# Medications and Comorbidities as Predictors of Older Driver Performance

Sherrilene Classen, PhD, MPH, OTR/L

ICADI

February 22, 2008

UF UNIVERSITY of FLORIDA

UF UNIVERSITY of FLORIDA

# Acknowledgement


## Research Team

Sherrilene Classen PhD

Anne Horgas, PhD

Kezia Awadzi, PhD

Barbara Messinger-Rapport, PhD, MD

Yongsung Joo, PhD

Orit Shectman, PhD

## NODRTC

National Older Driver Research and Training Center, UF, Gainesville, FL.

Dennis McCarthy, PhD

Desiree Lanford, MOT, CDRS

Eugenia Rodriques, RA

## Funding Agency

University of Florida's Age Network Multidisciplinary Research Enhancement Funding

# Background

- The 2000 census found 35 million adults are $65^{+}$
  - 12.2% increase from 1990
- The population of older drivers
  - increased by about 29% in the same period to approximately 19 million.
- As baby boomers age we estimate that nearly 100% will be driving by age 65
  - and will want to continue driving to maintain mobility and quality of life
- As a group, older drivers have lower crash rates than younger drivers
- Because of age-related frailty, they are at an increased risk for crash-related injury or death

UF UNIVERSITY of FLORIDA

# Background

- Medication use: Among those ≥ 65 [3]
  - more than 90% use ≥ 1 per week
  - more than 40% use ≥ 5 per week
  - about 12% use ≥ 10 per week
- Compared with the general population, older adults
  - take more medications
  - have more comorbidities
  - have more opportunity for polypharmacy, inappropriately prescribed medications (IPM), and drug-drug interactions (DDIs) and
  - adverse drug reactions [4-7]

# Background

In those $\geq$ 65 the effect of medications and comorbidities as predictors of crashes has been studied from crash and fatality data

- The IMMORTAL study in Europe [11]
  - narcotic analgesics, Benzodiazepines, and cyclic antidepressants
  - neurological conditions
- A case control crash study in Alabama [2]
  - CNS, anti-inflammatory, cardio vascular treatment agents
    - Benzodiazepine use, NSAIDs, angiotensin converting enzyme (ACE) inhibitors, and anticoagulants were associated
  - heart disease, stroke, arthritis in women

# Background

- Tennessee Medicaid Study [12]
  - CNS agents
    - Benzodiazepines and antidepressants as crash predictors for enrollees
- Rural Iowa study [13]
  - NSAIDs
  - back pain
- Group Health Cooperative of Puget Sound [14]
  - diabetes medications
  - diabetes in members
- Epidemiological studies published as technical reports
  - Use of multiple simultaneous drugs [17, 18]
  - CNS agents
    - antihistamines, [15] Benzodiazepines, narcotic analgesics, and cyclic antidepressants [16]

# Significance

- Our current understanding of the effect of medications and comorbidities is primarily limited to data from epidemiological studies of crash related fatality or injury
  - Although few older drivers experience one of these outcomes
  - A larger population of older adults, with multiple comorbidities taking multiple medications, is at risk for crash related outcomes
  - Aside from a small study of antihistamines using a driving simulator, there is no study relating medication classes and co-morbidities in older adults to on-the road driver performance

# Purpose

- Primary objective
  - To determine the effect of self-reported medications and co-morbidities, as well as age, gender, cognition to failing a standardized road test.
- Secondary objective
  - To understand the effect of the above variables on driver maneuver scores, an indication of accuracy of vehicle maneuvering during driving.

# Methods

UF UNIVERSITY of FLORIDA

# Sample

- Participants were recruited from North Central Florida
  - Paid advertisements in newspapers
  - Flyers distributed to aging service centers
  - Health clubs
  - Apartment complexes
  - Community centers
  - Open houses held at UF's Gator-Tech Smart House
  - Word-of-mouth referrals
  - Movement Disorder Clinic
- Three waves of recruitment yielded 251 participants
- Participants completed a telephone and informed consent before enrolling in the study
- Final analysis 127 participants
- Approval from UF's IRB

# Setting

- All participants were tested at the National Older Driver Research and Training Center, in Gainesville, FL
- Participated, from that location, in a standardized open road course [19]
  - varying levels of complexity
    - parking lot
    - residential driving
    - urban driving
    - highway driving

UF UNIVERSITY of FLORIDA

# Design

- Analyses of the clinical predictors of failing a road course after completion of the driving evaluation studies.

# Procedure

- Data collection
  - Three driving rehabilitation specialists (primarily OTRs)
  - Telephone interview, clinical tests and
  - On-road test
    - We used a dual-brake controlled 2004 Buick Century
    - A trained driving evaluator sat in the passenger seat of the vehicle
    - The inter-rater reliability among the driving evaluators was good-excellent
      - (ICC coefficient = 0.80-1.00) [25]

# Procedure

Data Collected on

- Demographic indicators
  - age, ethnicity, gender
- Health, function, driving history
  - health (e.g., medication, comorbidities)
  - physical (e.g., sensory, motor)
  - mental (e.g., cognition, attention)
  - driving–related (driving history, driving habits)
- Driving performance
  - Sum of maneuvers score (0-273)
  - Global rating score
    - four outcomes --pass, pass with recommendation, fail with recommendation, fail

# Procedure

Drug data were classified according to the American Hospital Formulary System (AHFS 2007) [26]

- Some drug categories were collapsed to reflect their primary disease treatment purpose. [4-9]
  - E.g., in the AHFS classifications, electrolytes and cardiovascular drugs are coded as distinct categories
  - in our sample, drugs in the electrolyte category consisted mainly of potassium supplements (and hypokalemia has cardiac effects)
  - we merged those drugs with the other cardiovascular drugs
- We focused on six drug categories to correspond with the six disease categories
  - Cardiovascular
  - Musculoskeletal
  - Glandular/hormone
  - Neurological
  - Urinary
  - Vision

# Measures

Independent variables

- Age and gender
- Self-reported medications
  - all prescription, over the counter (OTC), nutraceuticals, herbs and vitamins, classified in six categories using the AHSF 2007
- Self-reported medical conditions
  - assessed and summarized with the Older Americans Resources and Services Health Questionnaire (self-report), a measure often used to assess the health status of older adults [20, 21]
- Cognition - Trail Making Part B [22]
  - a standardized paper and pencil cognitive test of divided attention
  - acceptable validity and reliability as a measure of executive functioning
  - to be conducted within 3 minutes or less [23, 24]

# Measures

Dependent variables

- Primary outcome: Global Rating Score (GRS)
  - For the purposes of this study, both pass categories were recoded to "pass", and both failing categories were recoded to "fail" outcome
- Secondary outcome: Sum of Maneuvers Score
  - computed as the driver performed maneuvers across the standardized road course
  - 91 maneuvers, and participant could receive a max score of 3 on each maneuver if they had no errors
  - range 0-273, with 273 indicative of perfect driving, or zero errors
  - driving evaluators supplemented the error data with general comments on testing conditions such as traffic conditions (e.g., traffic flow), weather conditions (e.g., cloudy or full sun), or other subject behaviors (e.g., emotional state)

# Analyses

- Analyzed with SAS version 9.0
- Two regression analyses
- Predictor variables
  - age, gender
  - cognition
  - classes of comorbidities
  - medications (number, classes of medications)
- Two dependent variables
  - GRS (pass/fail): logistic regression
  - Sum of Maneuvers Score: linear regression

# Results

UF UNIVERSITY of FLORIDA

# Results: Demographics

- Mean age: 74.8 years (SD 6.3)
- Female 46.5%
- Medications
  - Range: 0-19
  - Mean number: 6.5 (SD 4.9)
  - About 1/5 of the cohort did not report any medication use
- Trails B
  - Mean time for completing: 114.3 sec (SD 82.8)

# Results: Comorbidities

- 67.5% reported a musculoskeletal problem
  - osteoarthritis primary as the diagnosis
- 60% reported cardiovascular diagnoses
  - hypertension, cardiac diseases as the primary diagnoses
- 34.9% reported vision problems
  - cataracts, glaucoma as the primary diagnoses
- 30.4% reported glandular disease
  - thyroid disease, diabetes as the primary diagnoses
- 25% reported neurological disease
  - stroke, Parkinson's Disease, dementia as the primary diagnoses
- 16.9% reported urinary disorders
  - UT, kidney disease as the primary diagnoses

# Results: Medication Categories

- Cardio vascular drug treatments N=269
  - antihypertensive, electrolyte, antilipemic, diuretic, anticoagulant agents
- Musculoskeletal drugs treatments N=81
  - mild pain; alendronate, opiate agonist agents
- Neurological drugs treatments N=56
  - antidepressant, Parkinson, sedative, hypnotic, Alzheimer disease, antipsychotic agents
- Glandular drugs treatments N=51
  - 31.4% Diabetic agents: (oral agents, insulin)
  - Non diabetic agents (thyroid, estrogens, hormones)
- Vision drugs treatments N=14
  - antiglaucoma, anti-infective agents
- Urinary drugs N=5
  - alpha blocker, antispasmodic, cholinergic agents

# Results: Driving Test

- Global Rating Score
  - Failing road test N=24 (18.9%)
- Sum of the Maneuvers Score
  - Mean 238.9 (SD 25)
    - Range 0 -273 [273 = perfect driving]

# Results

Table 1. Comorbidities and Medications as Predictors of Failing a Road Course

| Effect | Point Estimates | 95% Wald Confidence Interval | |
|---|---|---|---|
| **Demographics** | | | |
| Age | 6.66 | 2.24 | 19.79 |
| Gender | 1.90 | 0.86 | 4.20 |
| Trail Making Part B | 2.50 | 1.04 | 5.92 |
| **Comorbidities [Disease]** | | | |
| Musculoskeletal | 0.26 | 0.10 | 0.72 |
| Cardiovascular | 2.39 | 0.83 | 6.84 |
| Neurological | 2.76 | 1.17 | 6.54 |
| Glandular | 2.36 | 0.89 | 6.29 |
| Urinary | 1.37 | 0.69 | 2.70 |
| Vision | 1.38 | 0.62 | 3.11 |
| **Drug Treatments [Agents]** | | | |
| Musculoskeletal | 0.33 | 0.10 | 1.06 |
| Cardiovascular | 2.03 | 0.92 | 4.52 |
| Neurological | 1.75 | 0.84 | 3.66 |
| Glandular Non-diabetic | 0.27 | 0.09 | 0.83 |
| Glandular Diabetic | 0.77 | 0.37 | 1.64 |
| Urinary | 0.88 | 0.44 | 1.78 |
| Vision | 1.12 | 0.61 | 2.06 |

# Results

Table 2: Comorbidities and Medications as Predictors of a Lower Sum of Maneuvers Score

| Effect | DF | Estimate | Standard Error | Wald 95% Confidence Intervals | | Chi-Square | P value |
|---|---|---|---|---|---|---|---|
| **Demographics** | | | | | | | |
| Age | 1 | -5.99 | 2.08 | -10.08 | -1.91 | 8.28 | <0.01 |
| Gender | 1 | -1.09 | 1.96 | -4.93 | 2.76 | 0.31 | 0.58 |
| Trail Making Part B | 1 | -9.09 | 2.03 | -13.07 | -5.10 | 19.97 | <0.01 |
| **Comorbidities [Disease]** | | | | | | | |
| Musculoskeletal | 1 | 4.80 | 2.05 | 0.79 | 8.81 | 5.51 | 0.02 |
| Cardiovascular | 1 | 2.25 | 2.04 | -1.76 | 6.25 | 1.21 | 0.27 |
| Neurological Disease | 1 | -3.43 | 2.06 | -7.46 | 0.61 | 2.77 | 0.10 |
| Glandular | 1 | 2.51 | 2.16 | -1.73 | 6.75 | 1.34 | 0.25 |
| Urinary | 1 | 0.64 | 2.10 | -3.48 | 4.76 | 0.09 | 0.76 |
| Vision | 1 | -0.21 | 2.02 | -4.16 | 3.75 | 0.01 | 0.92 |
| **Drug Treatments [Agents]** | | | | | | | |
| Musculoskeletal | 1 | -1.56 | 1.88 | -5.24 | 2.13 | 0.69 | 0.41 |
| Cardiovascular | 1 | -1.63 | 2.12 | -5.78 | 2.52 | 0.59 | 0.44 |
| Neurological | 1 | -4.75 | 2.45 | -9.54 | 0.05 | 3.76 | 0.05 |
| Glandular Non-diabetic | 1 | 0.69 | 2.06 | -3.35 | 4.74 | 0.11 | 0.74 |
| Glandular Diabetic | 1 | 0.81 | 2.01 | -3.13 | 4.75 | 0.16 | 0.69 |
| Urinary | 1 | 1.89 | 2.19 | -2.41 | 6.18 | 0.74 | 0.39 |
| Vision | 1 | -0.25 | 1.66 | -3.51 | 3.01 | 0.02 | 0.88 |

# Discussion

- In this population of licensed drivers, nearly 1/5 failed the standardized road test
  - many older persons self-restrict their driving, going only to familiar places, avoiding highways and urban areas
  - this road test included a range of complexities in daytime driving conditions which may have exceeded those driven by many of the participants
- Advanced age and prolonged time to complete the Trails B were two major predictors of
  - failing a road test
  - having a lower sum of maneuvers score

# Discussion

- Having a neurological diagnosis was associated with test failure, and taking medications from the neurological class was associated with a lower sum of maneuvers score.
  - The AHFS neurological drug category in our study contained antidepressant agents, primarily SSRI agents, and Parkinson's disease agents as the main treatments
    - Tricyclic antidepressants [11, 12] and SSRI use [17] have appeared in other crash studies as predictors of adverse outcomes
  - Our study did have a relatively large percentage (7.3%) of persons with Parkinson's Disease
    - A simulator study [27] and road tests [28, 29] of persons with Parkinson's disease demonstrate navigational errors and lower driver safety

# Discussion

- Our finding of the possible role of non-diabetic glandular medications as decreasing the risk of failing the driver evaluation was not addressed in previous driver studies.
  - The two major categories in our participants were thyroid medications and hormone therapy (HT).
    - Although thyroid deficiency or excess could cause cognitive and physical deficits, there is no relation known with driving.
    - The impact of hormonal therapy on all physical and cognitive function is controversial.
      - E.g. while the Cache county study suggests that long-term use of HRT is protective to developing dementia [30]
      - Women's Health Initiative study suggests HT is associated with an increased risk of developing dementia.[31]
  - The relationship of HT to driving requires further investigation

# Discussion

- A diagnosis of a musculoskeletal disease
  - primarily osteoarthritis of the large joints or spine (with or without surgery) appeared protective
  - reduced risk of failing the driving test
  - reduced risk of scoring poorly on the sum of maneuvers score
    - This contraindicates prior studies implicating arthritis in women [2] and back pain [13] as predictors of crashes
    - Comparisons between these studies are complicated because we do not know the disease duration or impact of disease on function
    - It is possible that the population in our study had access to multiple treatment modalities including therapy, medication, surgery, rehabilitation and thus the impact on function is limited
      - Elderly persons treated with either physical conditioning therapy,[32] or driving therapy (on the road as well as classroom) for arthritic as well as other physical conditions [33] can improve their driving performance

# Discussion

- Limitations
  - The sample size
    - We did not have a sufficient number of subjects to examine the effects of individual medications
      - E.g., understanding the effect of calcium channel blockers or beta blockers, on driving
  - Lack of information on
    - compliance, therapeutic levels, or long term use of drugs
    - severity, duration, confirmation on comorbidities

# Summary

- Despite the limitations, we have a robust relationship between advanced age, impaired cognition, and diagnosis of neurological diseases AND failing the driving test.
- We do not have an answer for the relationship between musculoskeletal diseases (primarily osteoarthritis) and reduced failure risk
  - but it appears to be consistent within the study as this category also predicted a lower sum of maneuver score.
- Aside from the neurological disease category no medication or disease class predicted test failure, or a lower sum of maneuvers score.
  - This finding suggests that the presence of a diagnosis or the use of a medication should not imply unsafe driving skills.
- A larger trial might be able to explain the apparent protective effect of musculoskeletal disease and non-diabetic glandular medications.

# Thank you!

## Contact Information

Sherrilene Classen, PhD, MPH, OTR/L
College of Public Health and Health Professions
University of Florida
PO Box 100164
Gainesville, FL, 32615
Tel: (352) 273-6062
E-mail: sclassen@phhp.ufl.edu

UF UNIVERSITY of FLORIDA