30%	
Never married	3%	
Household income		
First quartile	27%	
Second quartile	30%	
Third quartile	25%	
Forth quartile	18%	
Health conditions		
Physical limitations		
ADLs(0-6)	0.44	1.11
IADLs(0-5)	0.35	0.95
Eye sight/vision		
Fair/poor	24%	
Good	43%	
Very good/excellent	33%	
Chronic health conditions		
High blood pressure	60%	
Diabetes	20%	
Cancer	17%	
Lung disease	11%	
Heart conditions	30%	
Stroke	8%	
Arthritis	66%	
Falls/fractures		
Incidence of fall	31%	
Hip fracture	1%	
Mental health		
Cognition(0-35)	19.94	7.79

Note. ADL = activities of daily living; IADL = instrumental activities of daily living.

Table 2. Driving Status by Wave.

	Year					
	1998	2000	2002	2004	2006	2008
Driving status						
Yes (%)	77.3	77.5	77.5	80.9	81.8	82.2
No (%)	22.7	22.5	22.5	19.1	18.2	17.8
Changed driving status from previous wave						
Drive−>not drive	x	5.6	5.3	4.7	4.8	4.5

Participants who suffered from diabetes and stroke were less likely to drive currently and in the future compared with those without the conditions. Participants who had a hip fracture were less likely to drive currently and in the future (OR = 0.66; CI = [0.51, 0.85], OR = 0.70; CI = [0.53, 0.93], $p < .05$, respectively). One interesting difference was found in regard to falls. An incidence of falls was predictive of future cessation, but not current cessation (OR = 0.92; CI = [0.85, 1.00], $p < .01$). With respect to psychological factors, the odds of current and future driving would be increased by approximately 6% with each unit increase in total cognition score (OR = 1.06; CI = [1.05, 1.07], OR = 1.06; CI = [1.06, 1.07], $p < .001$, respectively). Thus, better cognition was associated with continued driving. Participants with arthritis had increased odds of current and future driving (OR = 1.21; CI = [1.09, 1.34], OR = 1.16; CI = [1.05, 1.28], $p < .01$, respectively). That is, having arthritis lowered the risk of current and future driving cessation.

With respect to the social demographic characteristics, the odds of current and future driving for males were much (369% and 293%) greater than the odds of current and future driving status for similar females (OR = 4.69; CI = [4.12, 5.34], OR = 3.93; CI = [3.48, 4.44], $p < .001$, respectively). The odds of current driving were decreased by 7% (OR = 0.93; CI = [0.92, 0.93], $p < .001$) and the odds of future driving were decreased 10% as a unit of age increased (OR = 0.90; CI = [0.90, 0.91], $p < .001$). However, the odds of current and future driving were increased by 8% and 5% with each unit increase in years of education (OR = 1.08; CI = [1.06, 1.09], OR = 1.05; CI = [1.04, 1.07], $p < .001$, respectively). Non-Hispanic White participants had greater odds of current and future driving than others (OR = 2.26; CI = [1.98, 2.58], OR = 2.15; CI = [1.88, 2.46], $p < .001$, respectively). Compared with married participants, never married participants were less likely to drive currently and in the future (OR = 0.48; CI = [0.36, 0.65], OR = 0.50; CI = [0.38, 0.66], $p < .001$, respectively). Finally, relative to persons with an income in the lowest quartile, participants in second, third, and fourth income quartiles had higher likelihood of current and future driving.

Table 3. Multivariate Logistic Regression Results.

	Current driver (N = 17,349)				Future driver (n = 14,595)			
Variables	Odds	*SE*	*p* value	95% CI	Odds	*SE*	*p* value	95% CI
Sociodemographics								
Age	0.93	0.00	.001	[0.92, 0.93]	0.90	0.00	.001	[0.90, 0.91]
Male	4.69	0.31	.001	[4.12, 5.34]	3.93	0.25	.001	[3.48, 4.44]
Education	1.08	0.01	.001	[1.06, 1.09]	1.05	0.01	.001	[1.04, 1.07]
Non-Hispanic Whites	2.26	0.15	.001	[1.98, 2.58]	2.15	0.15	.001	[1.88, 2.46]
Marital status								
Married								
Divorced/separated	1.12	0.11	.244	[0.92, 1.36]	1.13	0.11	.230	[0.93, 1.37]
Widow	1.10	0.07	.126	[0.97, 1.24]	1.09	0.07	.164	[0.97, 1.22]
Never married	0.48	0.07	.001	[0.36, 0.65]	0.50	0.07	.001	[0.38, 0.66]
Household income								
First quartile								
Second quartile	1.64	0.08	.001	[1.49, 1.82]	1.62	0.09	.001	[1.46, 1.79]
Third quartile	2.15	0.13	.001	[1.90, 2.43]	1.96	0.13	.001	[1.73, 2.22]
Forth quartile	2.76	0.23	.001	[2.34, 3.26]	2.56	0.22	.001	[2.17, 3.02]
Psychological								
Cognition	1.06	0.00	.001	[1.05, 1.07]	1.06	0.00	.001	[1.06, 1.07]
Biomedical								
Physical limitations								
ADLs	0.78	0.02	.001	[0.74, 0.81]	0.78	0.02	.001	[0.74, 0.82]
IADLs	0.46	0.01	.001	[0.43, 0.48]	0.49	0.02	.001	[0.45, 0.52]
Incidence of fall	0.96	0.04	.335	[0.89, 1.04]	0.92	0.04	.045	[0.85, 1.00]
Hip fracture	0.66	0.09	.001	[0.51, 0.85]	0.70	0.10	.014	[0.53, 0.93]
Eye sight								
Fair/poor	0.56	0.02	.001	[0.51, 0.61]	0.57	0.03	.001	[0.52, 0.63]
Good								
Very good/excellent	1.20	0.05	.001	[1.10, 1.31]	1.18	0.05	.001	[1.09, 1.29]
Chronic health								
High blood pressure	1.01	0.05	.911	[0.91, 1.11]	0.97	0.05	.487	[0.88, 1.06]
Diabetes	0.83	0.05	.001	[0.73, 0.93]	0.78	0.05	.001	[0.70, 0.88]
Cancer	1.02	0.07	.704	[0.90, 1.16]	0.98	0.06	.710	[0.86, 1.11]
Lung disease	1.06	0.08	.431	[0.92, 1.22]	0.92	0.07	.270	[0.80, 1.07]
Heart conditions	1.02	0.05	.697	[0.92, 1.13]	0.98	0.05	.658	[0.88, 1.08]
Stroke	0.61	0.05	.001	[0.52, 0.71]	0.64	0.05	.001	[0.54, 0.75]
Arthritis	1.21	0.06	.001	[1.09, 1.34]	1.16	0.06	.004	[1.05, 1.28]
Pseudo-R^2			.40				.35	

Note. ADL = activities of daily living; IADL = instrumental activities of daily living.

The sensitivity analyses showed that the models correctly classified 87% (current) and 85% (future) of cases. The current model was a slightly better fit than the future driving model. (One note about interpreting the Pseudo-R^2 values of .40 and .35 reported in Table 3: The values do not mean that the model explains about 35% to 40% of the variance in driving status because they are not based on analysis of variance sum of squared deviations as is the R^2 for a linear regression model. They mean that adding the covariate factors in the model increased the log-likelihood function by nearly 40% from its base value with only a constant.)

Discussion

This study examined a broad range of risk factors for current and future driving cessation in a nationally representative sample. As expected, we found support for a biopsychosocial model. The biomedical, social, and psychological risk factors for current driving cessation and future driving cessation were remarkably consistent. One interesting difference concerned falls. Falls were not a significant risk for current cessation, but were for driving cessation 2 years in the future. We hope that by knowing that falls increase risk for future driving cessation, adults with a falls history may be even more motivated to work to prevent recurrent falls in order to preserve driving fitness. Balance and falls prevention programs often require daily exercise and attention, making adherence a challenging issue for some. However, viewing falls prevention as a potential pathway to continued independence and driving may provide extra motivation. Perhaps this finding may also provide an opportunity for older adults, their health care providers, and family members to discuss driving fitness and mobility plans.

We were surprised to discover that adults with arthritis were more likely to keep driving than those who did not have the condition. This is a counter-intuitive finding because arthritis can make getting in and out of the vehicle, gripping the steering wheel, looking over one's shoulder, or using the gas or brake pedals more difficult. Yet, we found that having arthritis increased the odds of current and future driving. Results showed that 66% of participants reported having arthritis. Yet, we do not know how severe the arthritis symptoms were, how pain and swelling were managed, or if drivers self-regulated to avoid driving when symptoms were severe. A closer investigation into arthritis and driving behavior is indicated.

Race was a significant risk factor for current and future driving cessation. Older drivers who were non-Hispanic White were more likely to maintain current and future driving compared with minority older drivers. This is consistent with research by Choi and colleagues (2012) that explored racial disparities in drivers in the ACTIVE study. In the longitudinal analysis of 1,789 adults (74% White), they found that racial disparities in cessation exist, and in fact widen with increasing age (Choi et al., 2012).

Consistent with past research we found IADL difficulties, poorer cognitive function, poor vision, being older, female, a member of a minority race or ethnicity, having lower income and education were significantly associated with driving cessation. It was surprising that several of the chronic disease variables were not risk factors for current or future cessation. Hypertension and heart conditions were not significant in our study unlike results reported by Sims et al. (2007). Similarly, cancer and lung disease were not significant risks for cessation contrary to our expectations. These findings reinforce Dellinger et al.'s (2001) argument that cessation is a complex process not explained by one factor alone.

Older drivers, family members, licensing authorities, and medical professionals should be alerted to these multiple risk factors. Several self-screening tools (e.g., AAA's Roadwise Review) or driving decision worksheets (Eby, Molnar, Shope, Vivoda, & Fordyce, 2003) are freely available. A mixed-methods evaluation of AAA's Roadwise Review reported that almost all participants found it useful, were more aware of changes that could affect driving, and more than 50% were prompted to have conversations with friends and family about their driving (Porter & Tuokko, 2011). Eby and colleagues (2003) developed an effective first-tier assessment tool that increased knowledge, self-awareness of changes in driving abilities related to aging, and increased family discussions about driving (Eby et al., 2003). Such simple tools can be effective mechanisms to raise awareness of threats to driving fitness. Thus, we encourage older drivers and their families to use them.

Interventions to prevent or delay cessation have been targeted at the driver, vehicle, roadway design, and social policy level. We note that evidence about promising interventions to preserve driving fitness is accumulating. However to date, there is no magic intervention that will completely eliminate the risk for driving cessation. We believe a solution will require a comprehensive public health approach with changes required across society from the micro to the macro levels (Dugan, Barton, Coyle, & Lee, 2013). To review effective interventions we start first at the driver level: cataract surgery (Owsley et al., 2002), cognitive training—specifically speed of processing (Ball, Edwards, & Ross, 2007; Edwards, Delahunt, & Mahncke, 2009), physical exercise—specifically range of motion and speed of movement conditioning can enhance driving performance (Marottoli, Allore, et al., 2007), older driver education programs (Bedard et al., 2008; Eby et al., 2003; Marottoli, Van Ness, et al., 2007; Owsley, Stalvey, & Phillips, 2003) have all shown benefit. Second, interventions at the vehicle level include: seat belt and airbag design, improved lines of sight, improved traction and braking, and vehicle stability control. The CarFit program is an educational program to improve driver–car fit that was created by the American Society on Aging developed in collaboration with the American Automobile Association, AARP, and the American Occupational Therapy Association. While evaluations of CarFit have not all demonstrated significant differences in outcomes, drivers do consistently rate it informative and useful (Gaines, Burke, Marx, Wagner, & Parrish, 2011; Stav, 2010). Third, interventions at the roadway design level are numerous. The U.S. Department of Transportation Federal Highway Administration has published a comprehensive guideline to make the roads safer for older drivers and pedestrians. The nearly 400-page handbook include recommendations ranging from intersection design (e.g., protected left-hand turns across traffic), the use of larger street signs with bigger lettering, to allowing extra time for pedestrian crossing (Staplin, Lococo, Byington, & Harkey, 2001). Finally, at the social policy level interventions require a total culture change. Policies that incentivize the creation of livable communities, and supporting creative sustainable alternative transportation options are needed. A change in perspective is needed to move away from the traditional choice faced by transportation policy makers to favor either safety or mobility—to one that enhances both is needed (Marottoli & Coughlin, 2011).

There are a number of limitations of our research. First, we relied on self-report information concerning driving status and it is possible that a few participants were not accurate in reporting. Social desirability bias may have led some participants to report they can/do drive, when they do not. Alternatively, some may have indicated they do not drive, when in fact they do. Second, while the HRS has extensive variables to analyze, it would be informative to work with more detailed clinical information to investigate how disease severity and treatment choices (e.g., medications) impact driving. For example, given our puzzling arthritis finding it would be informative to pair imaging data on disease severity and patient self-report and examine driving behavior.

Declaration of Conflicting Interests

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