The Influence of Climate and Road Conditions on Driving Patterns in the Elderly Population

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SUMMARY. Road conditions may have a significant impact on the ability of elders to continue to drive safely. To explore the relationship of these conditions to driving patterns, forty participants from Western New York (WNY) and North Florida (NFl) answered questions about driving and conditions they avoid. Although they drove more, 60 percent of WNY participants altered their driving during the winter while 20 percent of NFl altered their driving due to the different seasons. WNY participants drove more both in terms of distance driven per week, and frequency of driving trips.

KEYWORDS. Driving, elderly, climate, road conditions

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INTRODUCTION

Driving is an essential instrumental activity of daily living. Older persons, especially those who have difficulty using alternatives to the automobile, may rely even more on their vehicle for trips to the doctor, stores, places of worship, and leisure pursuits. Yet as we age, we face normal age related declines and chronic conditions that can impact vision, hearing, motor function and cognition, all of which can impact ability to drive. We know that many elders reduce the distances that they drive and the number of trips they make. This present study sought to better understand the reasons elders reduce their driving, focusing on road conditions and climate, and comparing two samples of elders, one in New York, and the other in Florida.

LITERATURE REVIEW

Several investigators have examined the importance of driving and its relationship to quality of life. Eisenhandler (1990) interviewed 50 older adults, aged 60-92, and found that many acknowledged physical limitation, and imposed self-limits on driving. They chose not to forfeit their driver's license, however, due to their self-perceptions and unwillingness to depend on others. Fears of losing driving privileges were reported by Steinfeld, Tomita, Mann, and DeGlopper (1999) who found frail elders would report problems they had getting in and out of automobiles but were reluctant to self-report problems with driving.

Dellinger, Sehgal, Sleet, and Barret (2001) surveyed 1,950 adults 55 and older living in California, and found that the mean age of the participants who had stopped driving was 85.5 years old. Hare (1992) in his discussion of frail elders residing in suburban areas states: "Driving should be considered an activity of daily living, because it is critical to daily living in suburban areas."

Fonda, Wallace, and Hersog (2001) investigated the negative impact that driving cessation or reduction has on people 70 and older. In their study of 5,239 adults, they found individuals who had stopped driving or had restricted their driving had a greater risk of worsening depressive symptoms. Marottoli, Mendes de Leon, Glass, Williams et al. (2000) studied 1,316 respondents 65 and older from New Haven and found that a decrease in out-of-home activity was strongly associated with driving cessation.

Risks Associated with Elderly Driving

Several investigators have explored the risks due to physical and cognitive limitations associated with the elder driver. Messinger-Rapport and Rader (2000) compared miles driven for drivers between 25-69 and found that drivers over the age of 70 are nine times more likely to be in a fatal accident. The rate for people over the age of 85 is higher than all other age groups. West, Haegerstrom, Oman, Gildengorin, and Reed (1997) studied 1,157 people 55 and older and found that increasing age, use of antidepressants, fewer sleeping hours, unrestricted driving habits, and other potential indicators of higher annual mileage which included being male, increased income, being employed, better memory, and more social activities, were significant predictors of accidents/moving violations.

Ball and Rebok (1994) studied 294 licensed drivers between the ages of 55 and 90 and found two factors most highly predictive of crash frequency: (1) reduction in the size of the useful field of view and (2) decline in mental status. Andersen, Cisneros, Saidpour, and Atchley (2000), using computerized displays, compared the ability of 20 younger adults and 20 older adults to detect likelihood of collisions. They found that older adults, especially at high speeds, had decreased ability to correctly detect possible collisions.

In a study that failed to find that older drivers were at higher risk, Carr, Jackson, Madden and Cohen (1992) assessed 60 healthy adults in three age groups (18-19, 25-33, and 69-84) using the Miller Road Test. They concluded there were frequent driving skill impairments across all age groups but no significant differences between the groups with regard to turning or stopping errors or total scores.

Self-Monitoring Behaviors

Several studies have investigated the utilization of self-limiting driving behaviors by the elderly who continue to drive. Straight (1997) surveyed 710 persons aged 75 and older on their habits, preferences, and attitudes, and found that of the 73 percent who were still driving, 63 percent avoided driving at night and 51 percent avoided driving during rush hour. Dellinger et al. (2001) found that nearly two-thirds of their participants reported driving less than 50 miles per week prior to driving cessation.

Kihl (1993) used a random sample of 98 participants (55 and older) to examine travel preferences and patterns of the rural elderly and found

they tended to drive more in the summer than in the winter. Many also reported a reluctance to drive at night and on major highways.

McGwin and Brown (1999) studied 136,465 police-reported traffic crashes in Alabama. They found that drivers over the age of 55 were less likely than younger and middle-aged drivers to have crashes which involved driver fatigue, driving during the evening and early morning, on curved roads, during adverse weather, involving a single vehicle, and while driving at high speeds. They concluded that the strength of the older driver is their avoidance of hazards.

Declines in physical and cognitive abilities impact on whether elderly people continue to drive. Stutts (1998) studied 3,238 drivers 65 and older to compare miles driven by individuals with cognitive versus visual impairment. She found a pattern of reduced driving for individuals with both conditions, with the cognitive group having a higher rate of reduced driving.

Shua and Gross (1996) conducted a four-person case study of individuals with Alzheimer's disease (the youngest being 64) in which they had another person ride with them when they drove. The people who rode with them were cognitively intact but had other disabilities that kept them from driving. In a one-year follow up, none of the individuals with Alzheimer's disease had a reported accident when accompanied by the other person.

As the elderly population grows, driving will be a major factor in maintaining independence and aging in place. Research has shown that many elderly people modify their driving due to conditions in their environment. There has been no comparison of older-driver patterns associated with different regions of the country. Most studies have utilized samples from the same region of the country or have used national databases. These studies have not differentiated the effect of climate and local geography on driving patterns of the elderly. The present study compared two different regions of the United States, Western New York and Northern Florida, to explore the relationship of climate and road conditions and how they relate to driving patterns of the elderly. New York and Florida have the second and third largest populations of people over 65 (Hobbs, 2001).

METHODS

This study addressed the hypothesis: Climate and road conditions influence the driving patterns of the elderly population.

Sample. The sample was drawn from the Rehabilitation Engineering Research Center Consumer Assessments Study (CAS) sample pool. The CAS was a longitudinal study of the coping strategies of elders with disabilities. From 1991 to 2001, 26 senior service agencies and hospital rehabilitation programs referred to the CAS individuals they currently served, or in the case of hospital rehabilitation programs, individuals discharged home. A comparison of initial interviews of the CAS sample with the 1986 National Health Interview Survey (Prohaska, Mermelstein, Miller, & Jack, 1992) and the 1987 National Medical Expenditure Survey (Leon & Lair, 1990) reported the CAS sample closely resembled the approximately eight to 12 percent of the elder population who have difficulty with at least one ADL or IADL (Mann, Hurren, Tomita, & Charvat, 1997).

The CAS was initiated in Western New York (WNY) where 791 elders were interviewed. In the final two years, the CAS was replicated with 312 study participants in Northern Florida (NFl). For the present report, we selected 20 participants from the NFl sample and 20 from the WNY sample. Inclusion criteria were over age 60, currently driving, and intact cognitive status (score of 24 or above on the Mini Mental Status Exam).

WNY participants ranged in age from 67 to 91 years, with a mean of 73.3. NFl participants ranged in age from 63 to 90 years, with a mean of 78.9. In the WNY sample, 80 percent of the participants were female and 75 percent of the participants were female in the NFl sample. Table 1 presents information on medical conditions and breaks down the global conditions and illnesses associated with each of the samples. WNY par-

TABLE 1. Comparison of Medical Conditions

New York sample (n = 20)		**Florida sample** (n = 20)
Medical Conditions	***New York***	***Florida***
	n (%)	n (%)
Eye disease	3 (15)	3 (15)
Glandular disorder	3 (15)	5 (25)
Heart disease	12 (60)	8 (40)
Lung disease	2 (10)	5 (25)
Musculoskeletal disorder	10 (50)	11 (55)
Nervous system disorder	6 (30)	2 (10)
Stomach/intestinal disorder	2 (10)	6 (30)
Urinary disease	2 (10)	4 (20)
“other”	2 (10)	5 (25)

ticipants had a mean of 2.10 chronic diseases or conditions. NFl participants had a mean of 2.45 chronic diseases or conditions.

Instruments. This study used a telephone survey developed by the investigators asking questions relating to driving frequency and miles driven, as well as climatic, seasonal, and road conditions that might affect decisions to drive.

Data Collection. Telephone interviews were conducted by the primary investigator, with mean interview time about 20 minutes. Participants who agreed to be in the study were given the option of completing a phone survey during the first contact call, or could arrange for a return call at a more convenient time, to ensure that they would be rested, comfortable, and not feel rushed.

ANALYSIS

Descriptive statistics were used to report characteristics of driving for the WNY and NFl samples. We found that the WNY sample was significantly younger (5.6 years difference: $t = -2.8$, $p = .008$). To explore differences between the two samples on total miles driven in a typical week, and total number of trips, we used an analysis of covariance, with age as the covariant. Analyses were completed using SPSS version 11.0.1.

RESULTS

Frequency and Distance. The means and standard deviations of distances driven and frequencies of trips to individual places during a typical week for WNY participants and NFl participants are presented in Table 2. Also in Table 2 are the results of the total distance driven and total frequency of trips in a typical week.

WNY participants, on average, drove 57.6 miles more ($t = 2.9$, $p = .007$), and made 6.5 more trips per week ($t = 4.5$, $p = p. 0001$), than NFl participants. WNY participants drove on average 107.6 (79.2) miles and averaged 12.1 (5.6) trips per week. NFl participants drove a mean of 50.0 (41.0) miles per week and averaged 5.6 (2.8) trips per week.

An analysis of covariance, with age as the covariate, was performed to compare the WNY and NFl participants' weekly driving distances and frequencies of trips. The results were significant for distance ($F = 4.6$, $p = .02$) and frequency ($F = 10.9$, $p = p. 0001$).

TABLE 2. Comparison of Mean Driving Distances and Frequencies During a Typical Week

	New York (n = 20)		**Florida** (n = 20)	
Places	**Distance** (miles) x (SD)	**Frequency** (per week) x (SD)	**Distance** (miles) x (SD)	**Frequency** (per week) x (SD)
Church	5.5 (6.6)	2.0 (2.1)	2.9 (4.6)	.5 (.9)
Grocery Store	6.4 (4.2)	2.1 (1.5)	4.9 (3.7)	1.6 (1.3)
Other Stores	5.8 (6.1)	.3 (.3)	5.6 (6.6)	.3 (.3)
Drug Store	4.3 (7.4)	.5 (.7)	3.1 (3.8)	.2 (.3)
Hair Cut/Beauty Salon	4.8 (6.9)	.3 (.4)	2.6 (3.6)	.1 (.2)
Volunteer Work	9.5 (22.5)	1.0 (1.5)	2.2 (5.4)	.4 (1.1)
Visit Relatives	27.1 (41.6)	1.4 (1.9)	42.59 (133.9)	.5 (.8)
Visit Friends	4.9 (6.2)	1.2 (1.4)	5.8 (15.1)	.3 (.7)
Bank	2.9 (3.0)	.5 (.6)	3.9 (4.1)	.4 (.5)
Out to Eat	7.4 (9.4)	.7 (.7)	2.6 (5.1)	.3 (.6)
Senior/Leisure Program	6.2 (7.9)	1.5 (2.1)	3.1 (5.1)	.4 (.9)
Medical Care	10.6 (11.1)	.6 (1.0)	8.6 (11.6)	.3 (.4)
Other	1.5 (4.6)	.05 (.2)	11.6 (36.1)	.3 (.8)

	New York x (SD)	**Florida** x (SD)	**Significance**	
Total Weekly Distances	107.6 (79.2)	50.0 (41.0)	t = 2.9	p = .007
Total Weekly Distances (controlled for age)			F = 4.6	p = .02
Total Weekly Frequencies	12.1 (5.8)	5.6 (2.8)	t = 4.5	p = .0001
Total Weekly Frequencies (controlled for age)			F = 10.9	p = .0001

Climatic/Environmental Conditions. Descriptive statistics on seasonal driving patterns and climatic/environmental conditions avoided are presented in Table 3.

As expected, 60 percent of WNY participants reported driving less during the winter while 20 percent of NFl participants reported driving less in various seasons (one participant decreased driving in the summer, one in the winter, one in the summer and winter, and one in the summer, spring, and fall). Results for seasonal changes in driving are summarized in Table 3.

TABLE 3. Environmental Conditions Avoided

	New York Sample (n = 20)		**Florida Sample** (n = 20)	
Avoid Environmental Conditions	17 (85%)		17 (85%)	
Any time of year drive less	12 (60%)		4 (20%)	(t = 2.8, p = .009)
	N	Mean days	N	Mean days
What Season?	0 Spring		1 Spring	2
	0 Summer		3 Summer	6.3
	0 Fall		1 Fall	2
	12 Winter	20.5	2 Winter	4.7
Type avoided:	**New York** n (%)		**Florida** n (%)	
Night Time	14 (70)		12 (60)	
Dark or Cloudy Days	2 (10)		3 (15)	
Rain	7 (35)		9 (45)	
Fog	11 (55)		8 (40)	
Snow, Sleet or Ice	11 (55)		4 (20)	
Driving into the Sun	3 (15)		7 (35)	
Cold Weather	2 (10)		2 (10)	
Hot Weather	2 (10)		2 (10)	
Other	0 (0)		2 (10)	

Participants in both WNY and NFL reported avoiding driving at night as the "condition" most avoided (WNY = 70% of participants, NFl = 60%). Snow, sleet, and ice (for obvious reasons) resulted in far greater numbers altering driving in WNY (WNY = 55%, NFl = 20%).

Road Condition. Descriptive statistics on participants who avoided some type of road condition and percentages for the types of road conditions avoided are presented in Table 4. Of the WNY sample, 70 percent reported avoiding at least one type of road condition while 80 percent of the NFl sample reported doing the same. The most reported road conditions avoided in WNY were roads less well maintained and expressways/interstates and highways, both with 45 percent of participants avoiding them. Fifty-five percent of NFl participants reported avoiding very busy roads and this was their most avoided road condition.

TABLE 4. Road Conditions Avoided

	New York (n = 20) n (%)	**Florida** (n = 20) n (%)
Avoid Road Condition	14 (70)	16 (80%)
Type avoided:		
Windy Roads	4 (20)	1 (5)
Very Busy Roads	7 (35)	11 (55)
Roads Less Well Maintained	9 (45)	3 (15)
Bridges	2 (10)	2 (10)
Narrow Roads	4 (20)	4 (20)
Construction	4 (20)	3 (15)
Expressways or Interstates/Hwys	9 (45)	4 (20)
Dirt Roads	4 (20)	2 (10)
"Other"	2 (10)	7 (35)

DISCUSSION

WNY participants drove significantly more miles and made more trips during a typical week than the NFl participants. This was an unexpected finding and did not support the original hypothesis that climate and road conditions influence the driving patterns of the elderly (although we did find that WNY participants had more days of altered driving due to seasonal conditions). The significant difference in age of the two samples was considered an explanation (the NFl sample was significantly older) but even when age was controlled in the analyses, frequency of trips and distances driven were significantly greater for the WNY participants. Adding to the difficulty in explaining these results, the WNY sample was more urban while the NFl sample was primarily suburban/rural. The density of available resources and the greater availability of public transportation in WNY would suggest a decreased need for driving. This was not supported by the results, but may have some relationship to the lifestyle pace of the two areas. The hypothesis that WNY has a more active lifestyle could be the reason that the participants reported driving more miles and taking more trips in a typical week. There is also the possibility that sampling bias impacted the results. With the relatively small sample size, it may simply be that there was an overrepresentation of more active participants in the WNY sample.

WNY participants altered their driving significantly more than NFl due to seasonal changes. Over half of WNY (60%) altered their driving

during the winter compared to only 20% of NFl during a particular season. This data supports the original hypothesis of climate influencing driving patterns of the elderly.

The environmental conditions avoided by the WNY and NFl participants were similar. Eighty-five percent of both samples reported avoiding at least one environmental condition. The most avoided condition for both groups was driving at night (WNY = 70%, NFl = 60%). Three conditions showed a difference between the samples of 15 percent or more: fog (WNY = 55%, NFl = 40%), driving into the sun (WNY = 15%, NFl = 35%), and snow, sleet, or ice (WNY = 55%, NFl = 20%). The reason for these discrepancies might be explained by the specific conditions being more extreme in the participants' environments.

High percentages of both WNY and NF1 participants avoided at least one type of road condition (WNY = 70%, NFl = 80%). The two most reported road conditions avoided by WNY participants were *roads less well maintained* (45% versus 15% of NFl participants) and *expressways or interstates/highways* (45% versus 10% of NFl participants). NFl participants reported *very busy roads* as the condition they most avoided (55% versus 35% for WNY participants).

CONCLUSION

Climate had a larger impact on number of days of altered driving in WNY but even with the higher number of days of altered driving in WNY, they still drove more. The study found that the participants in WNY drove significantly more than the NFl participants, which does not support the original hypothesis. However, climate and environment did have a significant effect on the driving habits of the elderly. WNY participants altered their driving more during the winter than the NFl participants altered their driving during any of the other seasons combined. Of the WNY participants who altered their driving during the winter, it was found that they did so at a higher level than the NFl participants who altered their driving during all of the other seasons.

Both samples reported night time driving as the most avoided environmental condition and the WNY sample reported avoiding driving on snow, sleet, or ice at a higher level than the NFl participants. Some trends were noted that might be specific to the participants' environments. More research is needed on differences in amount of driving by the elderly based on different regions of the country.

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