



UNIVERSITY of MARYLAND
SCHOOL OF MEDICINE
SHOCK, TRAUMA AND ANESTHESIOLOGY
RESEARCH CENTER

Changing Patterns of Distal Lower Extremity Injury in Motor Vehicle Crashes

University of Maryland CIREN Center


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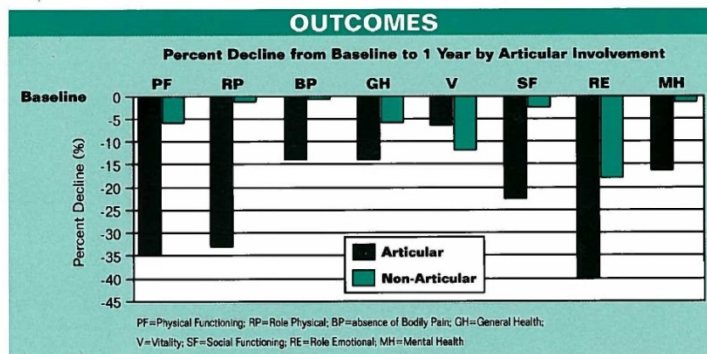
Background

- What do we know about *lower extremity injuries*?
 - Common in frontal crashes
 - Frequently, but not always, associated with intrusion
 - Higher incidence in obese drivers
 - More ankle/foot fractures in women & shorter drivers
 - Often related to long-term disability, especially ankle/foot fractures involving articular surfaces
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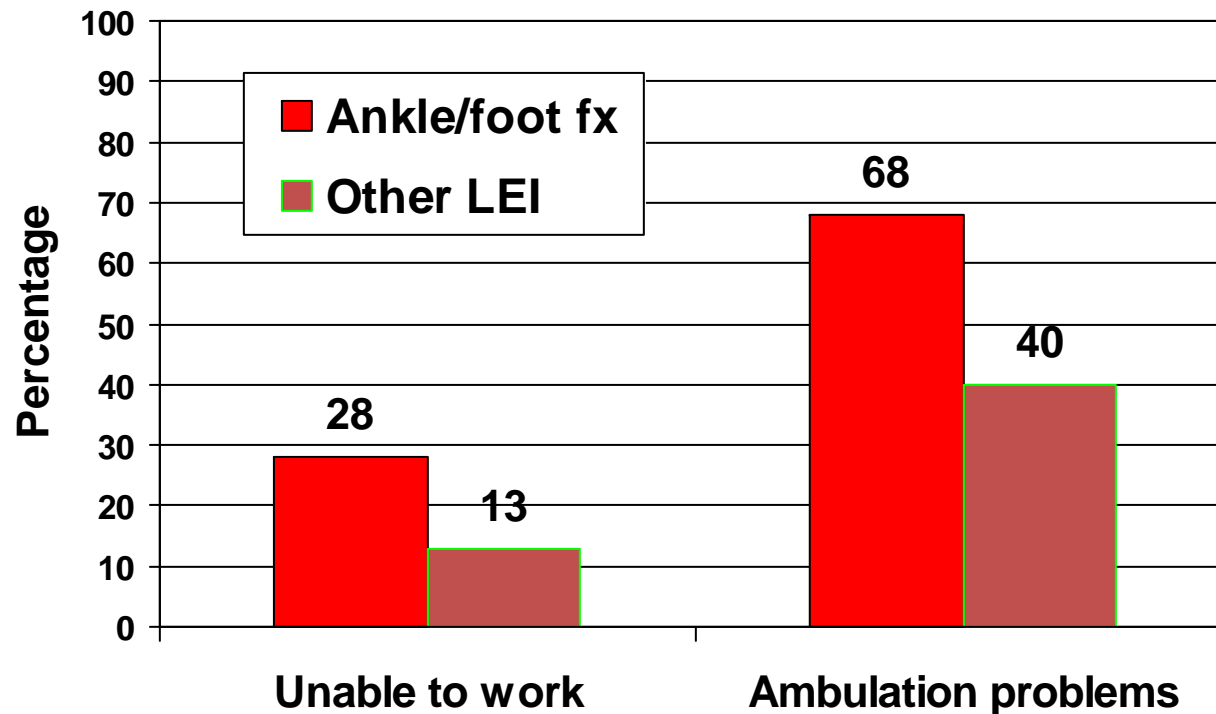


CIREN Report

Consequences and Costs of Lower- Extremity Injuries



Adverse Outcomes of Physical Functioning 1 Year Post-injury



Dischinger PC, Read KM, Kufera JA, Kerns TJ, Ho SM, Burch CA, Jawed N, Burgess AR. CIREN report: Consequences and costs of lower extremity injuries. U.S. Department of Transportation, National Highway Traffic Safety Administration, DOT HS 809 871, June 2005.



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BRIEF COMMUNICATIONS AND RESEARCH NOTES

LOWER EXTREMITY FRACTURES IN MOTOR VEHICLE COLLISIONS: THE ROLE OF DRIVER GENDER AND HEIGHT*

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Abstract—In a previous study it was noted that there was a higher incidence of lower-extremity fractures among women drivers. Analyses were based on a linkage between trauma registry and police crash report data. The present study addresses the issue of whether the differences noted are attributed to driver gender or are merely a reflection of differences in driver height.

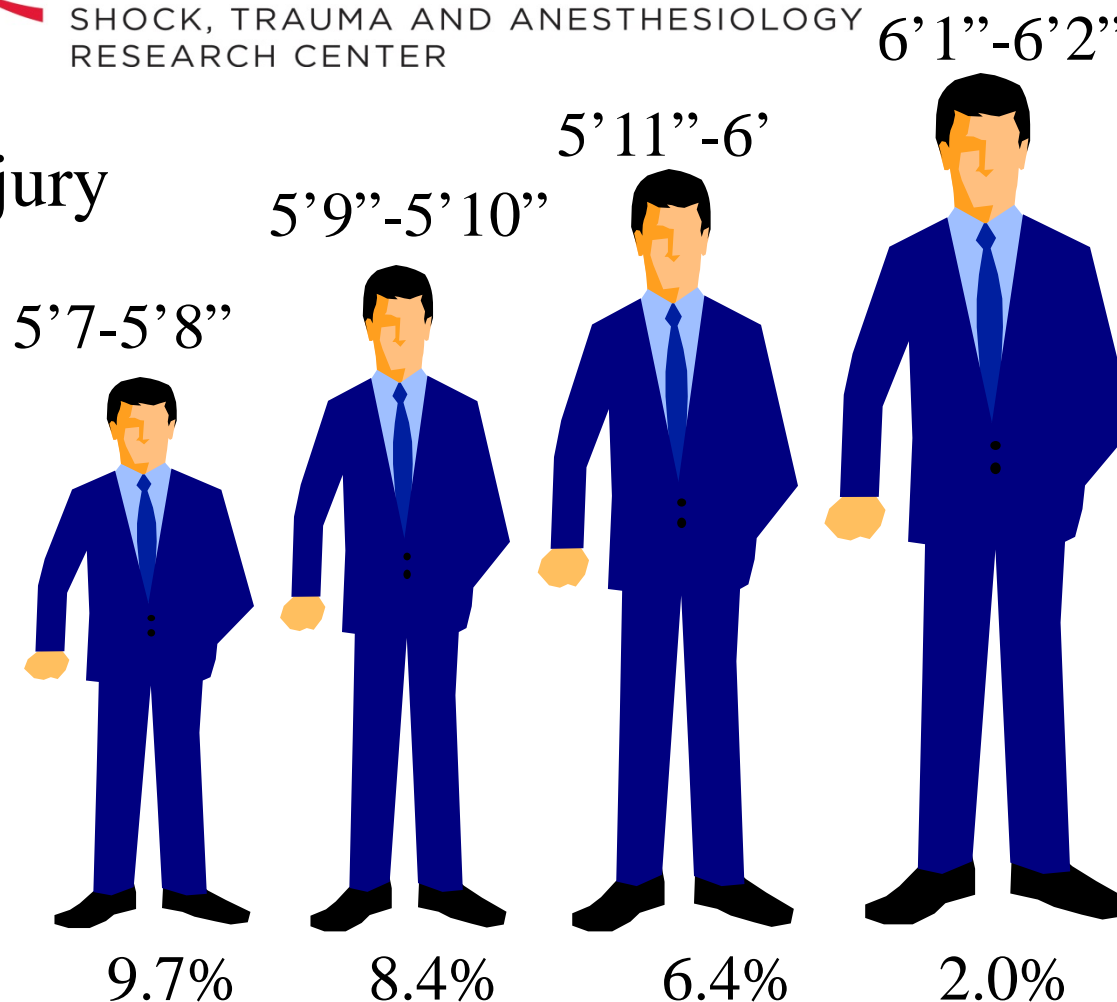
An inverse association was noted between driver height and the incidence of lower-extremity fractures. Those shorter than average (5'7") for this population had a 64% increase in lower-extremity fracture, which can be mainly attributed to ankle/tarsal injuries. Thus, the incidence of these injuries appears to be a function of driver height, with an increase among shorter drivers, most of whom are women.

Keywords—Lower-extremity injuries, Gender, Height, Motor vehicle occupant



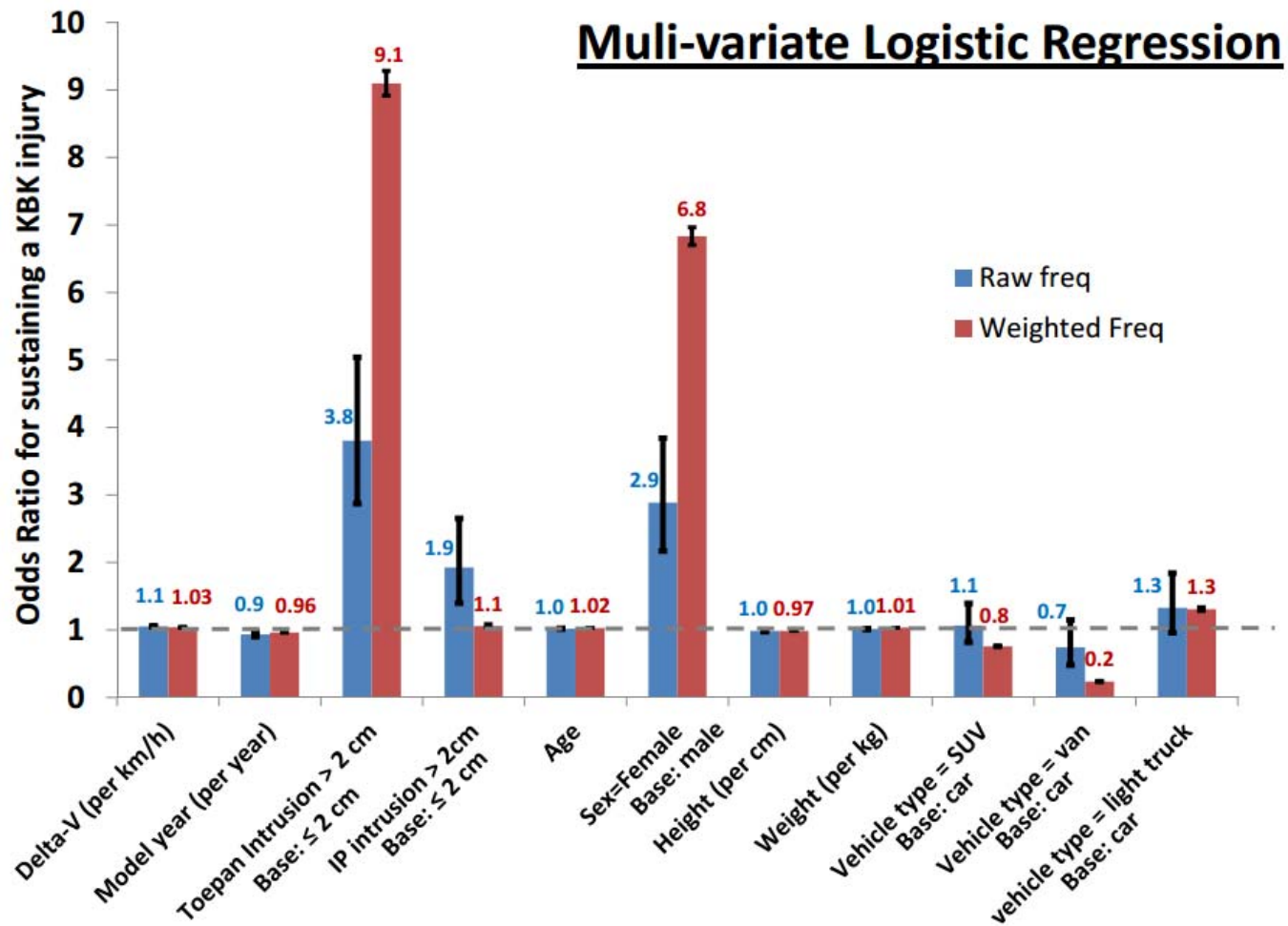
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Incidence of Ankle/Tarsal Injury In Males



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UVA CIREN 2012

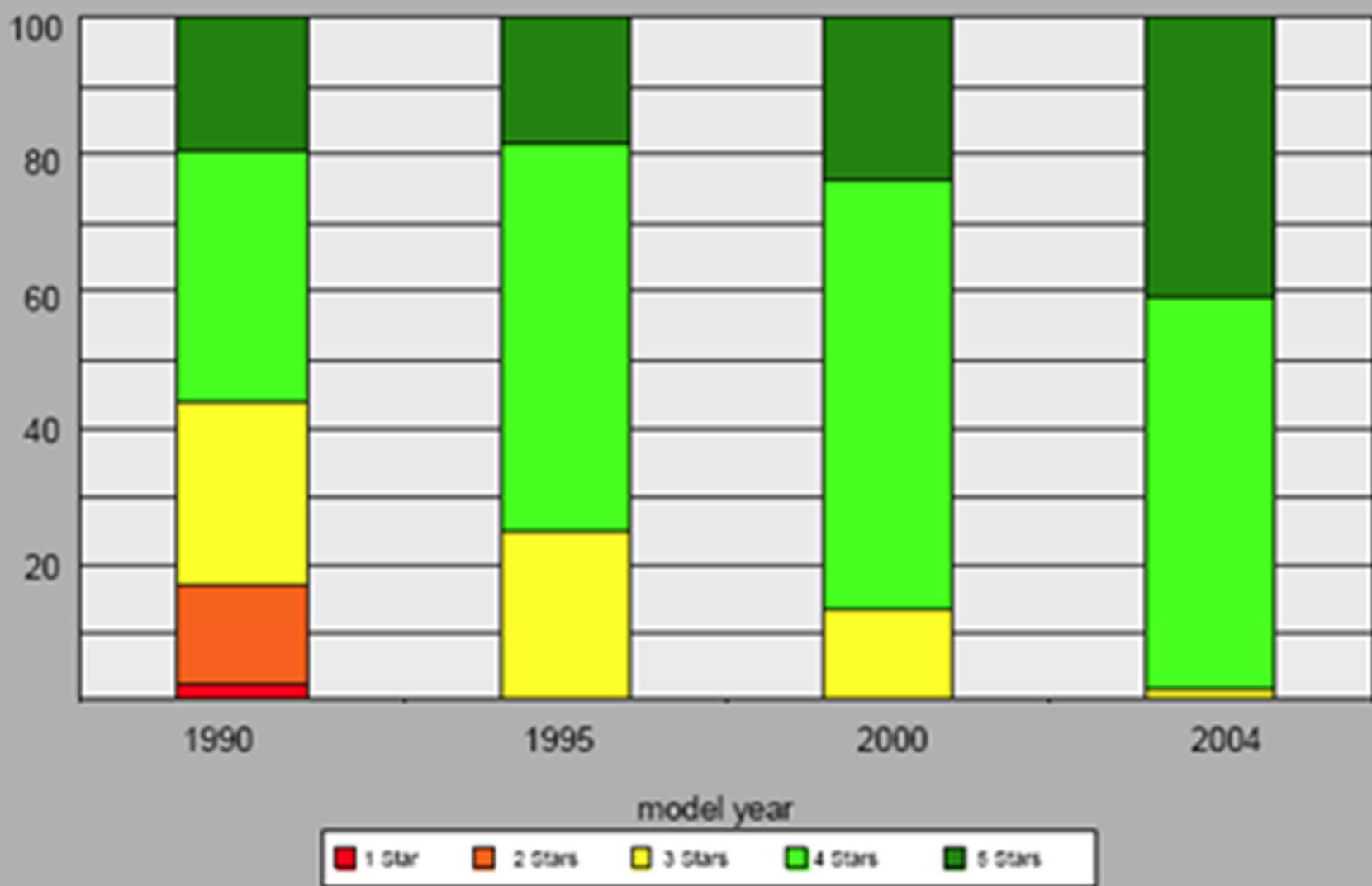


BMI, PDOF – not significant

Selection criteria: NASS 1998-2010, 10988 cases ,drivers >= 16 yrs, belted, non-ejected, frontal PDOF ± 30°


NHTSA frontal NCAP ratings for drivers

Percent of results by star rating





Analysis of Foot & Ankle Injuries in CIREN Comparison of Early vs. Late Model Year Vehicles

- All CIREN centers
 - Model years 2001-2014
 - Drivers
 - Passenger vehicles
 - Frontal collisions
 - 1,411 cases
- 



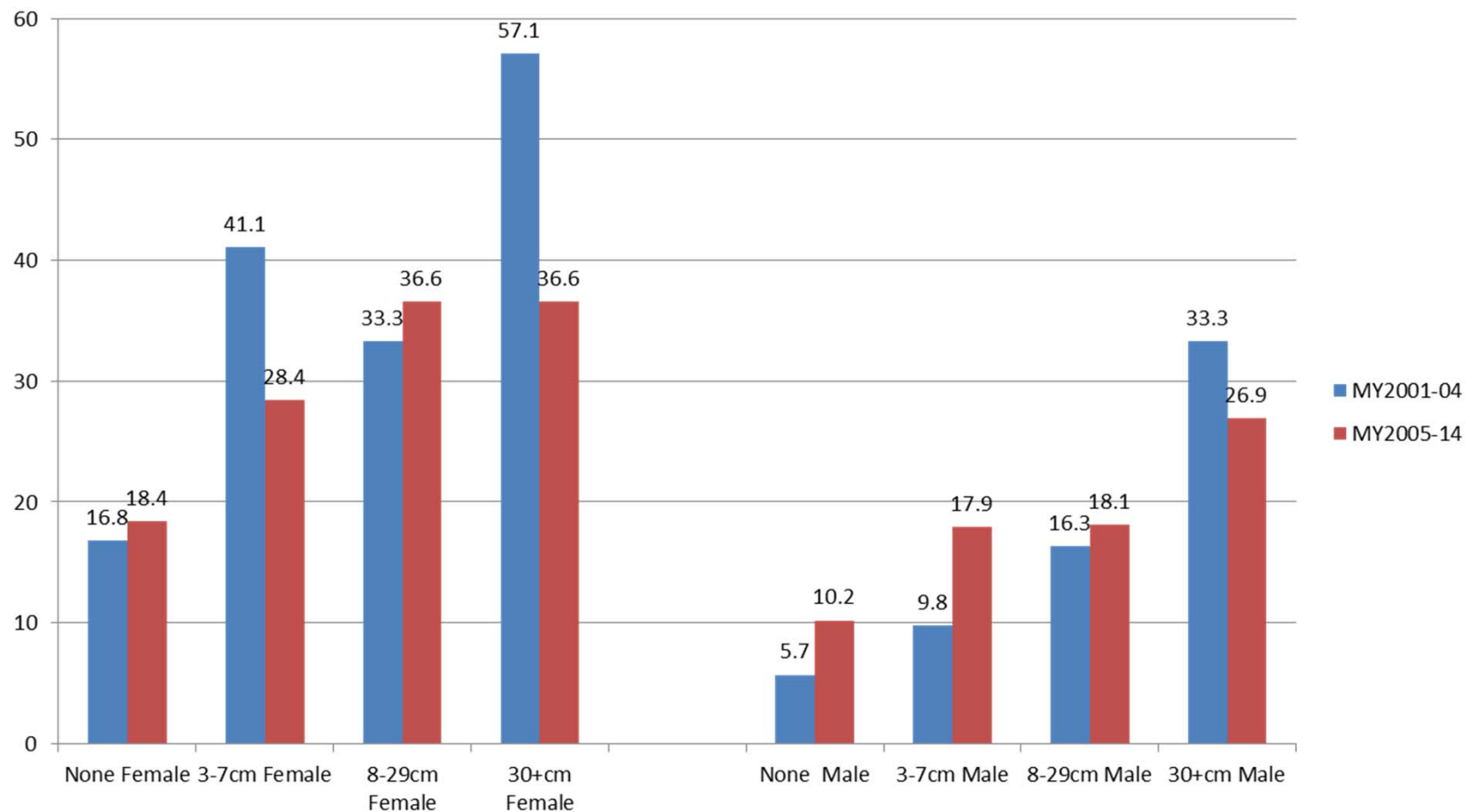
Definitions of Lower Extremity Injuries

Fractures and Dislocations

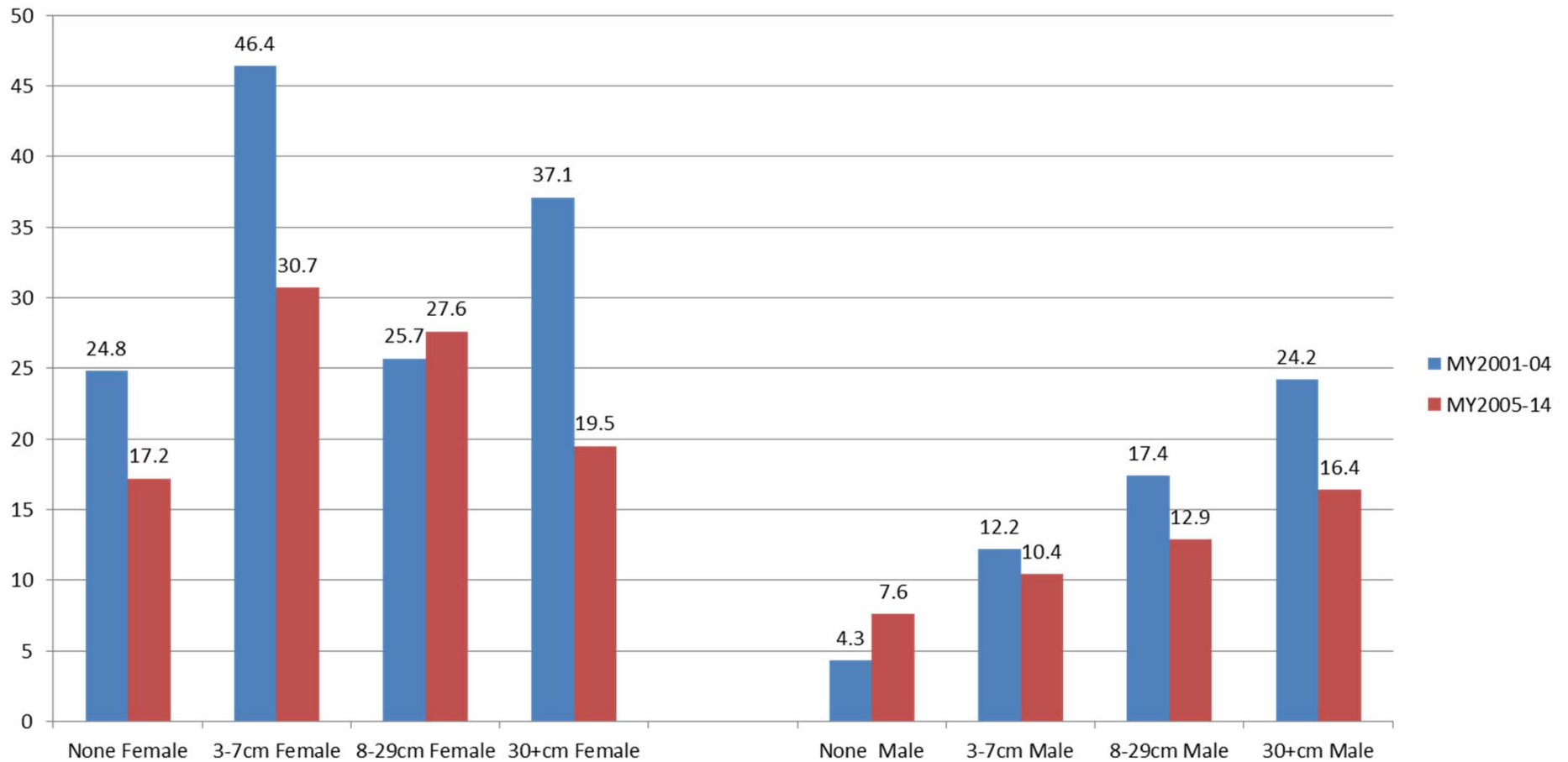
- Foot
 - Talus
 - Calcaneus
 - Tarsal/metatarsal bones
- Ankle
 - Malleolar
 - Distal tibia/fibula



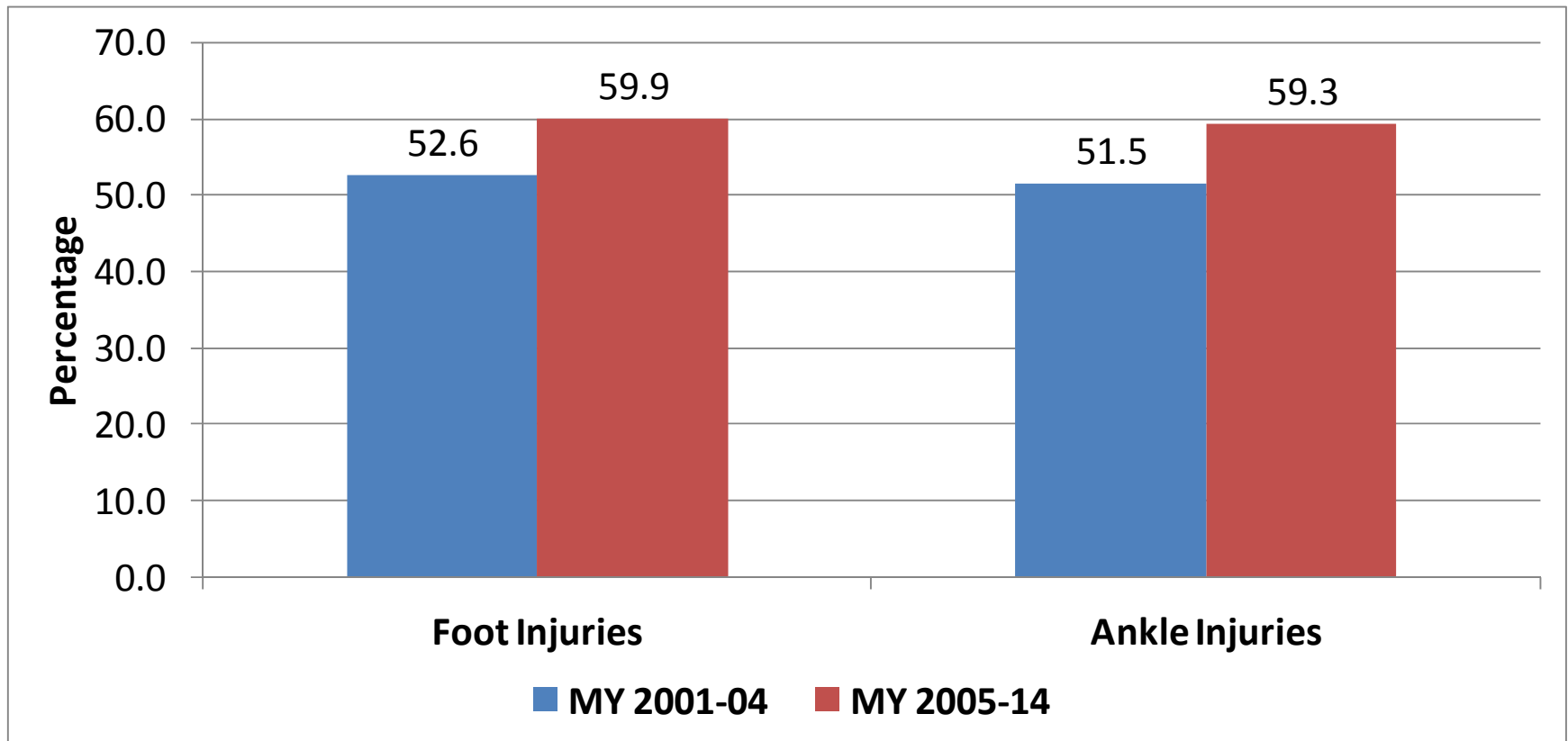
Foot Injuries Occurring in CIREN By Gender and Intrusion Model Years 2001-04 vs. 2005-14



Ankle Injuries Occurring in CIREN By Gender and Intrusion Model Years 2001-04 vs. 2005-14




Foot and Ankle Injuries in CIREN at High Delta V (46+ kph)





Aim of Current Analyses

Weighted NASS Data

- To assess trends over past 14 years in ankle/foot injuries occurring among drivers in passenger vehicles involved in frontal collisions
 - To determine whether gender differences still exist for these injuries
 - To identify risk factors for foot and ankle injuries
 - Crash and host related factors
 - Separately for men and women
- 



Analysis of Foot & Ankle Injuries in NASS

Comparison of Early vs. Late Model Year Vehicles

- Weighted data
 - Model years 2001-2014
 - Drivers
 - Passenger vehicles
 - Frontal collisions
 - 19,174 cases (unweighted)
 - 10,268 men, 8,906 women
 - 488 foot injuries, 386 ankle injuries
- 

Incidence of Foot Injuries in Weighted NASS Data Passenger Vehicle Drivers in Frontal Crashes Model Years 2001-04 vs. 2005-14

	MY 2001-04 (%)	MY 2005-14 (%)	p	OR	95% CI for OR
All drivers	2.03	0.49	< 0.001	4.20	1.70-10.38
Females	3.44	0.59	< 0.001	6.00	1.99-18.08
Males	0.68	0.39	0.09	1.73	0.86-3.46

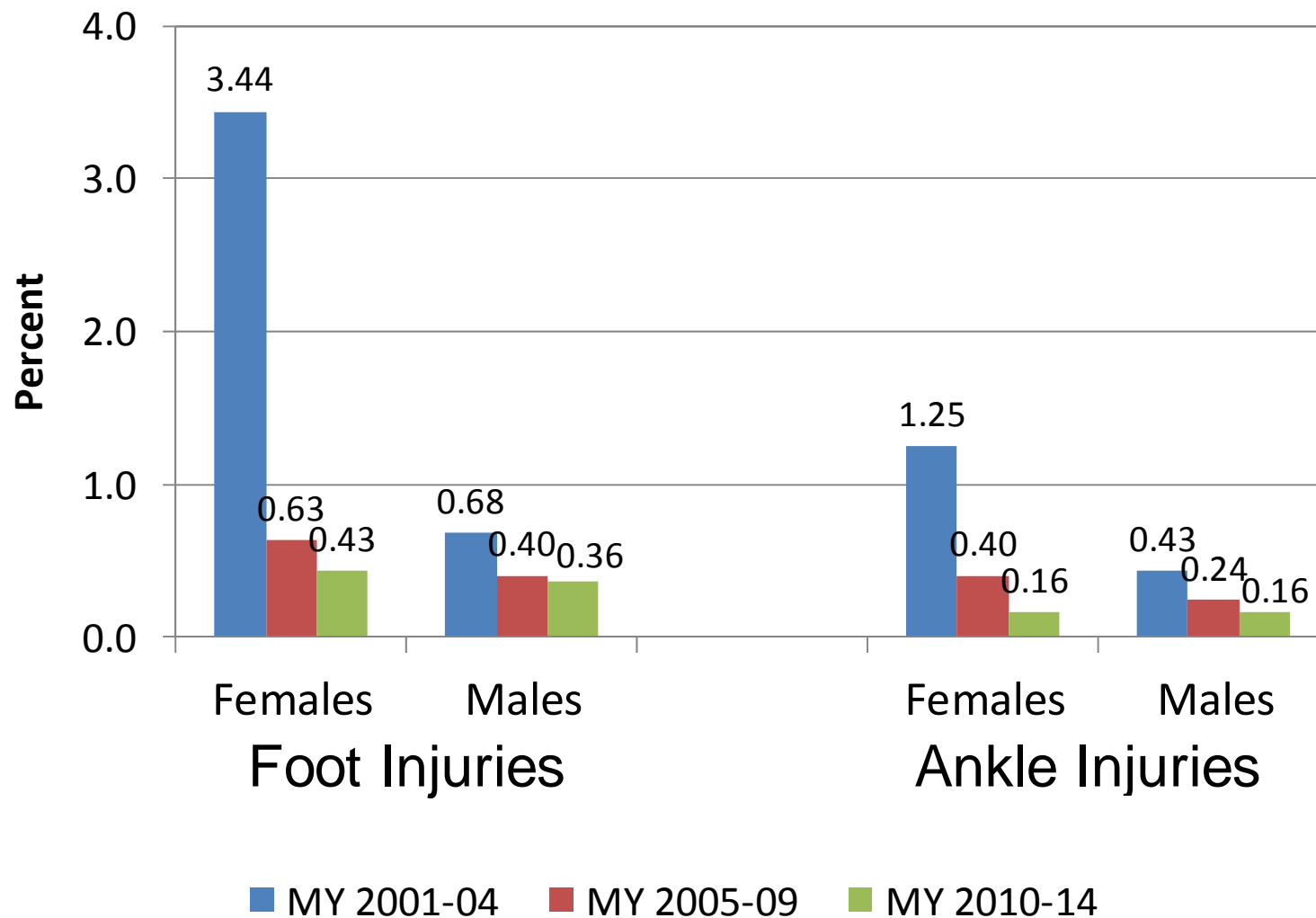
Incidence of Ankle Injuries in Weighted NASS Data

Passenger Vehicle Drivers in Frontal Crashes

Model Years 2001-04 vs. 2005-14

	MY 2001-04 (%)	MY 2005-14 (%)	p	OR	95% CI for OR
All drivers	0.83	0.28	< 0.001	2.95	1.92-4.52
Females	1.25	0.35	<0.001	3.62	1.35-9.70
Males	0.43	0.23	0.22	1.95	0.59-6.46

Incidence of Foot & Ankle Injuries for Females & Males Passenger Vehicle Drivers in Frontal Crashes Model Years 2001-04 vs. 2005-09 vs. 2010-14





Covariates for Logistic Regression

Incidence of Foot & Ankle Injury by Gender

- Model years
 - 2001-04 vs. 2005-14
 - 2005-09 vs. 2010-14
 - Age 55+ vs. < 55
 - Belted vs. Unbelted
 - Toepan/panel intrusion vs. no intrusion
 - Highly associated with Delta V
 - Height & Weight categories (vs. Tall & Lean)
 - Short & Lean
 - Short & Overweight
 - Tall & Overweight
- 



Cut Points for Height and Weight

CDC 2012 Data

- Men
 - Mean height: 5 feet 9 inches
 - Mean weight: 195 pounds
- Women
 - Mean height: 5 feet 4 inches
 - Mean weight: 166 pounds
- Definitions
 - Short /Tall: below /above mean height
 - Lean/Overweight: below/above mean weight



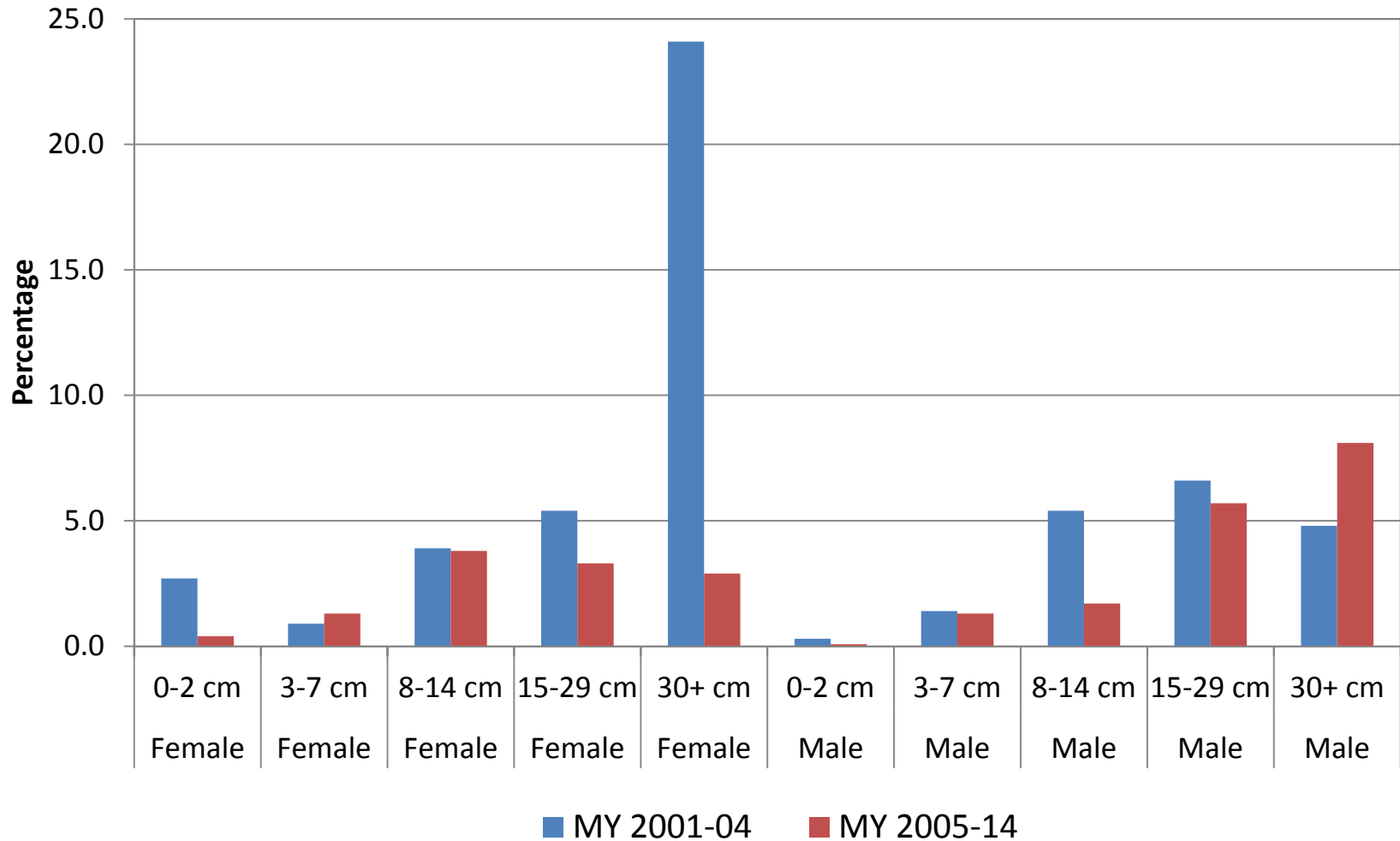
Multivariable Regression of Weighted NASS Model Years 2001-14 Outcome = Incidence of Foot Injury

Parameter	FEMALES		MALES	
	p	OR	p	OR
MY 2001-04	<0.001	9.49	0.11	1.78
Age 55+	0.007	6.65	0.65	0.81
Belted	0.30	0.67	0.17	0.52
Intrusion	<0.001	16.93	<0.001	36.92
Short/Lean	0.08	0.68	0.13	2.24
Short/Overweight	0.05	5.24	0.08	2.88
Tall/Overweight	<0.001	18.43	0.27	2.27

Incidence of Foot Injuries

Distributed by Gender and Intrusion Magnitude

Weighted NASS MY 2001-04 vs. MY 2005-14



Multivariable Regression of Weighted NASS Model Years 2001-14

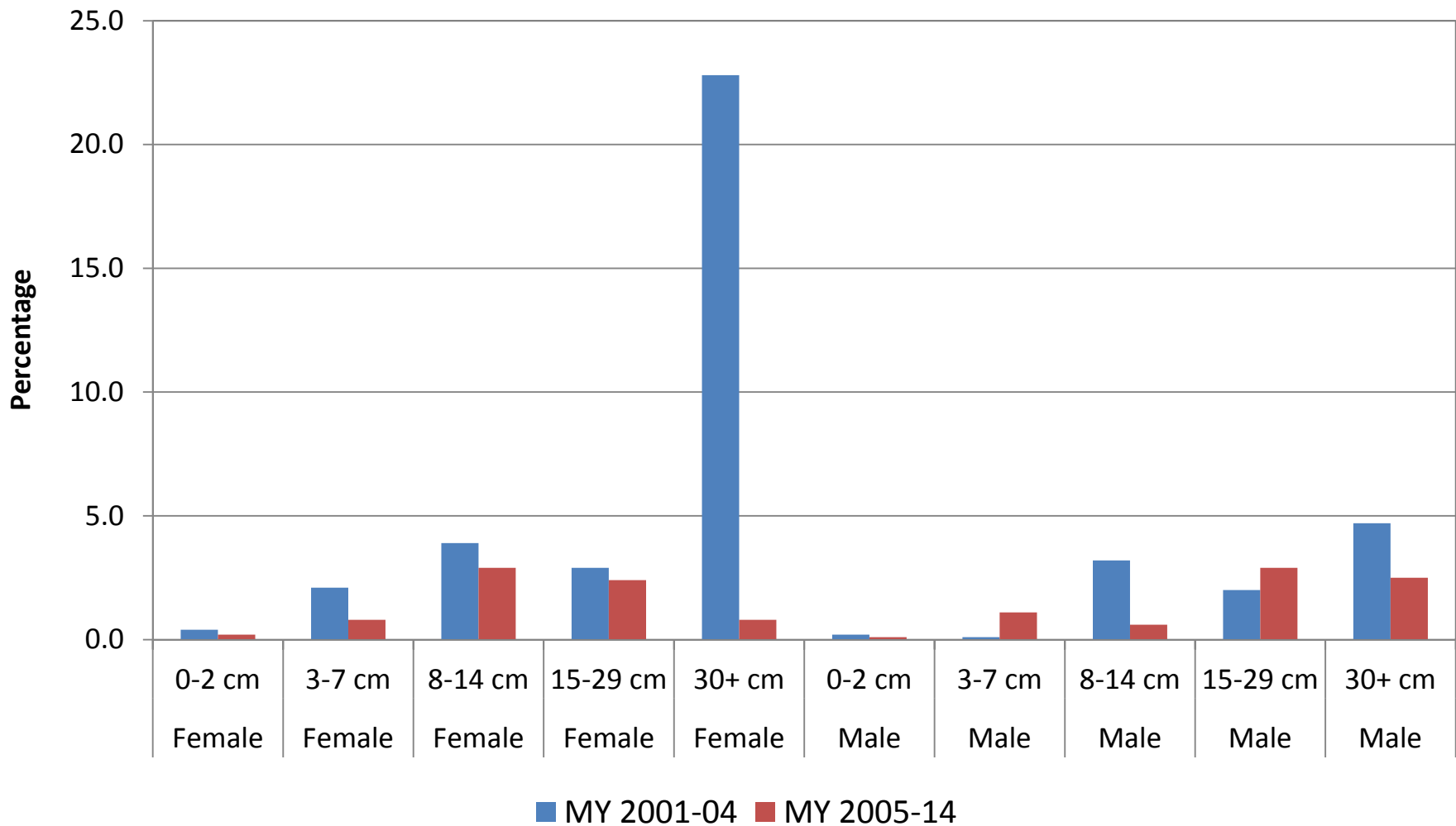
Outcome = Incidence of Ankle Injury

Parameter	FEMALES		MALES	
	p	OR	p	OR
MY 2001-04	0.002	5.51	0.19	2.45
Age 55+	0.64	1.52	0.34	0.68
Belted	0.06	0.49	0.79	1.12
Intrusion	<0.001	46.66	<0.001	15.23
Short/Lean	0.86	1.10	0.96	0.98
Short/Overweight	0.07	1.59	0.004	5.44
Tall/Overweight	0.04	6.66	0.09	4.71

Incidence of Ankle Injuries

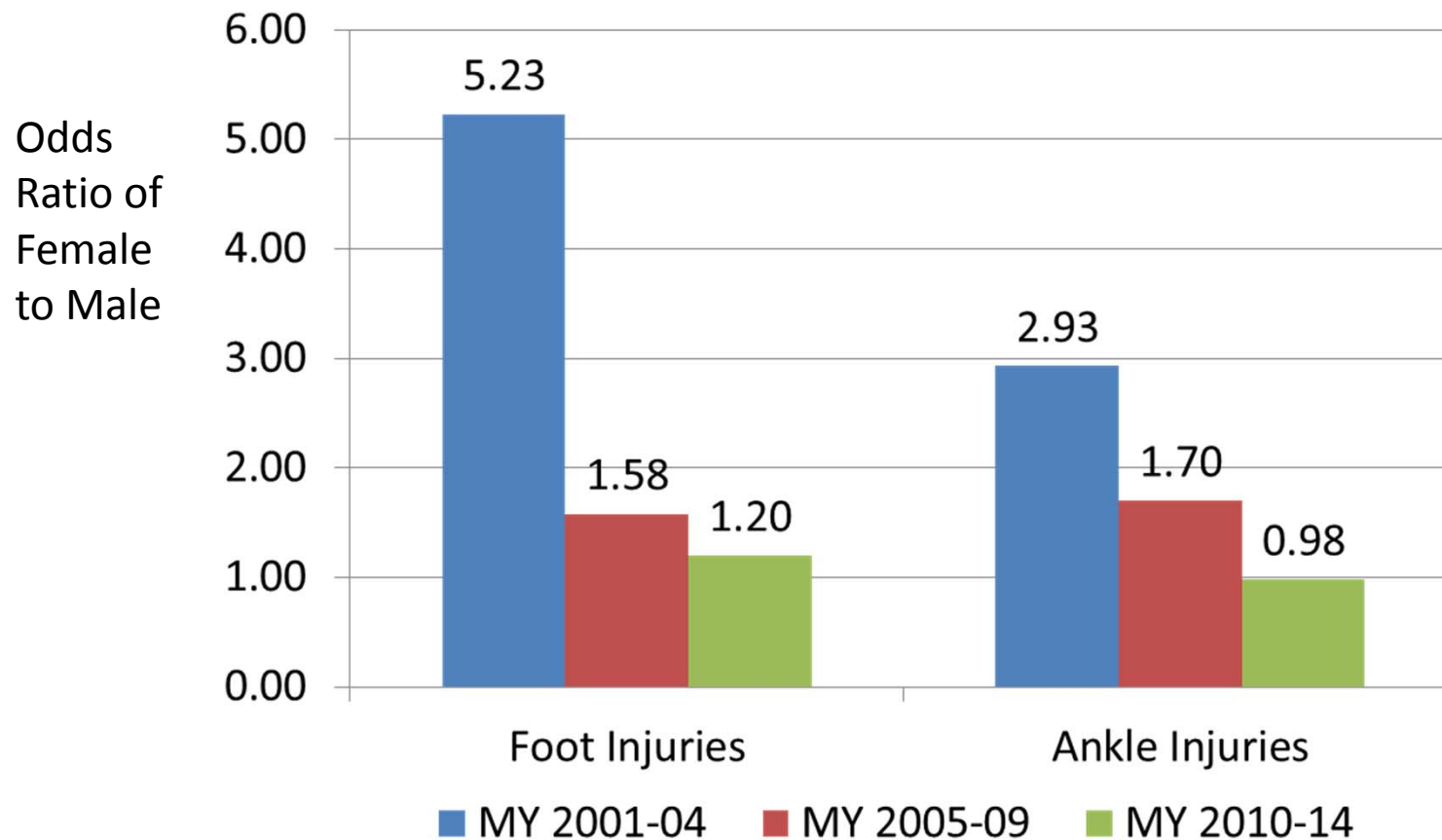
Distributed by Gender and Intrusion Magnitude

Weighted NASS MY 2001-04 vs. MY 2005-14



Incidence of LEI in Weighted NASS

Odds Ratios of Females Relative to Males




Summary

- During the past 10 years there has been a marked decline in ankle/foot injuries in frontal collisions, especially for women
- Foot injuries
 - The ratio of female to male injuries in the newest model years is now 1.20
 - Intrusion remains a major risk factor for both men and women
 - For women, however, age 55+ and being overweight (regardless of height) remain significant risk factors



Summary (cont'd)

- Ankle injuries
 - The ratio of female to male injuries in the newest model years has now declined to 0.98
 - Intrusion is the strongest risk factor for both men and women
 - Being tall and overweight increases risk for women, while being short and overweight is a risk for men
- 



Future Steps

- To examine specific foot and ankle bones to determine possible interactions with gender differences
 - To determine whether there are differences observed in CIREN data regarding contact points between earlier and later model year vehicles involved in frontal crashes
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