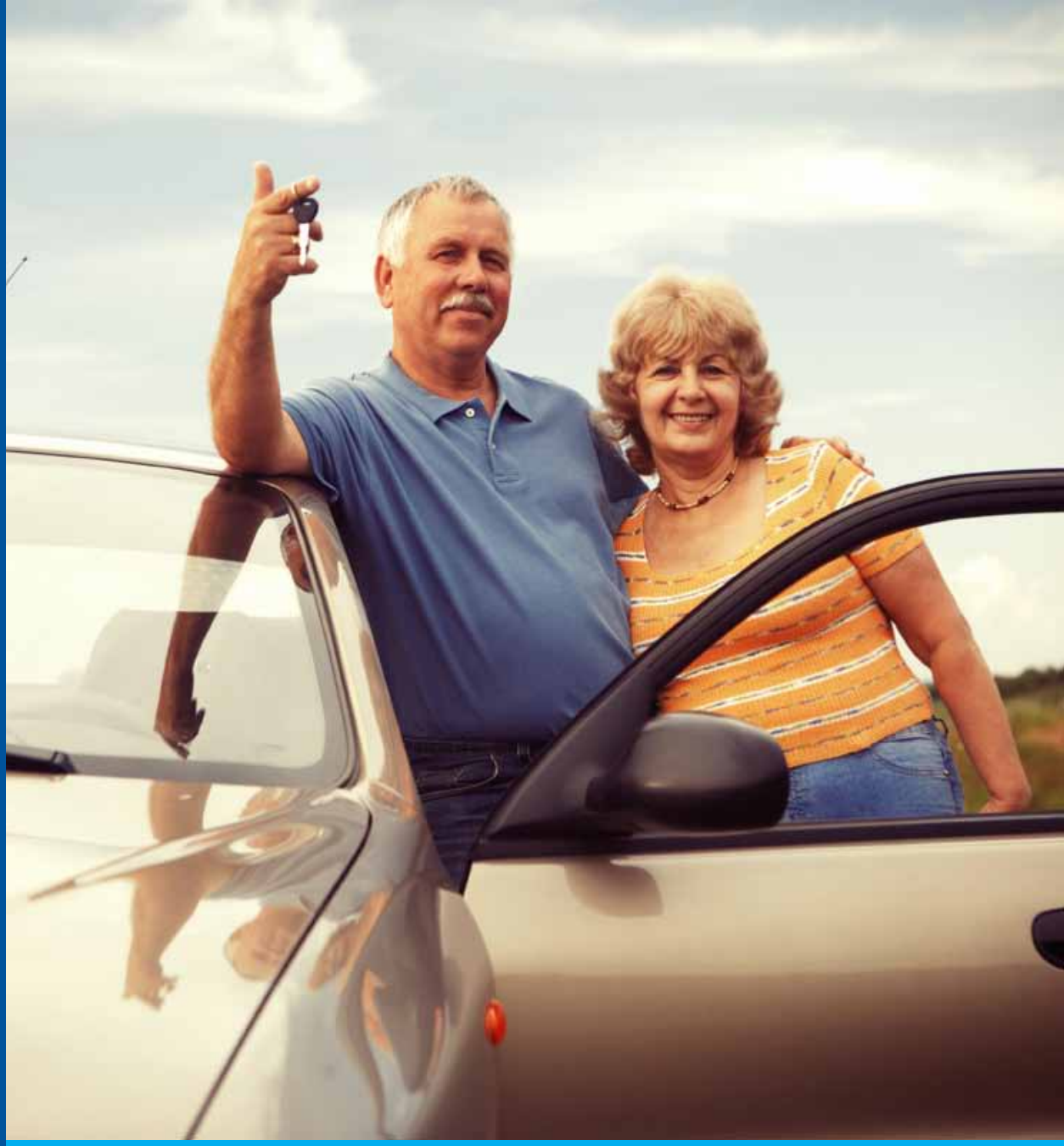
Seniors face serious driving safety and mobility issues.



Understanding Older Drivers: An Examination of Medical Conditions, Medication Use, and Travel Behavior

April 2014

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Title

Understanding Older Drivers: An Examination of Medical Conditions, Medication Use, and Travel Behavior *(April 2014)*

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About the Sponsor

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Executive Summary

This first phase of an Urban Institute study funded by the AAA Foundation for Traffic Safety focuses on creating baseline information on older driver behavior, medication use, and medical conditions from two large national data bases: the 2009 National Household Travel Survey (NHTS) and the 2011 National Health and Aging Trends Study (NHATS).

Overall our findings suggest that:

- Older drivers are substantially more likely to report having a medical condition or a disability than younger drivers:
  - The youngest cohort of older drivers (65 – 69) is twice as likely to report having a medical condition as younger drivers 24 – 64.
- Medication use and polypharmacy (the use of multiple medications) is very high among older drivers:
  - Over 90% of older drivers take prescription medications; and
  - Over two-thirds of those taking any medication take multiple medications.
- Older drivers who report using medications or having a medical condition are more likely to self-regulate all aspects of their driving behavior:
  - Three-quarters of drivers 65 and older who have a medical condition report reduced daily travel;
  - Older drivers using medications drive fewer days each week;
  - Older drivers using medications avoid night driving at double the rate of those 24 – 64; and
  - Roughly one in five male and one in three female drivers 65 and over who take medications report avoiding night driving.
- Gender differences in all aspects of medication use, travel behavior, and driving self-regulation among those 65 and older are extremely large:
  - Women drivers are more likely to report having medical conditions and using multiple medications;
  - Women drivers who use medications or who have a medical condition are more likely to self-regulate their driving than comparable men; and
  - Women without a medical condition drive less than men *with* a medical condition measured in vehicle miles traveled (VMTs) and by days driving during the previous week.
- Older drivers still drive frequently and for some distance, even when practicing self-regulation:
  - Over three-quarters of male drivers and 60% of women drivers over 85 drove five or more days a week; and
  - Fewer than 5% of male drivers and 10% of female drivers 85 and older drove less than once a week.
- Increasing income is associated with more driving and less self-regulation among older drivers for reasons not immediately clear:
  - Self-regulation appears to decrease with income until at least the age of 80;
  - With incomes above $70,000 men 80 – 84 were as likely to drive on the day they were surveyed as men 70 – 74 and not much less than those 65 – 69; and
  - Women drivers 65 – 69 with incomes under $13,000 were 62% more likely to restrict their nighttime driving than women of that age with incomes over $70,000.

Introduction

The majority of older people are active drivers today. In 2011, well over 86 percent of people 65 and older were drivers. That means that more than one out of six drivers on the road in the United States are 65 and older (FHWA, 2013). Most older people are safe drivers, but as they age they may experience more crashes and suffer higher injury and fatality risks. Moreover, as people age they are more likely to use multiple medications (AAA Foundation for Traffic Safety [AAAFTS], 2009) that might impair their driving, making medication use a growing safety concern (NHTSA, 2009; Staplin, *et al*, 2012).

Yet current research on the impact of various medications on the driving behavior, let alone the crash risks, of older people is sparse and contradictory. Moreover, it is hard to separate the impact of the basic medical problems that create the need for medications from the impact of medications themselves. In addition, older people differ markedly in their individual responses to medical problems or medication. Finally, older drivers frequently self-regulate their driving behavior to respond to perceived problems in driving, possibly including negative reactions to their medications. All of these factors make it difficult to understand how medications directly impact driving safety.

The overall study examines the relationships between a wide variety of medical problems and medications on the one hand, and the driving behavior and mobility of older people on the other. This report provides baseline data on what is currently known or can be identified about these relationships from two nationally representative studies:

- 2009 National Household Travel Survey (NHTS); and,
- 2011 National Health and Aging Trends Study (NHATS).

Our objective in this report is to understand and synthesize the information that already exists on medical problems, medication use, and older driver behavior. To do so, we tabulated data from these two surveys to create a portrait of senior driver behavior. Doing so establishes the context for a second, forthcoming, report that will examine the relationship between driving behaviors and senior medical conditions, characteristics, and attitudes. As such, we do not seek to engage statistical significance testing in this report because the policy relevant investigation is more appropriate for our upcoming multivariate analyses.

The ultimate research goal is to assist policy analysts to construct targeted safety interventions, develop appropriate public policies, and provide comprehensive information to a range of stakeholders on how to address older driver safety problems created by the use of medications. This will be achieved by compiling and analyzing studies conducted by the Urban Institute and the soon-to-be-launched five-year prospective AAA FTS cohort study conducted by Columbia University and the University of Michigan.

The analyses of the NHATS and NHTS data reported on here parallel the existing research base in many ways; we found that many older people take multiple medications and have a medical condition that interferes with travel. Older drivers with a medical condition or those who took medication were more likely to reduce their driving in expected ways, such as at night or on highways. Women were more likely to self-regulate than men, so much so

that they may put themselves at risk of the "low mileage bias;" that is, driving so little that their inexperience and anxiety could increase their crash risk when they do drive.

On the other hand, we uncovered unexpected patterns. For example, reduction in driving or increases in self-regulation did not always go up with age. Moreover, income had sometimes unexpected impacts; in both data sets, driving went up and self-regulation went down with increasing income among those with a medical problem or who took multiple medications.

The most important message is that many older drivers, particularly men, still drive frequently even in the face of medical problems or when using multiple medications – and even if they report different kinds of self-regulatory behavior. Our preliminary and explorative findings suggest that we have much to learn about how medication use independently impacts older driver behavior and ultimately safety. Our efforts justify more intensive research.

This report has six major sections. First, we briefly describe what is known about 1) the impacts of medication use, and medical problems, on the crash risks of older drivers, and 2) trends in the automobility and travel behavior of older people. Next we describe our research approach and the two major data sources. Subsequent sections describe baseline data from the NHATS and NHTS on medication use and medical conditions among older drivers, medication use and travel behavior and self-regulation, and the complex relationship between income and travel behavior among those using medications or with a medical condition. The final major section summarizes and assesses our main findings.

Background

Medications and Driving

We do not have comprehensive or consistent information on the impact of specific medications, alone or in combination, on driving behavior, crash risks, and crash outcomes among older drivers. This is due, in part, to inconsistent research findings. But the contradictory nature of those studies might be due, at least in part, to the fact that medical conditions themselves may affect driving behavior independent of any medications that older drivers take to address those conditions. Moreover, older drivers may reduce or restrict their driving to respond to the side-effects of medication. Each of these issues is briefly addressed below.

The existing literature shows that:

- Some medications may be or have been associated with increased crash risks for older people, including benzodiazapines, anti-depressants, opoid analgesics, and psychoactive drugs (Knight and McIntyre 2012; Monárrez-Espino, *et al*, 2013a; Dischinger, *et al,* 2011, Meuleners, *et al,* 2011);
- Some medications, such as anxiolytics (anti-panic drugs) are associated with increased crash risks for drivers younger than 65 but NOT for those over 65 (Weaver, *et al*, 2010; Ravera, *et al,* 2012);

- Medical professionals are unsure about the impacts of various medications on driving and reluctant or unable to discuss these issues with older drivers (and their families) (Legrand, *et al*, 2012; Verster and Roth, 2012; Leuing, 2012); and
- Older drivers themselves do not understand the potential impacts on their driving of certain medications, taken alone or with other medications, in part because their physicians have not raised the issue (Rosenbloom, 2006; AAA FTS, 2009; Orriols, *et al*, 2012; Sargent-Cox, *et al*, 2011; Smyth, *et al*, 2013).

Both driver and doctor uncertainty is understandable. First, Leuing (2012) concluded that it was impossible to derive meaningful guidelines for older drivers on specific medication use or fitness to drive from the existing research base. Monárrez-Espino, *et al* (2013b) found that there was no clear evidence of the impact of specific drugs on senior driver crash patterns because research results were mixed and many published studies had serious methodological problems. For example, using two different research methods to explore the impact of the use of analgesics on older driver crash risks, the same set of researchers (Ravera, *et al,* 2011; Ravera, *et al,* 2012) found diametrically opposite results.

Ultimately, expert panels convened by the National Highway Traffic Safety Administration (NHTSA) to develop lists of safe and unsafe drugs were unable to do more than reiterate the *potential* impacts of various medications. The experts (NHTSA, 2011) concluded that one of the barriers to classifying drugs based on their impact on driving was the "lack of a standardized protocol for assessing the impairing potential" of various medicines.

Secondly, medical conditions that cause older drivers to take medications may have independent impacts on older driver behavior (Marshall, 2008; NHTSA, 2009; Clark, *et al*, 2010). A British study found that 10 percent of crashes involving older drivers were caused by chronic or acute illnesses (Clark, *et al*, 2010, p 1023). A variety of studies show that drivers of any age with diabetes mellius, pulmonary and cardiovascular diseases, epilepsy, vision impairments, and many different psychological or emotional problems have a greater crash risk, whether or not they are medicated. Sleep disturbances such as insomnia and sleep apnea are also associated with lower levels of driving capacity that may be linked to higher crash rates (Vaz, *et al*, 2008).

However, most studies show the impact of having medical conditions is a much stronger predictor of crash risks or injury than is the use of medications to treat the condition (Vernon, *et al*, 2002; Sagberg, 2006; Van, *et al*, 2003; Charlton, *et al*, 2004; 2010; Cox, *et al*, 2009; 2013). A nationally representative Canadian study found that having asthma, arthritis and rheumatism, and back problems was associated with higher crash injuries *even controlling for medication use* (as well as age and sex) (Vingilis and Wilk, 2102). That is, the researchers found that the effect (high crash injury rates) persisted whether or not the drivers used medications to treat their condition. They noted,

> Few studies examining all three variables [medical condition, medication use, crash injuries] are available; and of those that are, the results are inconclusive primarily due to contradictory findings possibly due to methodological differences (p. 328).

In addition, older drivers may develop conditions that affect driving for which no medications are available. It is well known, for example, that many older people do not seek cataract surgery when their vision is impaired. Yet studies show that older adults who have cataract surgery have roughly half the crash rates of comparable older people who do not have surgery to correct their eyes (Mennemeyer, *et al*, 2013).

At the same time, few researchers believe that having a diagnosis of one or more of these medical conditions is useful in determining fitness to drive. Medical conditions and diseases differ in severity and whether they exist in parallel with other conditions. Most of all, individual abilities, skills, and performance differ markedly in response to medical conditions and medications.

A third issue not directly addressed in the literature is the possible impact of older driver self-regulation on any crash risks associated with increasing medication use. A large research literature shows that older drivers restrict their driving in many ways, directly and indirectly, to cope with problems that they face in driving or getting out of the house (Rosenbloom & Herbel, 2009; Braitman & Williams, 2011; IIHS, 2011; Siren & Meng, 2013; Tuokko, *et al*, 2013).

Self-regulatory behavior can range from taking different routes or avoiding problematic situations like nighttime or freeway driving, to sharply reducing driving. And this behavior can differ in response to a variety of lifestyle choices and personal attributes (Molnar, *et al*, 2013b; Siren and Meng, 2013), attitudes, and even personality (Gwyther & Holland, 2012; Thompson, *et al*, 2013; Molnar, *et al*, 2013a; Tuokko, *et al*, 2013). For example, Molnar, *et al* (2014) conclude that drivers may consciously use self-regulatory strategies to extend the period of time when they can drive, lengthening the transition to driving cessation.

A large body of literature shows substantial differences in self-regulation by gender; at all ages women drivers are less likely to drive overall, less likely to drive the vehicle in which they are riding, more likely to express anxiety or experience stress in driving, and more likely to self-regulate their driving (Rosenbloom & Herbel, 2009; Blanchard and Myers, 2010; Gwyther and Holland, 2012; Tuokko, *et al*, 2013). While researchers question how accurately older drivers recognize their problems in driving and how appropriately they respond when they do (Molnar and Eby, 2008; Tuokko, *et al*, 2013; Molnar, *et al*, 2014), there is little doubt that many older drivers practice a range of self-regulatory behaviors in both the short and long run.

Molnar and colleagues (2014) conclude that self-perceptions of health may be directly related to driving self-regulation—and may, in fact, provide fairly accurate predictors of self-regulatory behavior. Therefore it is possible that some older drivers may also self-regulate to respond to the problems created by medications that make them dizzy or sleepy or disoriented—even if they do not know or recognize the link between using those medications and the problems they are experiencing. The inconsistent findings about the relationship between the use of certain medications and crash risk (described above) could be the result of self-regulation by older drivers even if they lack good information about the medications that they take. Unfortunately we do not know *which* drivers self-regulate and how they do so in response to problems they may experience with medications.

Licensing and Travel Patterns

Growing use of multiple medications by older people occurs in an environment where most are drivers. In 2010, almost 84 percent of all people 65 and over had licenses (94% of men and 76% of women) (FHWA, DL-20, 2011; US Census, 2011). This is in sharp contrast to licensing patterns just a few decades earlier; in the early 1970s barely over half of all people 65 and over had licenses (although even then three-quarters of all men had licenses but only 40% of all women did).

Table 1 compares driver status in the two national data sets to each other and to licensing data by age from the Federal Highway Administration (FHWA). The FHWA licensing data, collected from state licensing agencies, indicate that a larger share of older people are drivers than do either the NHTS or NHATS data. And the NHTS data indicate that a larger share of older people are drivers than does NHATS data. The FHWA data are the highest because they are based on licenses issued. States rarely record changes in the licensing status of older people, even when they give up driving or die. Moreover, state data on the number of licenses issued may include replacement licenses for those who lost or misplaced their actual license.[1]

Table 1. Driver Status (%) by Sex and Age

	65 - 69		*70 - 74*		*75 - 79*		*80 - 84*	
	M	**W**	**M**	**W**	**M**	**W**	**M**	**W**
FHWA*	99.2	89.6	96.5	83.2	93.5	76.0	89.6	66.8
NHTS n=86,112	93.5	87.1	92.1	80.5	89.2	72.7	84.4	63.4
NHATS n=7,433	92.2	85.6	89.5	79.9	87.3	67.3	81.1	60.1

**Out of 100%*
Sources: FHWA (2011), DL-20 plus US Census; original data from the 2009 NHTS and 2011 NHATS

Neither the NHTS nor the NHATS ask respondents their licensing status; these data represent people who say or are said to be driving. This disparity suggests two things: some older people stop driving without officially giving up their licenses (because there is no reason to do so and the license has value as identification), and some older people who no longer drive may be unwilling to identify themselves as non-drivers (Rosenbloom, 2006).

The differences between the NHTS and NHATS represent additional differences in how drivers are identified. The NHTS considers people to be drivers if they report driving or identify themselves as a driver or are identified by family members as a driver. In contrast, the NHATS identifies drivers by asking people when they last drove; the data in Table 1 represent those who said that they drove in the last month. The NHATS data may be lower because they include only Medicare recipients, while NHTS is a nationally representative

[1] 2011 licensing data are available; we use 2010 for comparability to the NHTS and NHATS data.

sample of all older people. Or the differences may arise from the sample size – the NHATS is based on a much smaller sample than is the NHTS.

It is clear that a very large number of older people are still on the road even at advanced ages, in spite of the differences between the three data sources. For example, the data show that at least two thirds of men and at least a third of women over 85 years of age still drive.

As Table 2, based on NHTS data, shows, every measure of automobility increased for older drivers between 1990 and 2009, even if 2009 numbers were sometimes lower than 2001 figures. (The decline between 2001 and 2009 is consistent with an average drop in all measures of travel in the 2009 NHTS. The 2009 NHTS was undertaken at the worst point in the recent economic downturn, and most analysts feel that sharp declines in employment and real income account for most of the drop in travel.) People 65 and older spent substantially more time driving, their average vehicle trips were longer, and they made more trips in 2009 than in 1990.

Table 2. Daily Travel Patterns of Drivers Ages 65+, 1990 – 2009

	1990	*1995*	*2001*	*2009*
Vehicle Trips per driver	2.27	2.94	2.84	2.67
VMT per driver	14.8	19.6	21.1	19.7
Percent Work Trips	4.8%	8.5%	6.2%	10.6%
Average Time Driving (min)	30.8	42.9	49.1	46.4
Person Trips per person	2.5	3.4	3.4	3.2

Sources: FHWA (2011) Summary of Travel Trends. Table 32

There are probably two major reasons for the increase over time in the average number and length of vehicle trips taken by older drivers. First, more older people are staying in the labor force past traditional retirement age. NHTS employment figures (which are slightly higher than the Census estimates of the civilian employed population) show that over 25 percent of men and 18 percent of women 65 and over were employed in 2009. This explains why the percentage of vehicle trips for work taken by those 65 and over in 2009 was more than double the 1990 number.

Table 3 shows the vehicle miles traveled (VMTs) by older and younger drivers rounded to the nearest hundred (regardless of driver status, VMTs are only accrued by the person actually driving the vehicle). The average annual VMT of older male workers (12,000) was only 13 percent less than younger workers (13,900). There was a greater gap between younger and older women; older women workers drove 23 percent fewer VMTs than those younger. The impact of being in the labor force appears to be stronger than increasing age; the table shows that older people who stayed in the work force drove almost as much as those younger, until they reached the age of 85.

Table 3. 2009 Per Capita Annual Vehicle Miles Travelled by Worker Status, Age, and Sex

	Worker		Non-Worker	
AGE	**M**	**W**	**M**	**W**
All 65+	12,162	7,321	7,360	2,751
65-69	12,626	8,233	9,820	5,059
70-74	12,280	5,918	7,978	2,956
75-79	12,603	6,674	7,473	2,552
80-84	10,039	7,044	5,579	1,597
85+	5,448	5,055	2,838	896
< 65	13,905	9,533	3,163	3,148

Sources: Data from the 2009 NHTS developed for this study

The second major reason for the growing automobility of older people between 1990 and 2009 is that older people are actually making more and longer *non-work* trips. Table 3 shows that older men not in the workforce drove more miles than did comparable women who were in the workforce and only 40 percent fewer miles than older men who were employed. In short, access to the car appears to promote a lifestyle for older people based on more and longer auto trips even after – or perhaps especially after – older people leave the workforce.

For example, people in the workforce often shop or conduct personal business and even recreational activities at sites close to work or along their commute route. Once freed from those temporal and spatial constraints in retirement, they appear to choose new destinations for those activities that are farther away while having the time to make more non-work trips (Rosenbloom, 2006).

NHATS data, shown in Table 4, also give some idea of how often even the oldest drivers drive; the table shows the frequency of driving in the previous week by age and sex. Older men drive more than older women, as the previous discussions show; for example, among those 65 – 69, over two-thirds of male drivers but only 46 percent of women drove every day. The frequency of driving dropped with age but not as much as might be expected, especially among men. Over two-thirds of men and almost 60 percent of women ***85 and older*** drove at least five days in the previous week. Conversely, women were more likely to drive fewer days per week. Yet relatively few older people drove less than one day per week; among those 85 and older less than five percent of men and 10 percent of women drivers drove less than one day in the previous week.

Table 4. Driving Frequency (%) by Age and Sex, 2011

Days Drove Last Week	*65 - 69*		*70 - 74*		*75 - 79*		*80 - 84*		*85 +*	
	M	**W**	**M**	**W**	**M**	**W**	**M**	**W**	**M**	**W**
7	68.2	46.3	66.9	37.4	56.5	38.4	59.3	33.0	52.5	28.0
5 - 6	18.1	28.9	20.2	30.5	20.2	30.5	23.9	30.8	24.2	31.6
2 - 4	10.0	18.6	8.4	24.3	9.9	19.9	13.0	28.0	18.8	30.6
< 1	3.7	6.2	4.5	7.8	4.0	9.6	3.9	8.3	4.4	9.8
N=	583	611	613	664	548	549	477	500	332	310

Source: NHATS data developed for this study

Research Approach and Data Sources

Many older people are active drivers and remain so until very old ages. But as they age older people use, on average, more medications that might impair their driving. The goal of the study is to identify what is known about the relationships between having medical problems, medication use, and travel behavior. The baseline research we report on here comes from two major national studies, each with its own strengths and deficiencies.

The National Health and Aging Trends Study (NHATS) and the National Household Travel Survey (NHTS) provide baseline measurements or knowledge of 1) the incidence of self-reported medical conditions among older drivers and the relationship to their travel behavior, including self-regulation; and 2) the use of medications among older drivers and the relationship to their travel behavior, including self-regulation.

We analyzed the two data sets separately to compare distributions, rates of travel, and common tendencies. We compared the variables in each data set most linked to medical problems and medication use by sex and age, and evaluated the impact of these factors on driving and self-regulatory behavior (as measured in each data set).

The **National Health and Aging Trends Study (NHATS)** is an annual multi-stage probability panel study of 8,000 nationally representative Medicare beneficiaries 65 and over.[2] The sample was stratified by age using five-year age groups between 65 and 90, plus all those over 90; African-Americans were over-sampled. A three-stage probability sample was used, with samples of 95 counties (or groups of counties) taken at stage 1; stage 2 took samples of 655 zip codes (or segments of those areas). Stage 3 took individual samples within the zip code areas also selected in this stage. The procedure was designed to yield equal chances of selection for persons within age by race groups.

The NHATS is designed to scientifically assess functioning in later life. It is undertaken by the Bloomberg School of Public Health, Johns Hopkins University in partnership with investigators at the Urban Institute and other institutions. The first round of data collection was fielded in 2011. While the NHATS will eventually be a prospective and longitudinal study, the baseline data currently available are cross-sectional.

The NHATS collects extensive health information on respondents (including selected medication use) and asks questions about driving and self-regulation. Respondents are questioned about 43 categories of variables including a full range of socio-demographic factors, medical issues, and medication use. Much of the data are self-reported, but NHATS respondents are tested annually for cognitive and physical performance. A full description of the NHATS methodology can be found at http:www.nhats.org/.

The second study on which we report here is the 2009 **National Household Travel Survey (NHTS);** it is a much larger nationally representative household study undertaken by the U.S. Department of Transportation. The survey has been administered seven times at varying intervals since 1969. The NHTS asks all members of the family ages five and older to keep a travel diary on one randomly assigned day that describes all aspects of their

[2] Roughly 93% of older Americans are enrolled in Medicare (AOA, 2012).

travel (the head of the household may answer for others in the household). The NHTS over-sampled people 65 and older. A random digit dial (RDD) probability sample of households in the U.S. was combined with 20 state and local area geographic RDD oversamples to create the overall data set, yielding 150,417 participating households and almost 310,000 person records—including just over 86,000 people 65 and older.

NHTS respondents are also asked a wide variety of attitudinal and personal questions, including disability, problems in driving and mobility, and safety. Many socio-demographic data are collected, including whether people who do not drive ever drove (new to the 2009 study). All of the NHTS data are cross-sectional. Full details of the survey design and methodology can be found at: http://nhts.ornl.gov.

The NHTS has data about everyone over the age of five in the household. In contrast, the NHATS is designed specifically to focus on people 65 and older receiving Medicare benefits (as well as the dual eligible, those receiving both Medicaid and Medicare). The NHATS also includes people living in nursing homes and other care facilities while the NHTS did not survey people living in group quarters. Both surveys have important and useful data on older driver behavior. At the same time, neither data set has any information about crash rates or injuries or specific medication use by name.

The NHTS has very detailed information about each and every trip each respondent makes on a randomly selected day but asks only one question about medical problems and only two questions about the response of older drivers to those problems. The NHTS also lacks information about medications used. However the NHTS does ask drivers if they have a condition that makes it difficult to travel,[3] and follows up with some questions about the kinds of coping mechanisms that respondents with such conditions use. In the text that follows we will use the term "medical condition" to indicate anyone who answered "yes" to this question.

In contrast, the NHATS has far less travel data but includes detailed information on medical conditions and some data on medication use. The NHATS asks only about the frequency of use of two classes of medications—sleep and pain—and then asks frequency of use of all "prescription" medications.[4] Both surveys ask a few questions about driving self-regulation. NHATS does not ask whether the existence of those conditions affects driving (although it does ask if certain issues, such as having pain, affects a person's daily activities).

Given the cross-sectional nature of the two databases, some or all of the findings may reflect certain biases; for example, older people who started using medications at 65 might be less healthy than older people who did not begin using medications until much later in their lives.

Because of their complex design, we were required to use analytical weights in tabulating the NHATS and NHTS data discussed in this report. The analytical weighting for both

[3] The question asks: "Do you have a temporary or permanent condition or handicap that has lasted more than six months that makes it difficult to travel outside the home?"

[4] Respondents are asked where their medications are obtained and how they are obtained, but they are not questioned about whether their medications include herbal or natural supplements.

these data bases follows conventional weighting protocols for these kinds of studies including: 1) a base weight to reflect the selection probability of the individual; 2) non-response adjustments to reduce bias associated with nonparticipation; and, 3) post-stratification weight adjustment to align the sample to known geographic and socio-demographic population distributions (*e.g.* the American Community Survey).

Finally, both the NHTS and NHATS data sets include replicate weights that reflect the complex nature of their respective sample designs and facilitate the calculation of sampling error of estimates. Details of the weighting process for the two data bases can be found at http://nhts.ornl.gov and http:www.nhats.org.

Medication Use and Medical Conditions

Medication Use

Research leads us to expect that, as people age, they will experience more medical and health problems while needing and using more medications. Both situations may affect their ability to safely drive (AAA FTS, 2013) as well as their interest in getting out of the house at all. Table 5 shows NHATS data on medication use among drivers by age cohort and sex. The data are based on responses to questions if, and how frequently, respondents used three ***categories*** of medication: sleep, pain, and prescription. For the first two categories of medications, we do not know if those who answered "yes" meant prescription or over-the-counter medications. Thus, these responses are not independent of one another.

Table 5. Self-Reported Medication Use in Previous Month by Drivers 65+ by Age and Sex, 2011 (%)

Medications Used	65 - 69		70 - 74		75 - 79		80 - 84		85+	
	M	W	M	W	M	W	M	W	M	W
Sleep	25.1	33.2	22.1	35.1	26.5	32.6	22.5	33.2	21.6	35.3
Pain	57.6	71.1	57.8	65.5	55.0	65.2	49.6	65.2	49.6	59.0
Prescription	82.5	87.6	91	91.2	91.4	92.2	92.8	92.6	91.4	92.7

Sources: Data from the NHATS developed for this study
Note: the data represent respondents who said that they ever took these medications, regardless of frequency. Sleep & pain medications may be over-the-counter or prescription.

The table shows that older female drivers are more likely to take medications than male drivers. Roughly a third of older women drivers take sleep medications, two thirds take pain medications, and over 90 percent take prescription medications. Among older male drivers, a little less than a fourth take sleep medications, a little over half take pain medications, and almost 90 percent take prescription medications.

However, medication use does not uniformly increase with age—and even when it does the increases are not very large. The oldest male drivers are slightly less likely to report taking sleep or pain medications than younger seniors and a little more likely to take prescription medications. The situation is somewhat reversed among female drivers; the oldest women are slightly more likely to take sleep medications and prescription medications but less

likely to take pain medications than younger senior women. But the differences are far less than one might assume from the literature.

Table 6 shows that, of the drivers who report using one or more categories of medications, very few of either sex only took sleeping medications or only pain medications. Slightly higher shares of older drivers took only prescription medications, and that went up with age; over 38 percent of men and 29 percent of women 85 and older reported taking only prescription medications (although we do not know if that was one prescription medication or many).

Table 6. Older Drivers Who Took Only One Category of Medication by Age and Sex, 2011 (%)

Medications Used	*65 - 69*		*70 - 74*		*75 - 79*		*80 - 84*		*85+*	
	M	*W*	*M*	*W*	*M*	*W*	*M*	*W*	*M*	*W*
	n=582	*n=611*	*n=612*	*n=663*	*n=548*	*n=549*	*n=474*	*n=500*	*n=329*	*n=309*
Only Sleep	0.8	0.3	0.8	1.6	0.7	0.3	0.5	0.4	0.0	0.0
Only Pain	4.8	4.9	4.8	4.9	2.8	2.9	0.8	2.4	2.5	2.7
Only Rx	31.4	22.6	25.8	19.2	30.7	23.1	33.7	23.7	38.3	29.0

Sources: Data from the NHATS developed for this study

Tables 5 and 6 taken together suggest that a substantial number of older people are taking over-the-counter medications. The extent to which purchasers ask a pharmacist or their own physicians about the impacts of non-prescription medications is unknown. But an AAA FTS report (2009) found that many drivers were unaware of the risks of most medications; moreover, doctors and other medical professionals rarely warned drivers about these risks. The study noted:

> Awareness, experience and healthcare working warning of PDI (potentially driving impairing) medications were low, especially among the oldest respondents and those with less educational attainment…awareness decreased with increasing age for both women and men. Few respondents had received a warning about PDI medications from a healthcare professional (p. 3).

Medical Conditions

The NHTS has less information about medical conditions and none about medication use. Respondents are asked if they have a medical condition that makes it difficult to travel. Table 7 shows that the percent of older drivers who report such difficulties goes up with age, as might be expected. At all ages, women drivers are more likely to report such conditions. Even the youngest cohort of older drivers (those 65-69) is twice as likely to report such conditions as those between the ages of 24 – 64 (unpublished data developed for this project but not shown in the table). At ages 85 and above, more than one in four drivers report a medical condition that makes it hard to travel.

Table 7. Older People Reporting a Medical Condition (%) by Driver Status, Age, and Sex, 2009

	65 - 69		70 - 74		75 - 79		80 - 85		85+	
	M	W	M	W	M	W	M	W	M	W
Drivers	11.3 *n=1233*	10.2 *n=1690*	12.6 *n=1114*	10.8 *n=1627*	16.9 *n=1225*	16.0 *n=1500*	21.1 *n=945*	17.2 *n=1291*	25.4 *n=643*	25.0 *n=711*
Non-Drivers	58.3 *n=222*	51.7 *n=472*	58.4 *n=286*	61.0 *n=677*	59.6 *n=394*	45.2 *n=887*	71.9 *n=491*	61.5 *n=1258*	74.3 *n=688*	71.5 *n=1852*

Sources: Data from the 2009 NHTS developed for this study

However, the NHTS data do show different patterns among drivers and non-drivers. At all ages non-drivers are many times more likely to report having a medical condition than are those who drive, although the gap narrows somewhat at the oldest ages. Moreover, at ages 75 and above, men who do not drive are *more* likely to report having a medical problem than are older women. These patterns are consistent with a substantial literature that suggests that men only stop driving when they have serious medical problems. Older women, on the other hand, may stop driving without having specific medical or other problems, simply because they find driving stressful or worrisome.

Unfortunately this question is not mode-specific; people who answer "yes" may mean that they have difficulty in walking in their neighborhood or to a transit stop or are unable to get safely to a seat on a moving bus. In fact, the question is not *transportation* specific; respondents who say "yes" may be reporting that their medical condition prevents them from leaving home. Moreover, even if respondents are addressing transportation problems, they may have difficulties in walking and using public transit but still feel confident in driving (Rosenbloom and Herbel, 2009; Siren and Haustein, 2013; Spawi, *et al*, 2013; Jancey, *et al*, 2013).

Driving and Self-Regulation

Both the NHATS and NHTS data give us useful information about the relationship between taking medications or having medical problems and travel behavior and driving self-regulation. The NHTS data give us some idea of the actions of older drivers who report a medical problem, while the NHATS data give us an idea of the driving behavior of older drivers who take different categories of medication.

Medical Conditions and Self-Regulation

The NHTS data in Figure I show that a very large share of drivers who report a medical condition reduce their daily travel. However, the percent of those reducing travel does not increase with increasing age. There may be two explanations for this counter-intuitive response. First, the actual magnitude of the reduction in travel may differ by age; it may be that the oldest drivers are making more drastic reductions even if fewer report reducing travel. Second, as all older people age they make, on average, fewer trips for a variety of

reasons; they may not report reduced travel as a response to medical problems because they have already changed their lifestyles in ways that decreased their travel (Molnar, *et al*, 2013a). That is, not driving or using public transit, etc. may be a moot point if older people have already decided to save time, money, and personal energy by not leaving their home as often as when they were younger (Rosenbloom, 2006).

Figure I. Older Drivers with a Medical Condition Who Reduce Daily Travel in Response, 2009

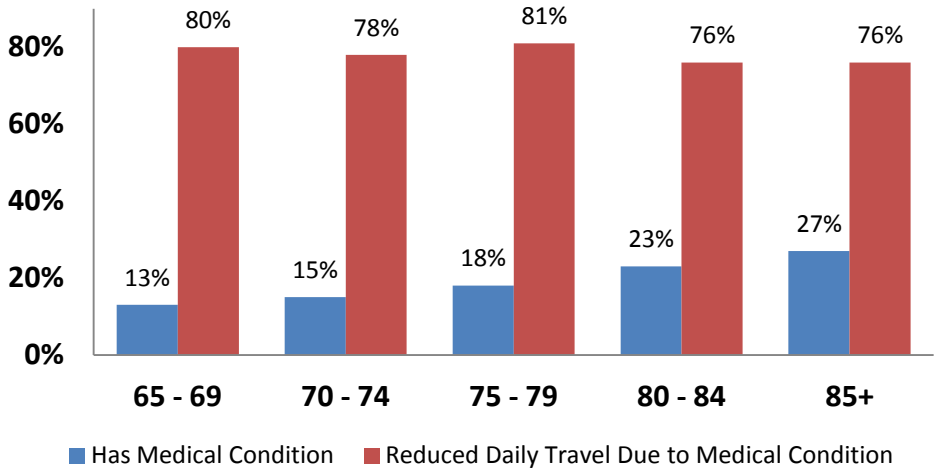


Figure II provides some elevation on these patterns. The figure shows that older drivers of both sexes drive far less in a year if they report having a medical condition. Both male and female drivers without a medical condition drive almost 75 percent more miles annually than do those with a medical condition. Clearly having a medical condition does affect driver behavior in both expected and unexpected ways.

Figure II. Annual Vehicle Miles Travelled by Older Drivers, With and Without a Medical Condition, by Sex, 2009

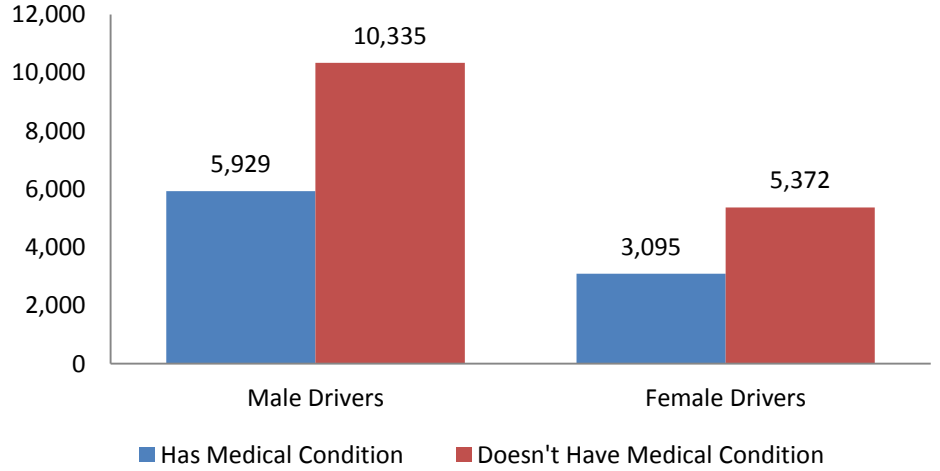
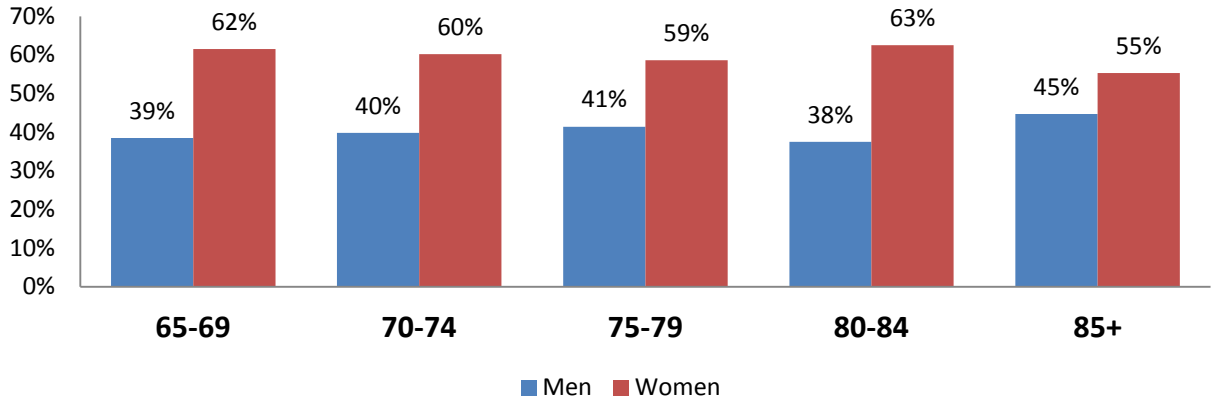


Figure III shows that a substantial percentage of older drivers limit their driving to the daytime—more than those reporting a medical condition affecting their ability to travel. The youngest cohort of older drivers is roughly twice as likely as those 24-64 to report that they

limit their driving to the daytime (information about those younger than 65 are from unpublished data prepared for this study). Again, this type of driving self-regulation is more prevalent among women than men, but it does not increase significantly with age, as we might expect. Less than half of male drivers ages 85 and older report that they don't drive at night.

Figure III. Percent of Older Drivers with a Medical Condition Who Limit Driving to the Daytime, by Age and Sex, 2009



The NHTS also asked older drivers reporting a medical condition if they asked others for rides instead of driving; 46 percent of all older drivers ask others for rides and this goes up slightly with increasing age. Conversely, about 10 percent of older drivers reduce public transit use to respond to their medical condition, and this response goes down with age. Again, this seemingly paradoxical finding may be the result of lifestyle decisions already made by older drivers; that is, they may not use public transit when they are active drivers so they don't report ceasing to use public transit when faced with a medical problem in traveling. Almost 30 percent of non-drivers 65 and over reported using public transit less when they had medical problems that interfered with travel. This suggests that this was a mode on which they relied, so reducing transit use was a decision that they could make.

Table 8 shows the impact of two types of driving self-regulation questioned in the NHTS: not driving at night and asking others for rides. The data clearly show that those who practice self-regulation drive significantly less than those who do not self-regulate, even if the latter report having a medical condition that interferes with travel. Men who don't drive at night drive less than half the annual miles of those who do; women drivers who ask for rides drive roughly a third of the annual miles of women who do not.

Table 8. Annual VMT by Older Drivers with a Medical Condition by Self-Regulation and Sex, 2009

	Men		*Women*	
	Yes	**No**	**Yes**	**No**
Limits Driving to Daytime	4,836	10,108	3,095	5,196
Asks for Rides	5,508	9,927	1,891	5,282

Sources: Data from the 2009 NHTS developed for this study

More significant is the actual mileage by older women who practice either type of self-regulation. Although there has been some debate (Staplin, *et al*, 2008), it is generally

accepted that there is a low mileage bias in crash rates (Langford, *et al*; 2008; Siren and Haustein, 2013). People who drive less than 1,854 miles (3,000) km a year tend to have ***more*** accidents than those who drive more, possibly because they have less experience and are more stressed when they do drive. Thus older women who self-regulate in this way may be increasing their crash risk.

Of course, the ultimate in self-regulation is ceasing to drive at all. The 2009 NHTS data, for the first time, tells us which current non-drivers gave up driving (as opposed to never having driven at all). Of the 1.9 million older men who did not drive in 2009, only 16 percent never drove—the overwhelming number of older male non-drivers had ceased to drive. Conversely, of the 6.1 million older women who did not drive in 2009, only a little over half had given up driving. The NHATS data show a slightly different pattern; 28 percent of all respondents never drove at all. However, we do not know how many of those who no longer drive gave up because of medical conditions or problems with medications.

It is possible that those who have never driven may actually be better off as they age because they may *not* have based their lifestyle on the mobility offered by the car. They may have instead chosen to live in areas where they can walk or use public transit. On the other hand, women who did not drive may have lived with spouses or family members who did drive, and may have become almost as auto-dependent as those with licenses—subject to sudden mobility losses if their driving spouse or family member loses the ability to drive (Rosenbloom & Herbel, 2009; Siren & Haustein, 2013).

Medication Use and Self-Regulation

The NHATS data provide insight into the relationship between the use of specific categories of medication and travel behavior. Overall, all older drivers who take medications are most likely to reduce night driving (as the literature generally shows), followed by avoiding highway driving and driving during bad weather, followed by refusing to drive alone.

Table 9 shows the differences in self-regulatory behavior among older drivers by their use of specific categories of medications. The table makes it clear, as expected, that women practice all four types of self-regulatory behavior more than men, whether or not they take medications. In fact, women who do not use specific medications are more likely to self-regulate than men who do take such medications. For example, over a third of women who do not take sleep medications avoid driving at night, while only a fifth of older men who *do* take sleep medications report the same self-regulatory behavior.

The table also shows that those who take medications are more likely to practice self-regulation than those who do not, as might be expected. Yet the differences are often not very large; substantial research suggests that many people, particularly women, begin to self-regulate their behavior before reaching 65 and before experiencing serious medical or medication issues. The table shows that for some self-regulatory behaviors there is only a few percentage points' difference between the travel behavior of those who do and don't take medications, especially among men—which may represent self-regulation begun years before becoming 65.

Table 9. Driving Self-Regulation (%) by Medication Use and Sex, 2011

Medications	AVOID DRIVING								
	At Night		*Alone*		*On Highways*		*In Bad Weather*		
	M	W	M	W	M	W	M	W	N =
Sleep									
Yes	20.8	42.2	7.7	9.6	12.9	23.4	14.6	26.5	1,430
No	18.3	33.5	4.7	6.3	9.6	21.8	10.0	18.6	3,752
Pain									
Yes	21.3	38.6	7.2	8.8	11.9	23.4	12.4	23.0	3,121
No	15.8	32.2	3.2	4.6	8.5	20.3	9.4	17.8	2,064
Prescription									
Yes	19.3	37.8	5.4	7.6	9.2	23.1	11.5	22.0	4,682
No	15.8	15.8	5.1	5.8	10.6	15.6	8.4	14.5	502

Source: NHATS data developed for this study

For example, among older men taking prescription medications (almost 90% of all men 65 and over), there was only a 0.3 percentage point difference between those who did and did not avoid driving alone. Among women taking pain medications (just over two-thirds of all older women), there were only 6.4 percentage points between those who did and did not avoid highway driving.

A second measure of self-regulation is actual reduction in driving frequency. Table 10 shows the number of times older drivers who did and did not take three categories of medications drove in the previous week. It is clear that taking medications is related to self-regulation, and more so among women than men. For example, among those who took sleeping medications, men were far more likely to drive daily than comparable women and far less likely to drive only a few days a week.

Table 10. Driving Frequency (%) by Medication Use and Sex, 2011

Medications	TIMES DROVE IN A WEEK								
	7 days		*5 – 6 Days*		*2 – 4 Days*		*< 1 Day*		
	M	W	M	W	M	W	M	W	N =
Sleep									
Yes	57.6	35.7	25.8	31.7	11.2	22.6	5.4	9.9	1,430
No	64.9	41.0	21.0	29.6	10.4	22.6	3.6	6.8	3,752
Pain									
Yes	61.3	35.8	23.4	31.0	11.1	24.6	4.2	8.6	3,121
No	65.7	46.2	20.6	29.1	9.8	18.5	3.9	6.3	2,064
Prescription									
Yes	63.0	38.5	22.1	30.8	10.9	23	3.9	7.7	4,682
No	64.6	46.6	21.9	26.3	8.5	18.4	5.0	8.7	500

Source: NHATS data developed for this study

The category of medication that seemed to have the most impact on driving frequency among women was pain medications; there was a 10.4 percentage point difference in driving every day between those taking and not taking medication. Of course, the reduction in driving may well have been due, not to any problems that women were experiencing in *driving,* but rather to the underlying condition that may have made them less likely to want to leave their homes. Taking sleep medications was the most likely to be associated with driving fewer than seven days a week among men; 65 percent of older male drivers who did not take sleep medications drove daily compared to just under 58 percent of men who did take such medications.

However, whether they take any of these categories of medications or not, most older drivers of both sexes drove fairly frequently. For example, almost 79 percent of women who were taking prescription medications drove at least five days a week, while almost 84 percent of men who took sleep medications drove that much. Conversely, among both men and women, taking sleep medications was most associated with driving less than one day a week. Still, only 10 percent of women and five percent of men taking sleep medications drove less than one day per week, and only four percent of men and eight percent of women taking prescription medications drove less than once a week.

Income and Older Driver Behavior

Early studies found an inverse relationship between an older person's income and having mobility problems, a relationship whose direction was not fully explained by the ability of those with more income to buy transport services (Rosenbloom, 1975). Both the NHTS and NHATS also show similarly complicated relationships between income and travel behavior. Some of the complexities may arise because income is itself a more complex situation for older adults; many may have limited current income but substantial resources (such as owning their home outright).[5]

Overall we expect that the higher someone's income the more they will travel and the more likely that they will travel by car. However, it is reasonable to assume that even older drivers with fairly high incomes may travel or drive less if they use medications or report medical problems because higher income cannot directly compensate for all the barriers they might face. However, our data call these assumptions into question. Table 11 presents NHTS data on the relationship of income and annual driver trips per capita by those who report a medical condition that interferes with travel. The income categories are quintiles.

The findings in Table 11 are relatively unambiguous; overall the number of trips taken by older drivers who report a medical condition increases as their income increases, regardless of age and in spite of reporting a medical condition. The pattern is the clearest for men; the higher the income a male driver had, the more driving trips he made, in spite of having a medical condition. The rate of increase clearly slowed down for women, but only after the fourth quintile.

[5] Older people may report their Social Security income but not their income from investments, thus artificially lowering their incomes. The NHATS asks not only about all sources of income but also about asset and debts, including the value of the home lived in and whether that home is mortgaged and for how much. We did not analyze differences in travel by these variables; these patterns deserve additional research.

Table 11. Annual Driver Trips Per Capita by Older Drivers with a Medical Condition, by Income, Age, and Sex, 2009

Income Quintiles	*65 - 69*		*70 - 74*		*75 - 79*		*80 - 84*		*85 +*	
	M	W	M	W	M	W	M	W	M	W
<$13,000	172.7	150.6	213.0	160.3	203.2	163.9	213.3	110.4	16.5	63.1
$13,000 - $24,999	243.0	183.2	216.5	189.8	249.2	94.6	194.5	55.5	175.4	91.7
$25,000 - $39,265	239.2	236.3	225.7	209.8	221.3	140.2	183.4	153.5	156.3	67.6
$39,266 - $70,000	279.4	190.1	248.1	119.5	213.4	178.3	216.5	52.5	132.5	45.9
>$70,000	273.6	190.8	273.8	157.7	241.1	154.5	282.2	43.5	169.0	25.0

Source: NHTS data developed for this study

Table 11 also makes two other relevant points. First, women with a medical condition always drive less than comparable men no matter what their income. Second, the older people are the less they drive, although this is clearly moderated by income. The big drop in driving for women with a mobility problem occurs at age 75. Men experience a far less dramatic drop in driving at all income quintiles as they age. Of course, the severity of those medical conditions may vary, and may vary with income. But the results still suggest that these relationships are complicated.

Table 12 presents NHATS data on the relationship between income and frequency of travel, as measured by the number of days the respondents drove in the previous week. The well-known positive relationship between income and frequency of travel is clear. As income increases for both men and women, the frequency of travel increases—but faster for men than women. Infrequent driving, however, does not show quite as clear a pattern. For men, as income increases, the likelihood of driving less than one day a week falls from 11 percent to one percent. However, among older women, the likelihood of driving less than one day a week first rises with rising income and then drops slightly.

The NHTS data also show the likelihood of someone with a medical condition driving on the respondent's randomly selected travel day (on which a travel diary was kept) by income. Overall, among male drivers of any age and female drivers under 75, there is a clear relationship between income and travel; as income increases the likelihood of driving increases (as seen in the more general population). But the expected pattern begins to disappear among older women who report a medical condition by the age of 70 (and after 85 for older men who have a medical condition). These data suggest that both sex and age may be more important than income in predicting the likelihood of driving on a travel day for those with a medical condition. Older women generally have more illnesses and conditions than older men, so greater income may not go as far in addressing those constraints. And at all incomes older women may prefer not to drive as much as comparable men.

Table 12. Driving Frequency by Income and Sex, 2011

Income Quintiles	TIMES DROVE IN A WEEK								
	7 Days		*5 – 6 Days*		*2 – 4 Days*		*< 1 Day*		
	M	W	M	W	M	W	M	W	N =
<$13,000	55.9	33.2	17.0	27.4	16.2	29.1	10.9	10.3	866
$13,000 - $24,999	59.7	37.2	16.6	28.5	14.6	26.1	9.1	8.1	1,084
$25,000 - $39,265	61.4	38.6	22.9	29.2	13.5	25.0	2.2	7.2	1,071
$39,266 - $70,000	63.2	41.8	26.0	32.4	7.9	17.5	2.8	8.4	1,219
>$70,000	69.3	44.6	23.1	33.9	6.6	16.3	1.0	5.2	982

Source: NHATS data developed for this study

Interestingly, the NHATS data shown in Table 13 indicate that there is an inverse relationship between income and driving self-regulation; that is, overall as income increases, driving self-regulation decreases. The likelihood that a male driver will avoid driving at night drops from 34 percent with an income less than $13,000 to 12 percent with an income of over $70,000. The likelihood that a woman will avoid driving in bad weather drops from 34 percent to 13 percent as her income increases from the first to fifth quintile. Male drivers are roughly one-third as likely to avoid driving at night if they make over $70,000 than if they make under $13,000. Female drivers are roughly one-fourth as likely to avoid driving alone if they make over $70,000 than if they make under $13,000.

It may be that those with higher incomes have better, safer vehicles or better insurance so they don't feel the need to self-regulate. On the other hand, these findings are still somewhat counter-intuitive—we might expect those with more money to be able to avoid driving by getting rides or using taxis. But there is little evidence that those with higher incomes are doing any of those things.

The NHTS data also show that same inverse relationship between self-regulation and income; overall, older drivers with a medical condition are less likely to self-regulate the higher their income, at least to the age of 80. Women are less likely to avoid night driving the higher their income to the age of 80, men to the age of 85. There are almost identical patterns in another coping mechanism, asking for rides; older drivers who respond to their medical conditions by asking others for rides instead of driving are more likely to do so as they age but less likely to do so the higher their income, with strong differences between men and women.

Table 13. Driving Self-Regulation (%) by Income and Sex, 2011

Income Quintiles	AVOID DRIVING								
	At Night		*Alone*		*On Highways*		*In Bad Weather*		
	M	W	M	W	M	W	M	W	N =
<$13,000	33.8	45.2	12.4	12.2	21.4	27.7	24.6	32.7	866
$13,000 - $24,999	28.7	44.6	8.5	8.7	15.3	26	16.9	24.7	1,048
$25,000 - $39,265	18.1	36.1	4.7	7.5	8.8	21.2	10.4	19.5	1,071
$39,266 - $70,000	14.9	33.1	2.7	5.8	8.5	20.1	8.9	17.8	1,219
>$70,000	11.9	23.8	3.9	3.5	6.2	17.7	5.2	13.4	982

Source: NHATS data developed for this study

In terms of reduced driving, those with a medical condition were more likely to resemble other drivers with comparable income than those of comparable age (to roughly 80), although the pattern was less consistent among women drivers. Over 70 percent of men ages 80 – 84 with an income over $70,000 drove on their NHTS travel day, compared to 76 percent of those 70 – 74 with comparable incomes. In contrast, only 47 percent of male drivers 65 – 69 or 80 – 84 with an income under $13,000 drove on their travel day. Men 75 – 79 with a medical condition and incomes over $70,000 were roughly 4.5 times less likely to restrict their nighttime driving than men of comparable age but incomes under $13,000.

These patterns were less clear among older women drivers with a medical condition, especially at higher ages. However, in general higher income was also associated with a lower likelihood of self-regulation among women. Women drivers ages 65 – 69 with incomes under $13,000, for example, were 12 percentage points less likely to drive on their travel day than those women with incomes over $70,000. And, women 70 – 74 with incomes over $70,000 were roughly one third as likely to restrict their nighttime driving as comparable women with incomes under $13,000.

These patterns may be an artifact of the way income data are reported or collected in the two data sets. Or income may be related to travel in unexpected ways for people using medications or having a medical condition. The actual medical conditions experienced by lower income older drivers may be more severe or they may receive less medical assistance in addressing those conditions. Even people with identical illnesses or handicaps of the same severity may face very different barriers with varying financial resources which play out in their travel patterns. Clearly these patterns demonstrate the need for further explanation of the role of income in driver self-regulation—and mobility.

In fact, the crucial role of income in explaining even the driving behavior of people with medical problems raises questions about mobility options for older people with lower incomes who drive less and self-regulate more, and of women who constitute the

overwhelming share of older people who do not drive, who live alone or not with another driver, and who have low incomes.

Do these older drivers have meaningful alternatives to driving if they want or need to reduce or cease driving? NHTS data show that few drivers (and less than 10% of non-drivers) 65 and over use special transit services or reduced fare taxis when they face medical conditions that create travel problems. These findings are consistent with many other studies (Rosenbloom, 2010). Research suggests that providing transportation alternatives to maintain the mobility of those who cease driving may be more complex and difficult than many analysts assume.

Summary and Assessments

This report provides baseline information from the research literature and two nationally representative surveys on the extent of medical problems and medication use among older drivers, and the relationship of medical problems and medication use with older driver behavior, including self-regulation.

Both the National Household Travel Survey and the National Health and Aging Trends Study rely heavily on self-reported information and have limited data about medical and medication use and no data on crash rates, risks, or outcomes. Even taken together, the data sets are not nearly comprehensive enough to allow us to fully understand the complex relationships we are examining. Both studies largely rely on self-reports and neither survey has data on medication use by name. But they still provide useful baseline information about older driver medication use, medical conditions, travel behavior, and driving self-regulation.

Building on this review of the literature and basic information on the travel patterns of older people, our analyses often found the same patterns as reported in the literature; at the same time we often found surprising differences that raise new questions or provide some new insights.

- NHATS data show that medication use is fairly high among older drivers; roughly 90 percent of both men and women 65 and over take prescription medications, and almost all take more than one category of medication.
    - Older women are substantially more likely to take all categories of medications than men are.
    - Reported medication use does not increase significantly with age.
    - Many older drivers use over-the-counter medications—about which they may receive no meaningful information regarding impact on driving safety, alone or in combination with other medications.
- NHTS data show that self-reported medical conditions that interfere with travel go up with age, and that at all ages more women report such conditions.
    - Non-drivers are many times more likely to report such conditions than drivers are.
- NHTS data show that the overwhelming percentage of older drivers with medical conditions report reducing their daily travel, women more than men.
    - However, the likelihood of older drivers reducing daily travel does not increase with age.

- NHTS data show that older drivers with a medical condition drive substantially less, measured in annual VMTs, than those older drivers without a medical condition.
    - There were very large gaps between the sexes; women *without* a medical condition drove less in a year than men *with* a medical condition.
- NHTS data indicate that many older people report driving only during the day, but the percentages of those avoiding night driving did not increase with age.
    - Women at all ages were more likely to report not driving at night than comparable men were.
- NHTS data show that older drivers with a medical condition who self-regulated (not driving at night or asking for rides rather than driving), drove substantially fewer annual VMTs than those with medical conditions who did not practice these types of self-regulation.
    - Women with medical conditions who restricted their driving so reduced their annual VMTs that they put themselves at risk of the problems associated with "low mileage bias" (higher crash risks due to inexperience and driving on riskier roads).
- NHATS data show that older drivers who took any category of medication were more likely to self-regulate their driving in one of four ways than those who did not take medications, although the differences, especially among male drivers, were often small.
    - Women were substantially more likely than comparable men to self-regulate their driving behavior when taking any category of medications.
    - Older drivers were most likely to avoid night driving and least likely to avoid driving alone of the four self-regulatory behaviors questioned in NHATS.
    - Older drivers were the most likely to self-regulate their driving behavior in one of four ways when taking sleep medications, the least likely when taking prescription medications.
- NHATS data show that older drivers who took medications drove less frequently in a week than those who did not; the differences were greatest among women.
    - Taking pain medications seemed to have the greatest dampening effect on the number of days that older women drove; taking sleep medications seemed to reduce older male driving the most.
- NHTS data indicate that rising income is associated with higher annual VMTs for both older men and women with a medical condition; income must in some way compensate for those medical problems.
    - Older drivers with a medical condition were also more likely to drive on their travel day as their income rose, to about the age of 75.
- NHATS data also indicate a positive relationship between income and the number of days driving; NHTS data shows that even those with a medical condition drove more if they had a higher income.
- Both NHATS and NHTS data show, somewhat surprisingly, that self-regulatory behavior declines with increasing income among people taking multiple medications or who have a medical condition.

Overall, the baseline data developed in this report confirm many of our expectations about older driver behavior in the face of a medical condition or taking certain categories of

medications. Both trip-making and self-regulatory behaviors were inversely related to age regardless of medication use or medical condition. Income, however, seemed to mediate some of these changes. There were always very large differences between comparable men and women, perhaps larger than seen in previous research.

Perhaps the most striking finding is the inverse relationship between income and self-regulation. While researchers are currently analyzing socio-behavioral factors that affect driving and self-regulation, most ignore income. While income may, in fact, be strongly related to other socio-behavioral factors that better explain driver behavior and self-regulation, it is important to note how much easier a datum it is to collect than more in-depth attitudinal and psychological information about drivers. On the other hand, we may not have used the best data on this issue; clearly this is an area in need of additional in-depth study.

In spite of the many changes that older drivers appear to make to respond to health issues or the medications they take, most still drive frequently to very old ages. This tells us that we have a lot to learn about the links between all these behaviors and patterns and crash risks and crash outcomes. The analyses reported here are a needed, if limited, first step in thinking about the factors that deserve additional study with more precision and robustness.

Our objective in this report was to identify and synthesize data on medical conditions, medication use, and older driver travel behavior in order to support a range of older driver research initiatives funded by the AAA Foundation for Traffic Safety. These initiatives will help target safety interventions, develop appropriate public policies, and provide comprehensive information to a range of stakeholders on how to safely address problems created by the use of medications. All these goals will be met over the next five years through studies conducted by the Urban Institute and the soon-to-be-launched five-year prospective cohort study to be conducted by Columbia University and the University of Michigan.

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