The Candrive Older Driver Study: Prospective Changes in Health Characteristics and Impact on Driving over 5 years

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Outline

1. Candrive Brief Background
2. Common Cohort Study Overview
3. Hypothesis
4. Results
5. Risk Stratification Tool

“To establish a national inter-disciplinary collaborative approach to identify, analyze and address the health-related safety and quality-of-life issues pertaining to older drivers.”

Candrive Vision

Candrive Goal: *To Bring Together*

- **Researchers**
- **Seniors Groups**
- **Clinicians**
- **Ministries of Transportation**
- **Other Governmental Organizations**
- **Non-Governmental Agencies**

Candrive Major Objectives

- To develop a scientifically valid, easy to use assessment tool that will identify safe older drivers or those who need to go on for further testing
- To extend the safe driving period for older persons

Candrive

CIHR funded grants 2002-2016 ($8.2M)

- Infrastructure Emerging Team Grant 2002-2007 ($1.25 million)
  - Development of a research network
- Team Grant 2008-2013 ($5.5 million)
  - Candrive Common Cohort Study and 6 related Subprojects
- Operating Grant 2014-2016 ($1.4 million)
  - Candrive Prospective Older Driver Study (continuation of the cohort)

- Co-Principal Investigators: Malcolm Man-Son-Hing & Shawn Marshall

Common Cohort Inclusion Criteria

- Age 70 or greater
- Life expectancy 5 years or greater
- General class (5) driver's license
- Have vehicle access and drive at least 4 times a week
- Consent to release personal driving record information from the provincial Ministry of Transportation for the duration of the study
- Under the care of a family physician or primary health care group

Common Cohort Recruitment

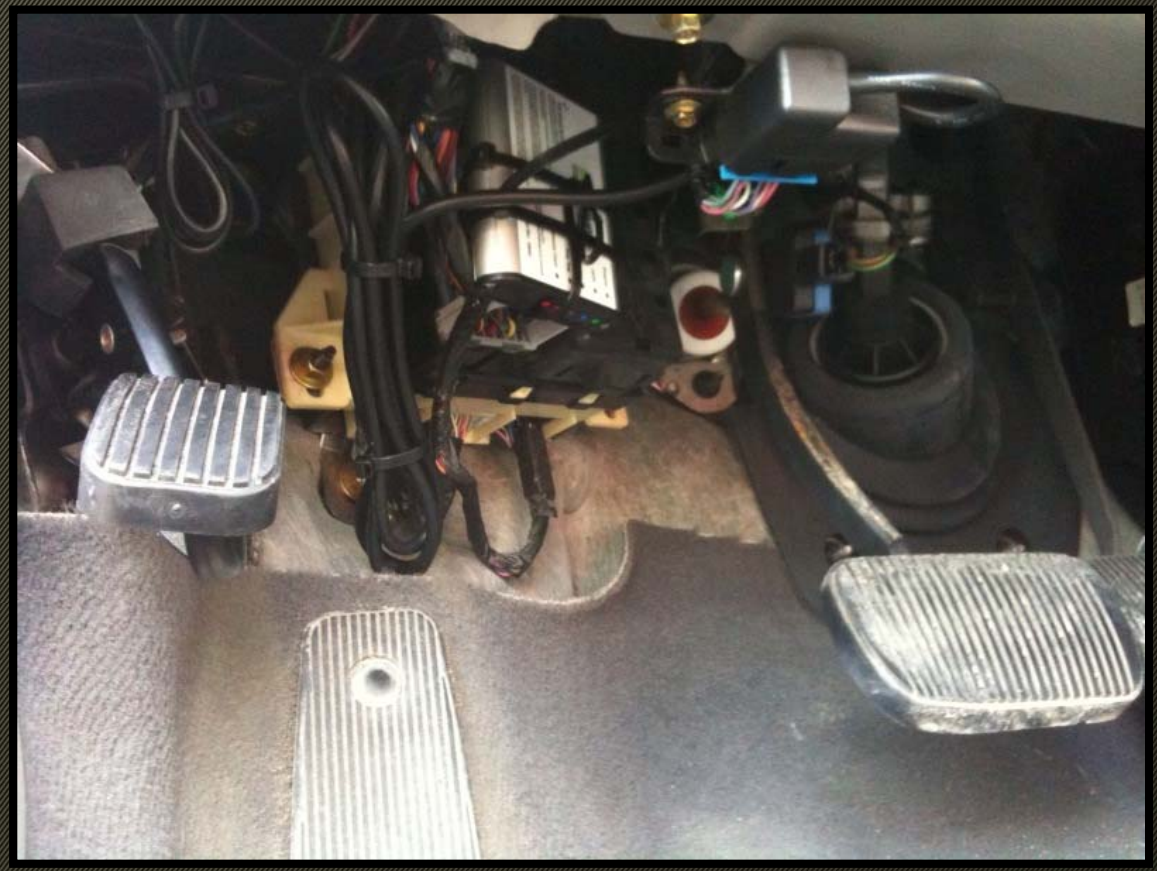
- 7 Canadian sites; 4 provinces
  - 928 older drivers age 70 and older

- Melbourne, Australia and Wellington, New Zealand
  - 257 (Melbourne) and 45 (Wellington) age 75 and older

Common Cohort Assessments

- **Annual Assessments**
  - Physical, sensory and cognitive assessments; driving habits and behaviours questionnaires
  - Psychosocial questionnaires
- **Follow up at 4 and 8 months (after Sept 2013, follow up only at 6 months)**
  - Review of driving record
  - Review overall health status
  - Self-reported collisions

GPS Unit



Provincial Licensing Bodies

- Accident data from all provincial licensing bodies
- Traffic violations
- Accident reports assessed for “at fault status” by 2 experts

Representative Sample – Candrive and CCHS HA Comparison

- Canadian Community Health Survey – Health Aging (CCHS HA)
- Selected participants 70 years and older who reported driving at least once a week
- Resulted in 3899 older drivers
- Compared CCHS HA and Candrive participants using the following variables:
  - Health and Functional Status
  - Type of Residence and Education Level
  - Socio-demographic

Conclusion:

- Candrive study participants are representative of the larger older Canadian driver population
- Results of the Candrive study can be generalized to the broader population of Canadian older drivers

Reference:
Gagnon, S., Marshall, S.C., Kadulina, Y., Stinchcombe, A., Bédard, M., Gélinas, I., Man-Son-Hing, M., Mazer, B., Naglie, G., Porter, M.M., Rapoport, M., Tuokko, H., Vrklnan, B., For the Candrive Research Team. Assessing the representativeness of a convenience sample of older drivers: A comparison between the CIHR Candrive cohort study sample and the household population of Canadians with valid driver's licenses. Canadian Journal on Aging. Volume 35 Supplement 2 (2016)

Socio-demographic characteristics

Parameters	Candrive Mean (SD) or N (%)	CCHS HA Mean (SD) or N (%)
Age (Mean and SD)	76.2 (4.85)	76.5 (5.12)
Gender, n (%)		
Men	578 (62%)	2278 (58%)
Women	350 (38%)	1621 (42%)
Marital status, n (%)		
Married	544 (59%)	2527 (65%)
Widowed	231 (25%)	947 (24%)
Single	116 (13%)	318 (8%)
Common Law	36 (4%)	108 (3%)
Education (Mean and SD)	2.87 (1.62)	2.95 (1.2)
Place of residence, n (%)		
City/urban	820 (88%)	2990 (77%)
Rural	106 (12%)	910 (23%)
Living arrangements, n (%)		
House	618 (66%)	2970 (76%)
Apartment/Condo	291 (31%)	838 (22%)
Other	19 (2%)	92 (2%)

Prospective Changes in Health Characteristics and Impact on Driving over 5 years

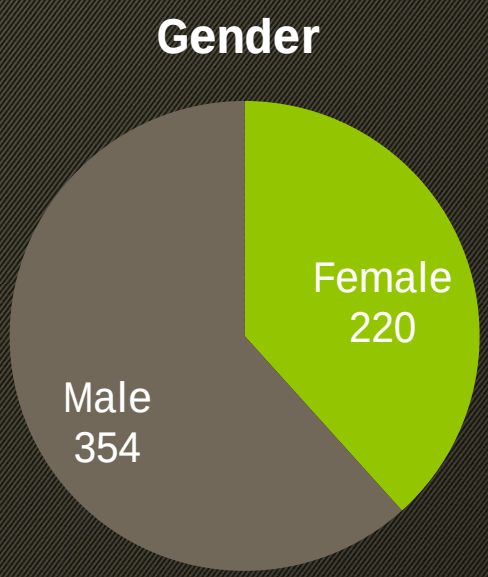
Candrive

“Over time the health status of Candrive study participants will decline over multiple domains. This will have an effect on their driving habits and patterns.”

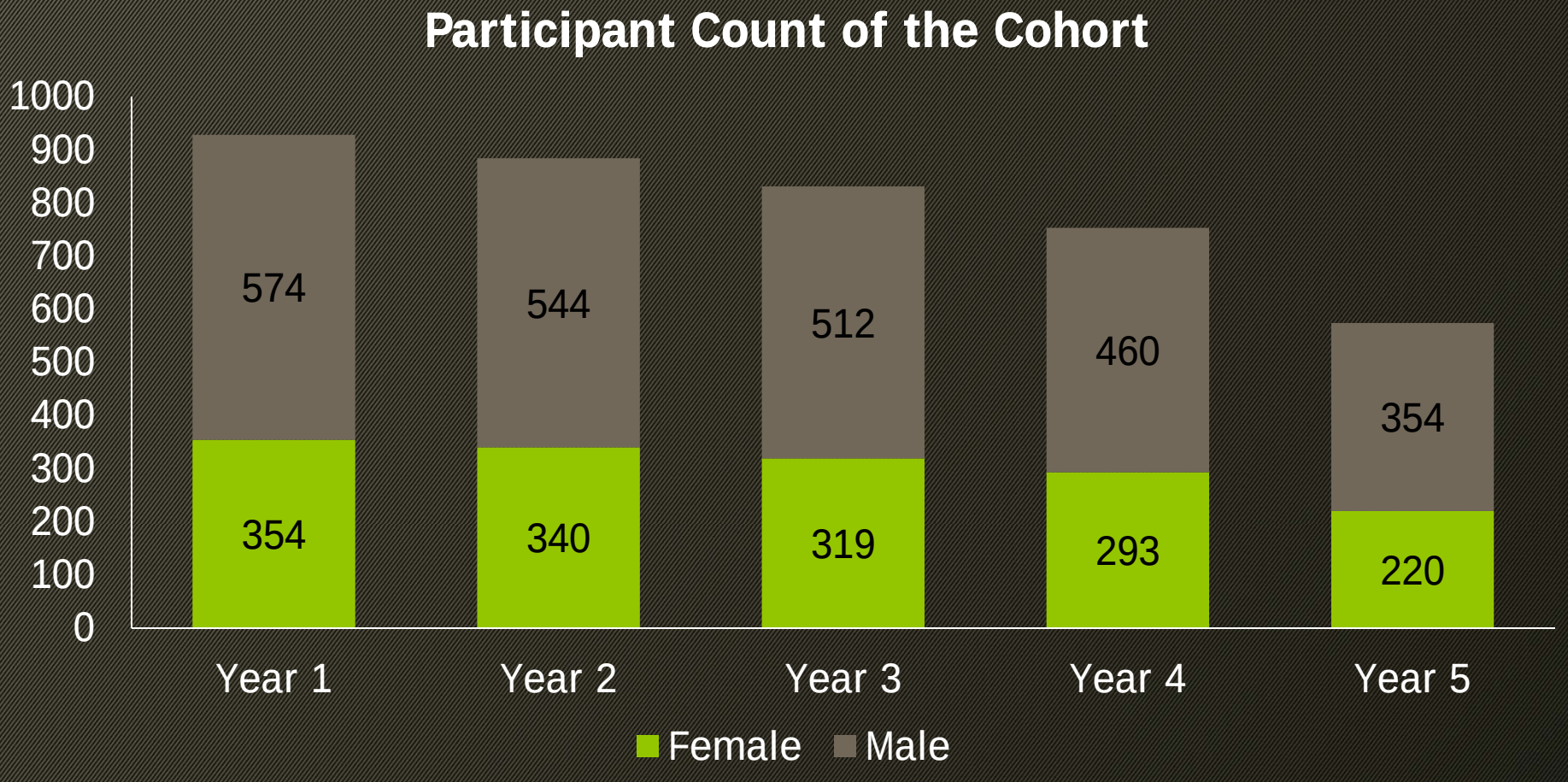
Hypothesis: Candrive Cohort

Methods

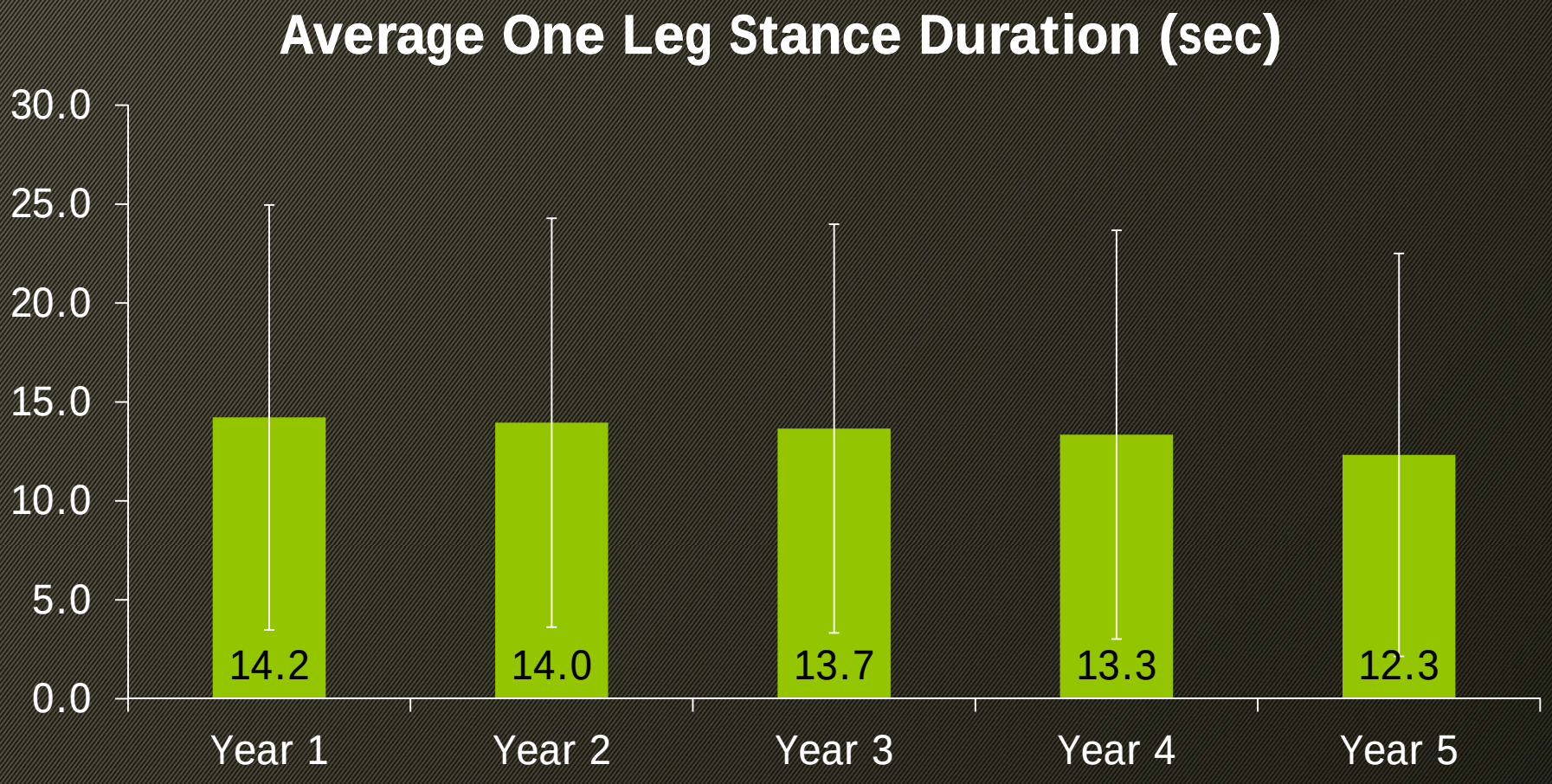
- 574 of the original 928 Candrive participants were chosen
  - Completed the Year 1 annual assessment
  - Completed the Year 5 annual assessment



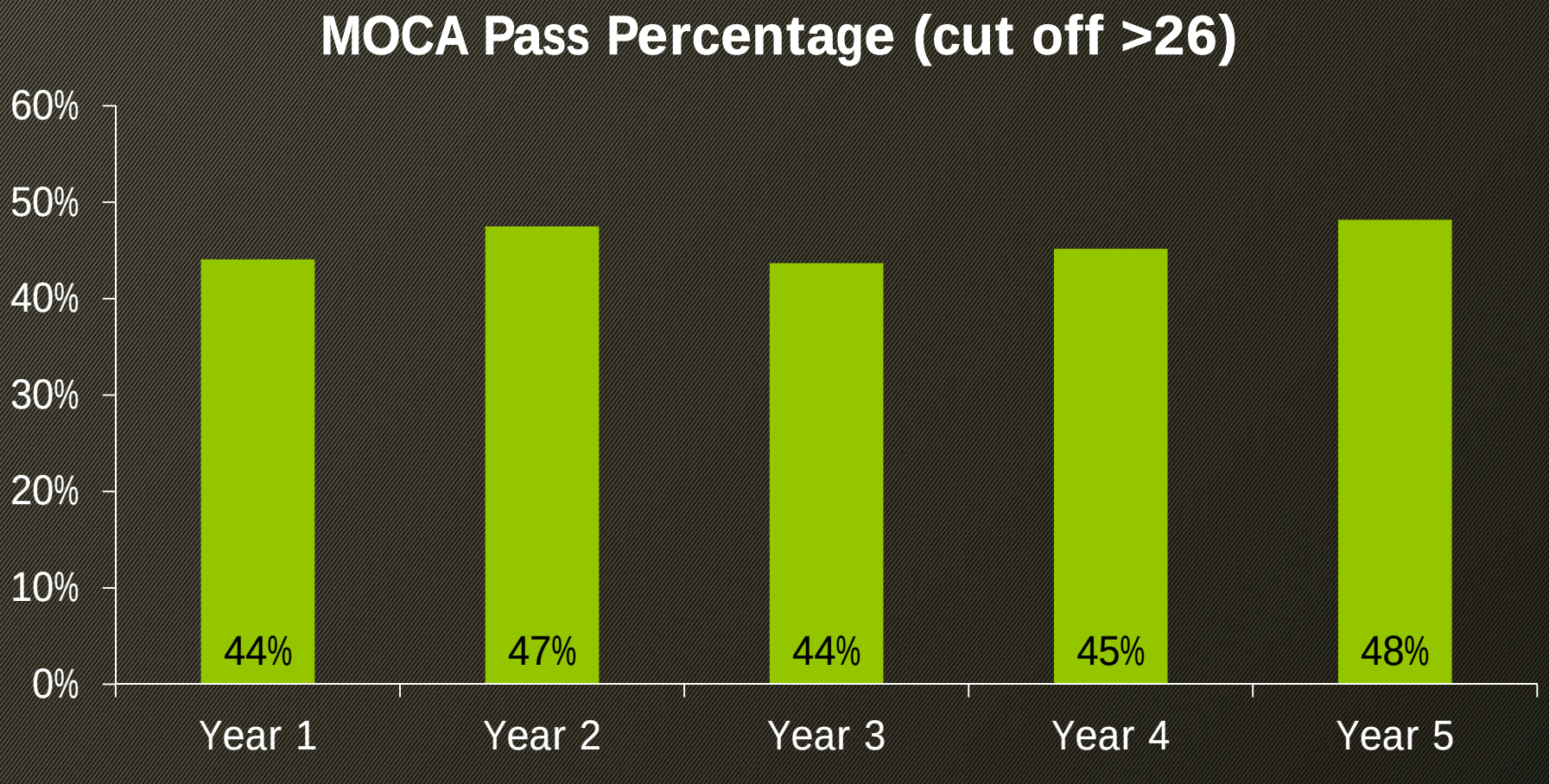
Results


Participant Count of the Cohort
1000
900
800
700
600
500
400
300
200
100
0
574
544
512
460
354
354
340
319
293
220
Year 1
Year 2
Year 3
Year 4
Year 5
Female
Male

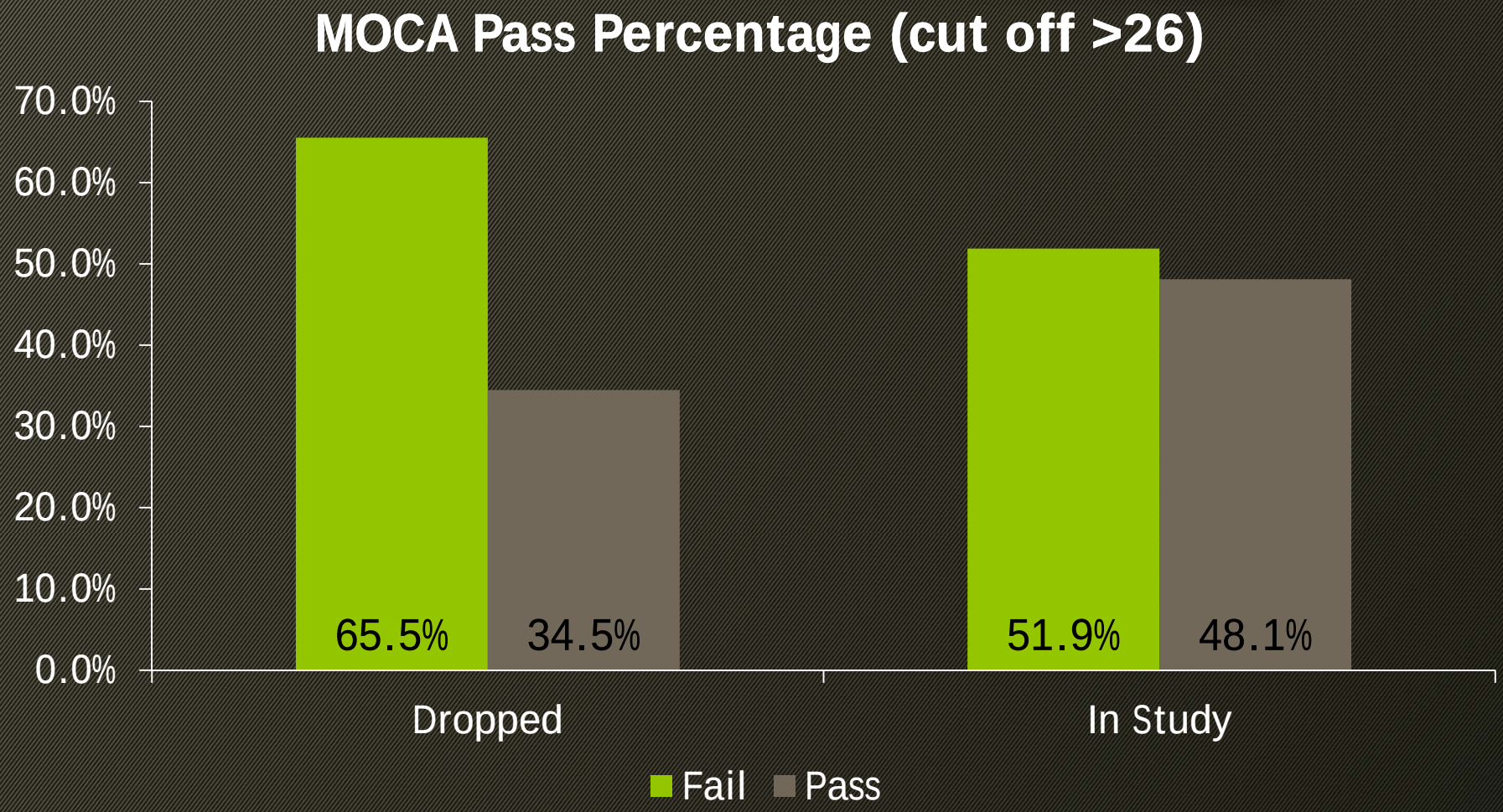
Results


Average One Leg Stance Duration (sec)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
14.2
14.0
13.7
13.3
12.3
Year 1
Year 2
Year 3
Year 4
Year 5

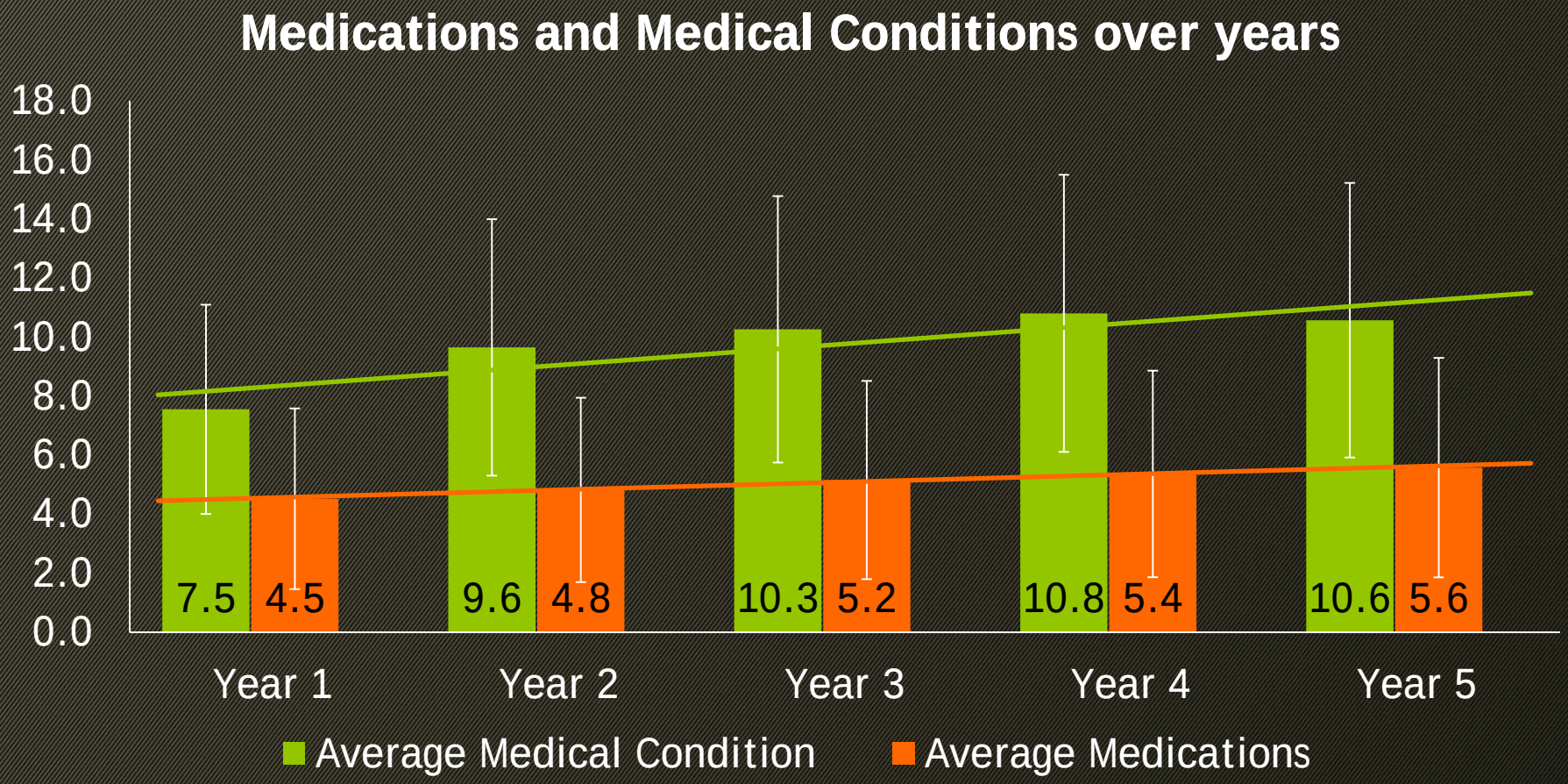
Results


MOCA Pass Percentage (cut off >26)
60%
50%
40%
30%
20%
10%
0%
44%
47%
44%
45%
48%
Year 1
Year 2
Year 3
Year 4
Year 5

Results


MOCA Pass Percentage (cut off >26)
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
65.5%
34.5%
51.9%
48.1%
Dropped
In Study
Fail
Pass

Results


Medications and Medical Conditions over years
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
7.5
4.5
9.6
4.8
10.3
5.2
10.8
5.4
10.6
5.6
Year 1
Year 2
Year 3
Year 4
Year 5
Average Medical Condition
Average Medications

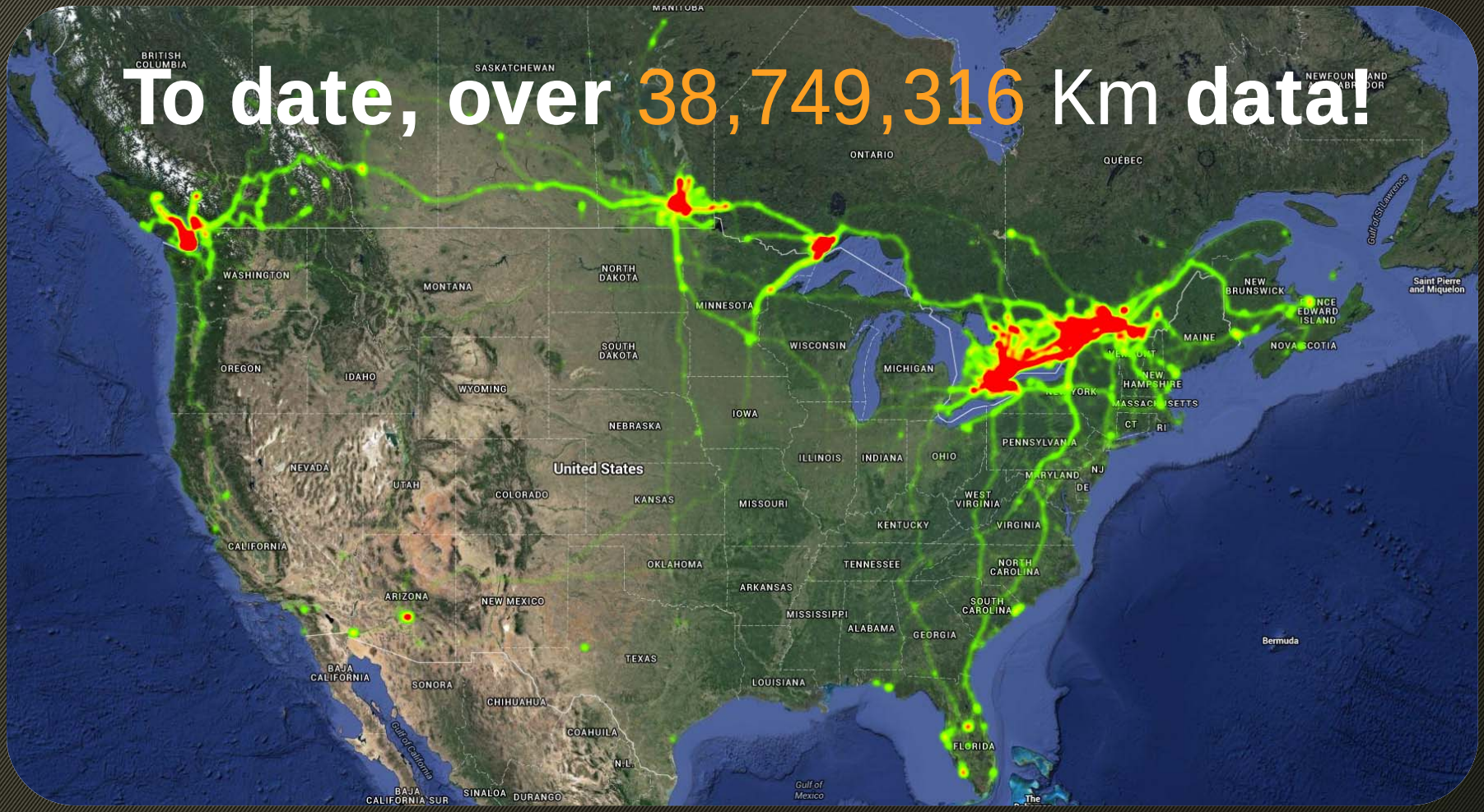
Results

	Year	n	mean	SD	P-Value
	Health and Function				
Current Medical Conditions	Year 1	574	7.04	3.26	p < 0.001
	Year 5	574	10.53	4.62	
OARS Total	Year 1	574	27.84	0.70	p < 0.001
	Year 5	570	27.71	0.73	
WOMAC	Year 1	572	3.83	5.16	p < 0.001
	Year 5	565	5.77	5.76	
	Physical				
One Leg Stance Average of Two Legs	Year 1	572	15.24	10.94	p < 0.001
	Year 5	574	12.38	10.18	
One Leg Stance Left Foot	Year 1	572	15.08	11.93	p < 0.001
	Year 5	574	12.23	10.95	
One Leg Stance Right Foot	Year 1	574	15.39	11.95	p < 0.001
	Year 5	574	12.53	11.25	
Rapid Foot Taps Left Foot	Year 1	574	25.29	7.05	p < 0.001
	Year 5	574	23.57	7.76	
Rapid Foot Taps Right Foot	Year 1	574	26.68	6.71	p < 0.001
	Year 5	574	24.60	7.81	

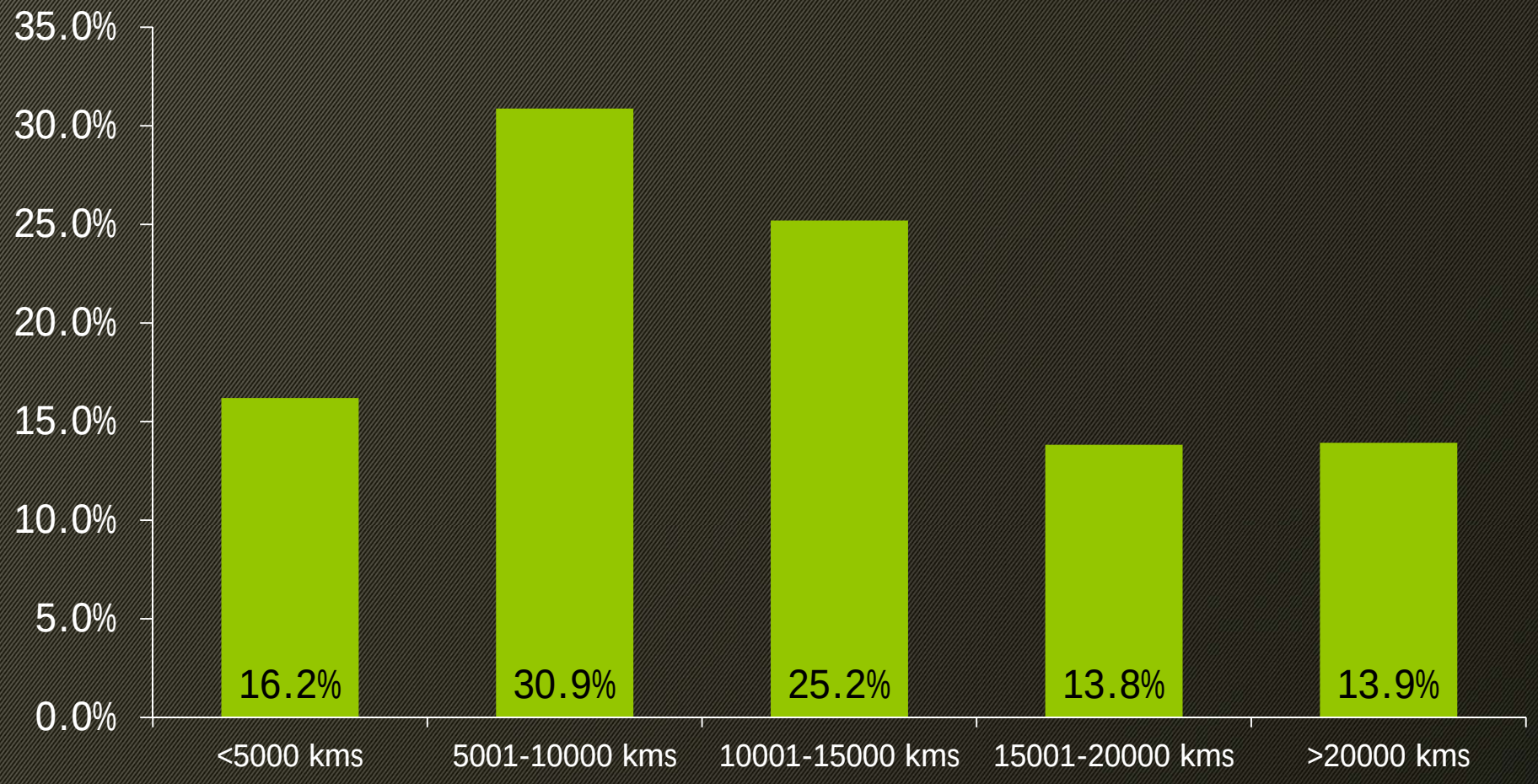
Results

	Year	n	mean	SD	P-Value
	Cognitive				
Geriatric Depression Scale	Year 1	570	14.35	1.10	p < 0.001
	Year 5	562	13.84	1.96	
MMSE Total Score	Year 1	574	28.11	1.72	p < 0.05
	Year 5	568	28.26	1.46	
	Driving Comfort and Perceived Abilities				
Daytime Comfort Scale	Year 1	570	5.55	3.39	p < 0.001
	Year 5	562	5.16	3.39	
Night-time Comfort Scale	Year 1	570	4.86	4.38	p < 0.001
	Year 5	562	4.33	4.38	
Perceived Driving Abilities Current	Year 1	570	36.25	5.99	p < 0.001
	Year 5	562	34.70	6.15	
Perceived Driving Abilities Vision	Year 1	570	16.36	3.13	p < 0.001
	Year 5	562	15.57	3.29	
Perceived Driving Abilities Night Vision	Year 1	570	5.97	1.82	p < 0.001
	Year 5	562	5.70	1.80	
Perceived Driving Abilities Executive Skills	Year 1	570	6.72	1.50	p < 0.001
	Year 5	562	6.46	1.49	
Avoidance Sum	Year 1	492	5.77	3.60	p < 0.001
	Year 5	500	6.55	4.03	

GPS Participant Driving Data



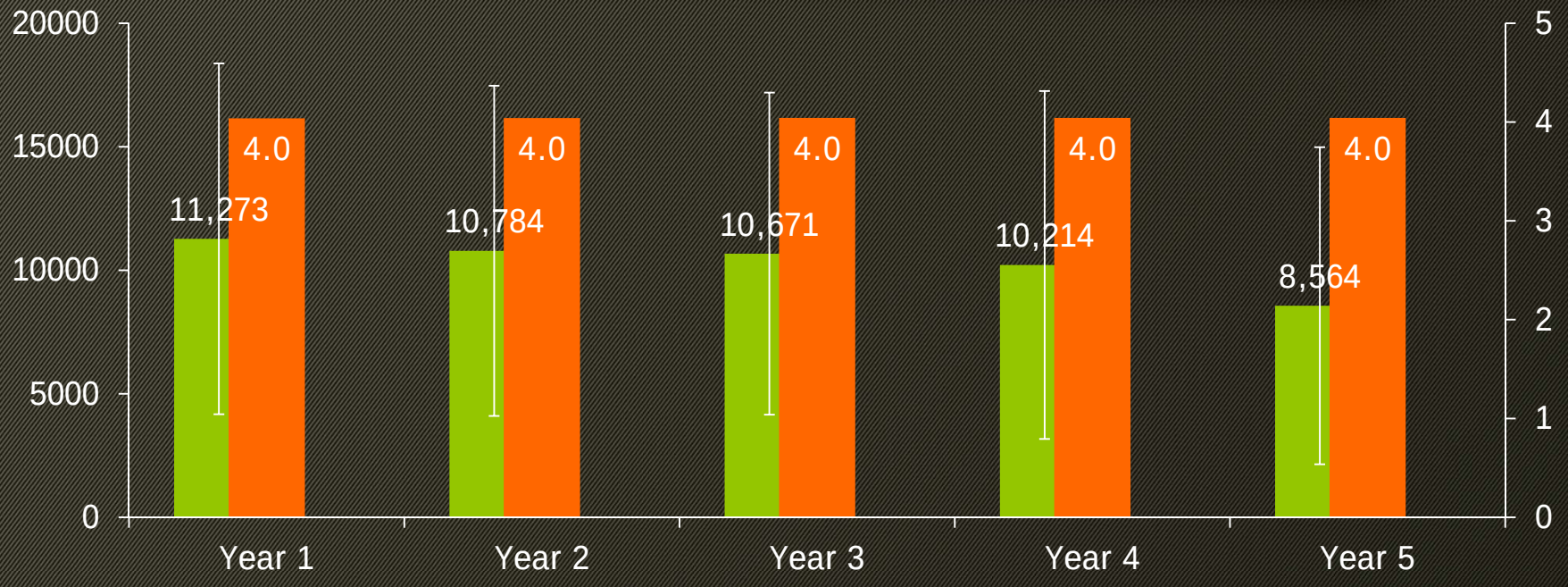
Self-Reported Driving Exposure



Results

	Year	n	mean	SD	P-Value
	Driving Data				
Average KM/Day	Year 1	571	43.87	22.62	p < 0.001
	Year 5	489	37.84	21.18	
Average Trip Distance (KM)	Year 1	571	9.18	4.21	p < 0.001
	Year 5	489	8.22	4.06	
Average Speed (KM/H)	Year 1	571	29.73	6.00	p < 0.001
	Year 5	489	27.88	6.05	
Average Weekly Number of Trips (Trips)	Year 1	571	26.67	11.48	p < 0.001
	Year 5	489	24.48	10.44	
Average Weekly Frequency (Days)	Year 1	571	4.04	0.14	p < 0.001
	Year 5	489	4.04	0.16	

Annual Exposure and Driving Frequency



	Year	n	mean	SD	P-Value
Mean Annual Exposure	Year 1	571	11273	7101	$p < 0.001$
	Year 5	489	8564	6418	

Crashes and At-Fault

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6*	Total
Total Crashes	32	32	35	32	34	10	172
At-Fault	17	14	19	16	23	5	94
% at Fault	53%	44%	54%	50%	68%	50%	54.7%

** Year 6 data collection just partially received but incomplete as of April 2016*

Conclusions

Comparing results from Years 1 and 5 in 574 study participants

- Over time the health status of Candrive participants declined shown by overall statistically significant changes in function, physical measures, cognitive measures, driving comfort, and perceived driving abilities.
- This change in health has significantly affected changes in driving patterns such as distance driven and speed. Participants drove as frequently over time but shortened their trip distances.

Main Study Objective:

Older Driver Risk Stratification Tool

Derivation and Analysis Plan

Three tools

1. Health Care Practitioner
2. Self-Assessment
3. Provincial Licensing Bodies

Older Driver Risk Stratification Tool

Objective:

- Find the best combinations of predictor variables that are highly specific for detecting the outcome measure while achieving the maximum possible sensitivity.

Primary Outcome:

- "At-fault" collision adjusted per kilometer driven

Methodology:

- 1480 variables in total
  - Univariate Generalized Estimating Equation (GEE) analysis of **601** assessment variables (selected as possible variables)
  - Identify significant variables
  - Select variables for the model
  - Identify clusters
  - Conduct multivariate analysis

Example

Risk Stratification Tool

Items	Score
1. Overall Health	
• Congestive Heart Failure or Extra Fluid on the Lungs	1
• Glaucoma	1
2. Physical	
• Timed Up and Go Test (> 10 seconds)	1
• One Leg Stance (cannot do)	3
3. Vision	
• Visual Acuity – Below Standard	2
4. Psychosocial	
• Discussion with a Family Member about Driving Safety	1
5. Cognition	
• Clock Drawing Test (Total Score < 3)	2
Total Score (0-11):	

Example: Older Driver Risk Stratification Tool

Risk Categories for At-Fault MVCs

Total Score	Risk	Category
0	2.2 %	**Low**
1	4.0 %	**Low**
2	5.8 %	**Medium**
3	7.2 %	**Medium**
4	8.8 %	**Medium**
5	12.5 %	**High**
6	20.9 %	**High**
7	32.9 %	**Very High**
8	47.5 %	**Very High**
9	62.6 %	**Very High**
10	75.6 %	**Very High**
11	91.4 %	**Very High**

Future Directions

- Finalize the derivation and validation of Each Tool
- Dissemination of the Tools
  - Knowledge Translation grant application Fall 2016

Candrive Contributors

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Thank You

Questions