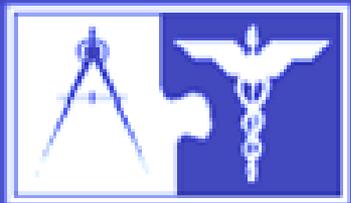


Trends in Lower Extremity Injury Patterns in Motor Vehicle Crashes

University of Maryland CIREN team



*Charles "McC." Mathias, Jr., National Study Center
for Trauma and Emergency Medical Systems*

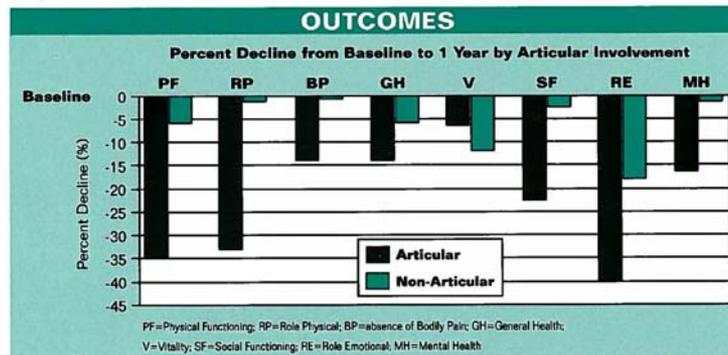
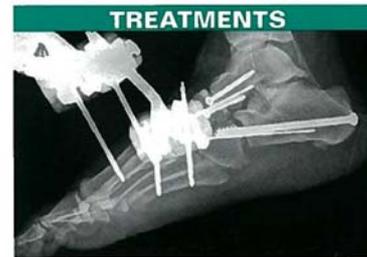
Background

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

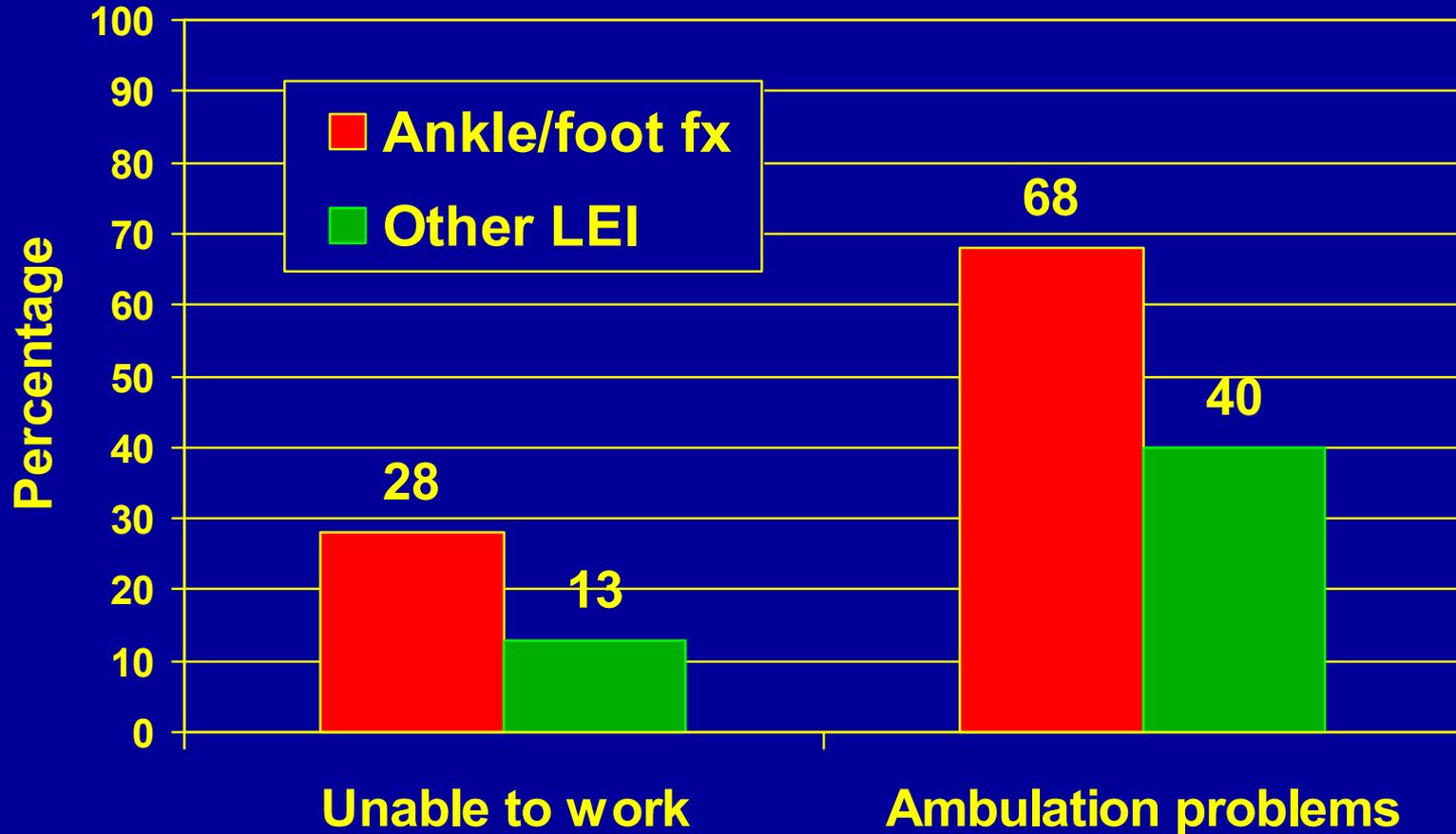


CIREN Report

Consequences and Costs of Lower- Extremity Injuries



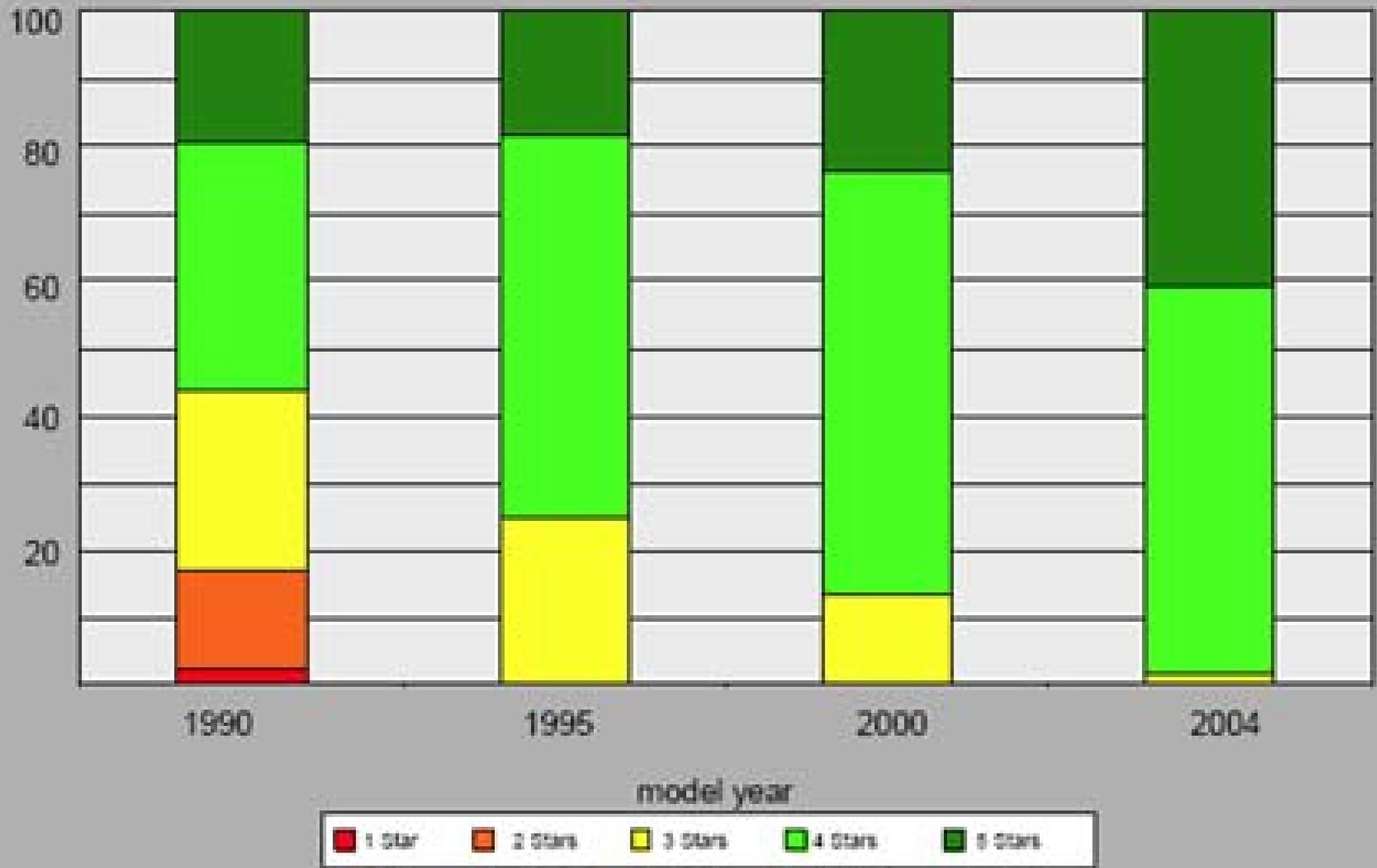
Adverse Outcomes of Physical Functioning 1 Year Post-injury



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.

NHTSA frontal NCAP ratings for drivers

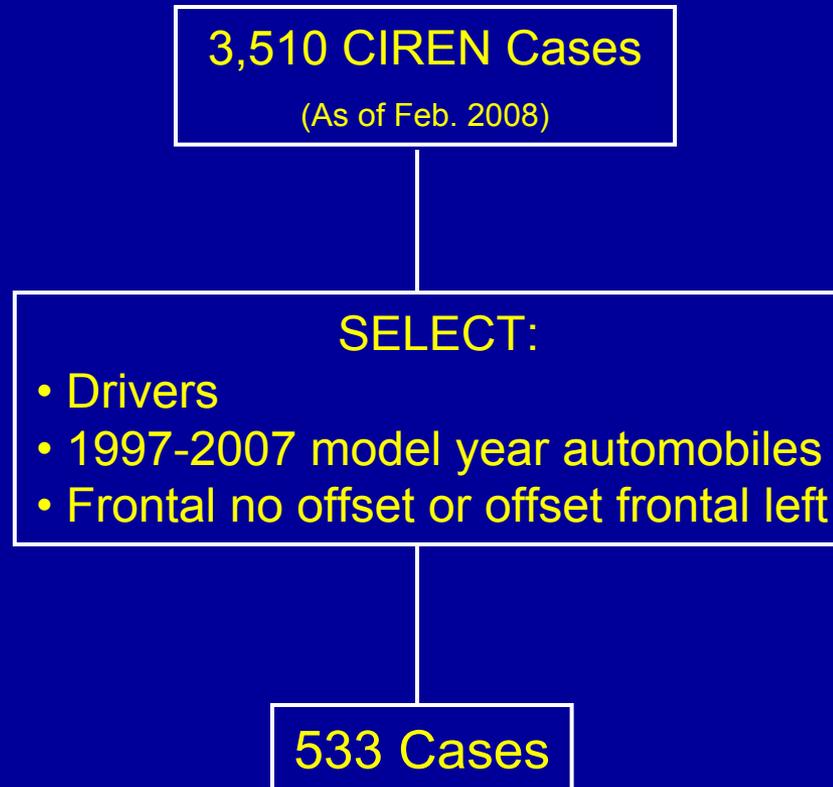
Percent of results by star rating



Purpose

- To determine trends in lower extremity injuries by vehicle model year, controlling for crash and occupant characteristics
- To compare these trends in CIREN with NASS-CDS and Maryland CODES databases

Selection Criteria for this Analysis



Definition of Frontal Impact

- Frontal (no offset)
 - Direct damage laterally distributed across frontal plane or primarily involving the center
- Frontal (offset left)
 - Direct damage to frontal plane, primarily left of the centerline

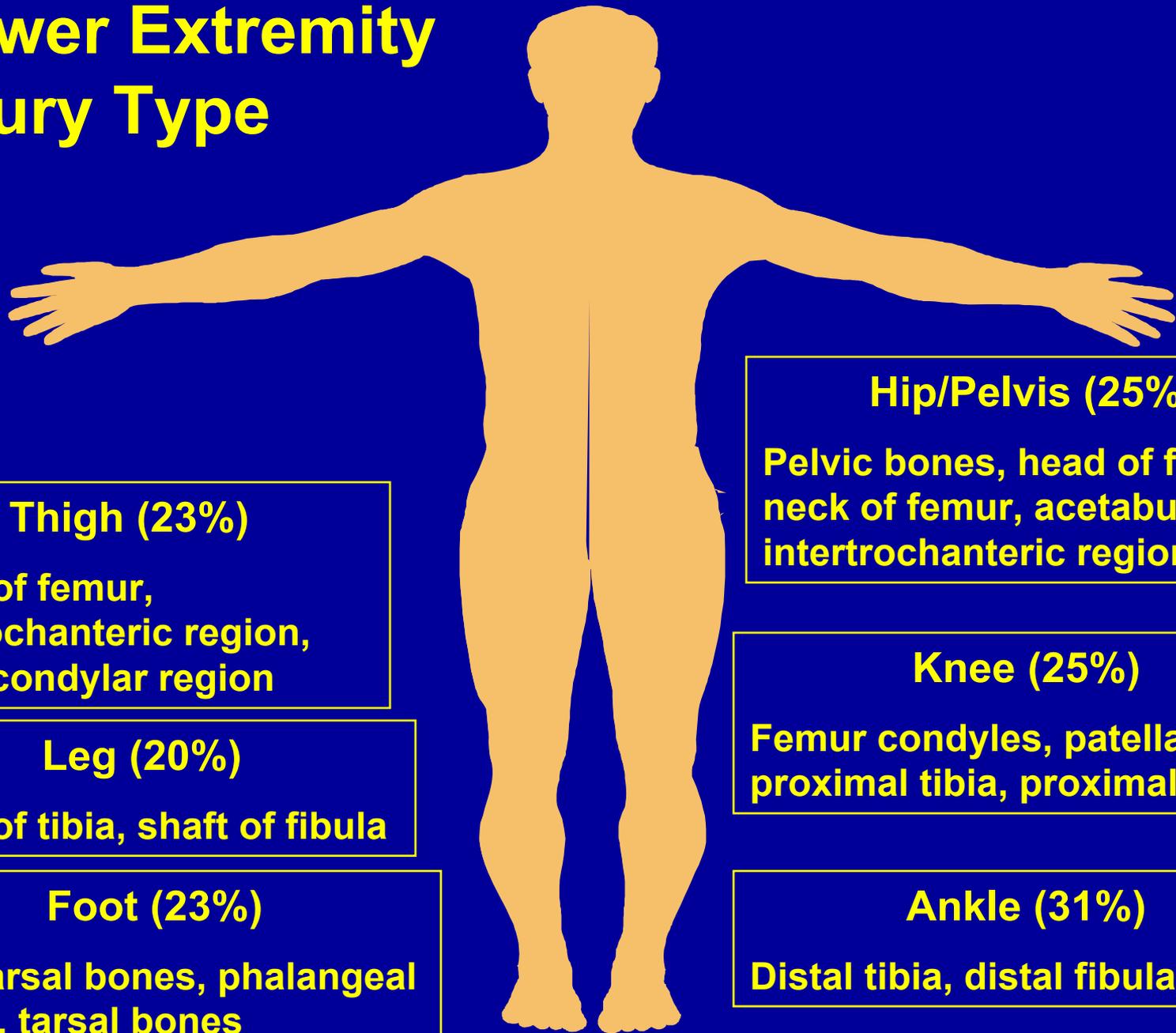
Characteristics of CIREN Drivers (N=533)

	%
Female	51
Overweight (BMI)	66
Frontal airbag	93
Proper seatbelt use	64
Frontal-no offset	52
Offset frontal left	48
MY 1997-1998	31
1999-2000	29
2001-2002	24
2003-2004	10
2005-2007	6

Characteristics of Lower Extremity Injuries (LEI) Among CIREN Drivers (N=533)

	%
LEI MAIS 1	13
LEI MAIS 2	73
Single MAIS 2+ LEI	17
Multiple MAIS 2+ LEI	56
Left side injury only	18
Right side injury only	31
Bilateral injury	24

Lower Extremity Injury Type



Hip/Pelvis (25%)

Pelvic bones, head of femur, neck of femur, acetabulum, intertrochanteric region

Thigh (23%)

Shaft of femur, subtrochanteric region, supracondylar region

Knee (25%)

Femur condyles, patella, proximal tibia, proximal fibula

Leg (20%)

Shaft of tibia, shaft of fibula

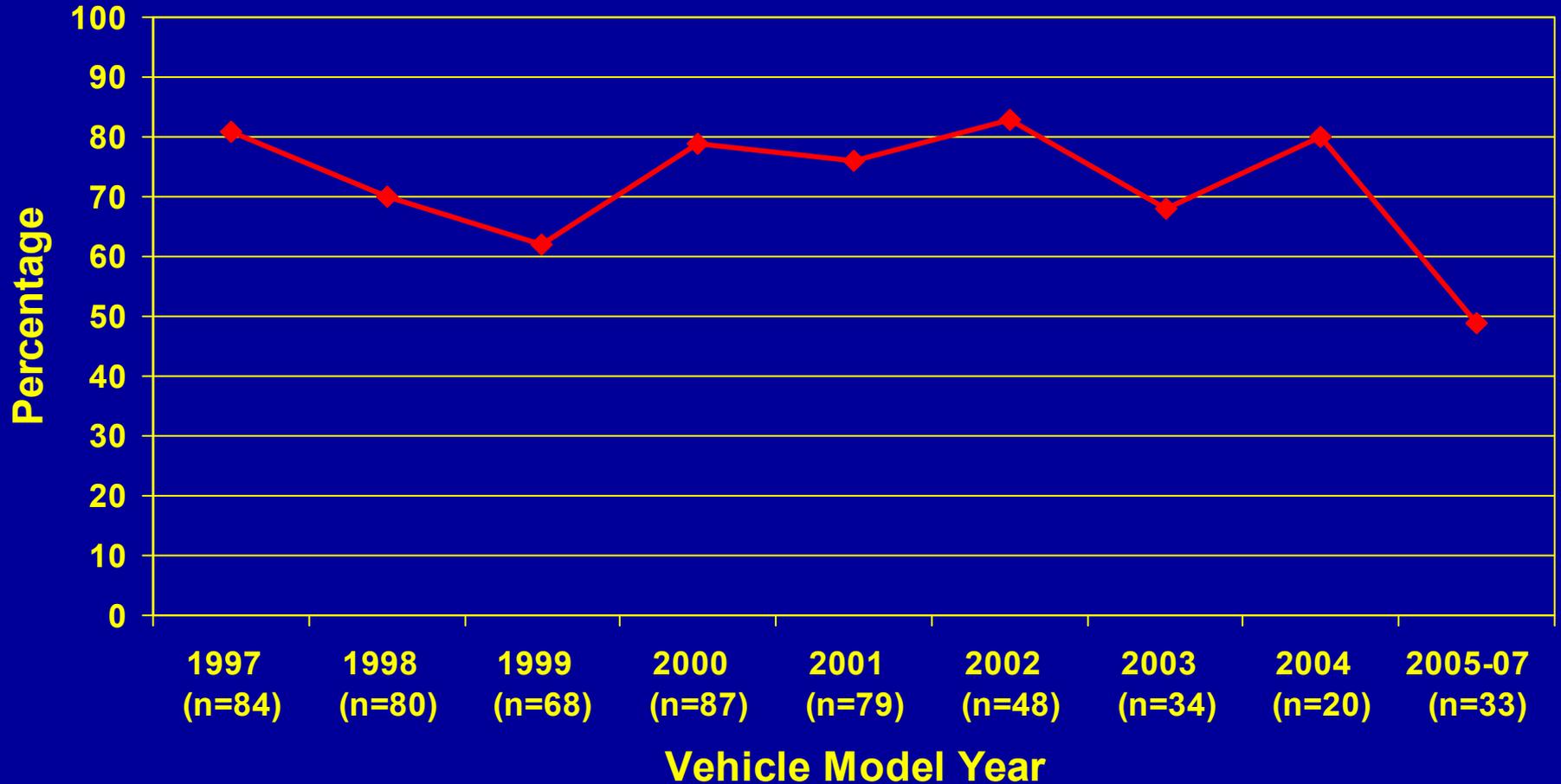
Ankle (31%)

Distal tibia, distal fibula, talus

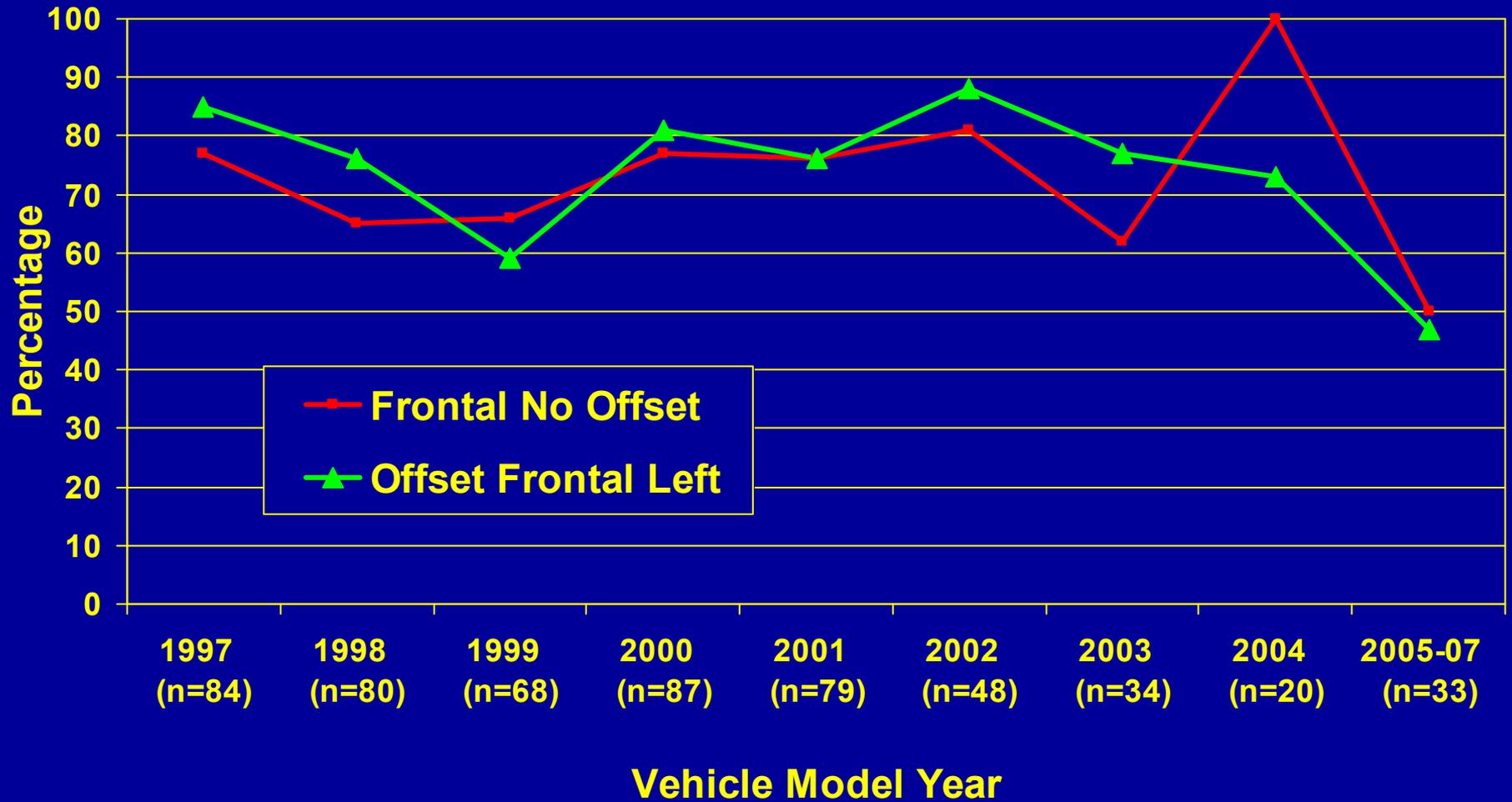
Foot (23%)

Metatarsal bones, phalangeal bones, tarsal bones

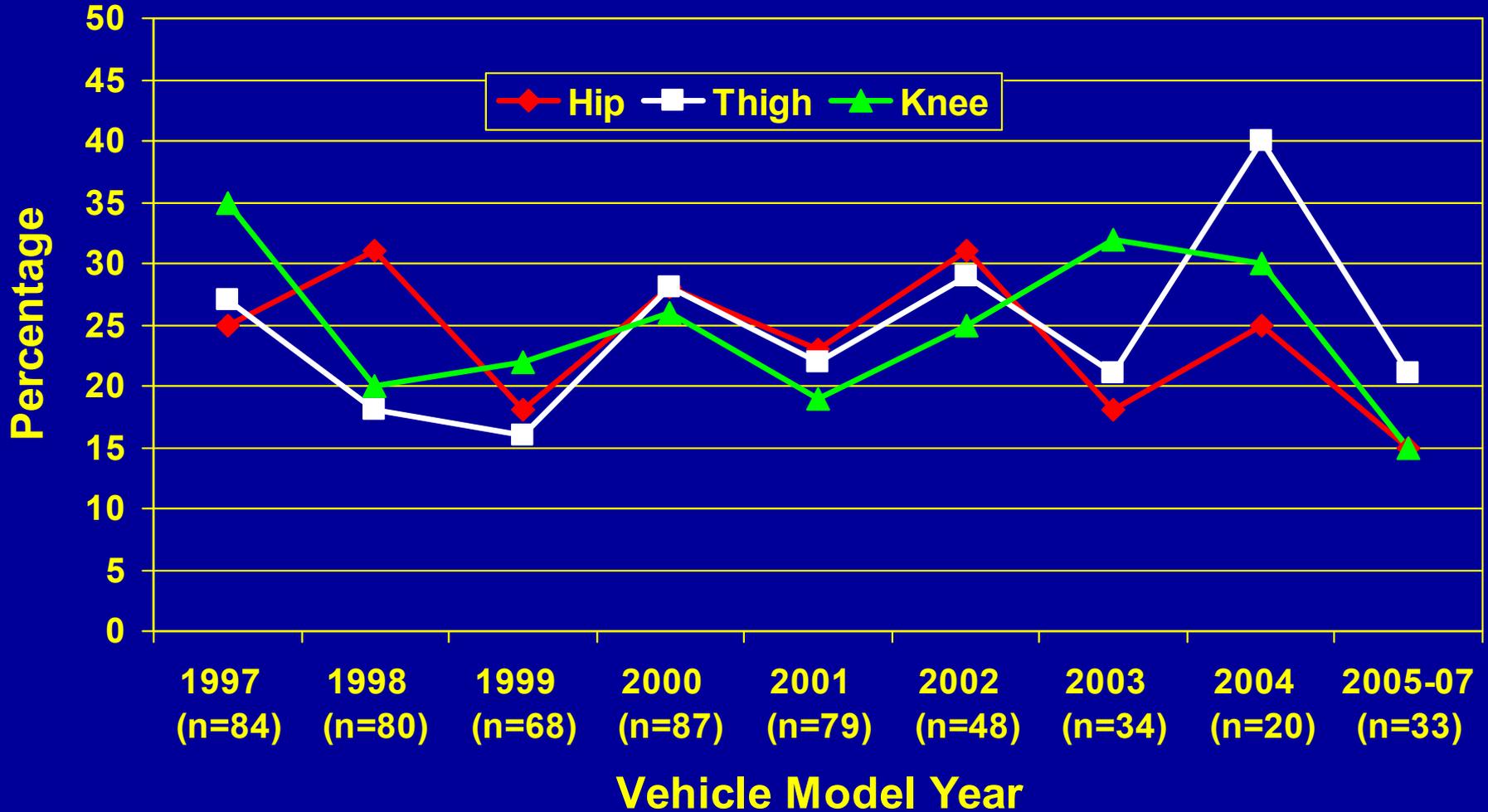
Incidence (%) of Lower Extremity Injuries (MAIS 2+) by Model Year



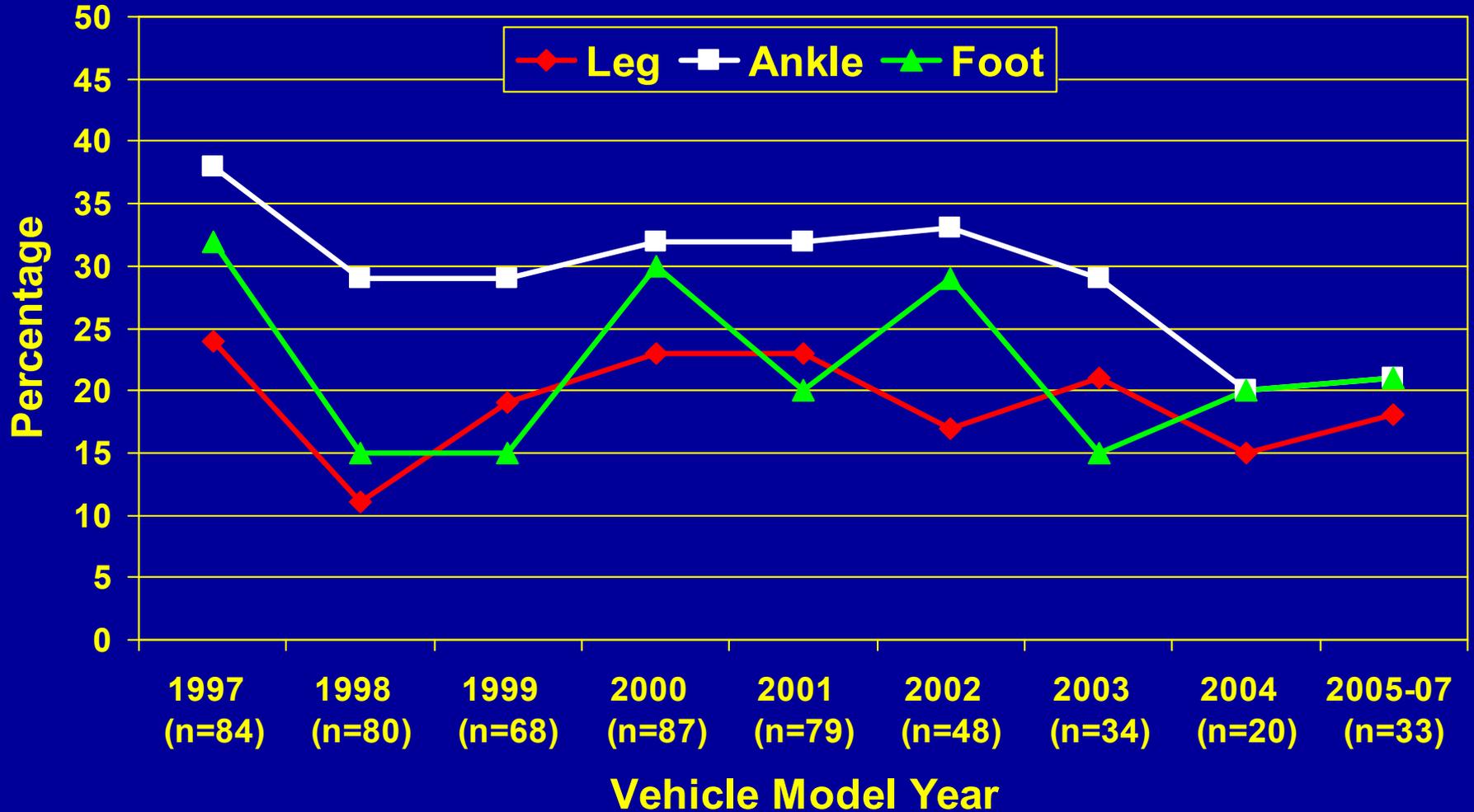
Incidence (%) of Lower Extremity Injuries (MAIS 2+) by Type of Impact



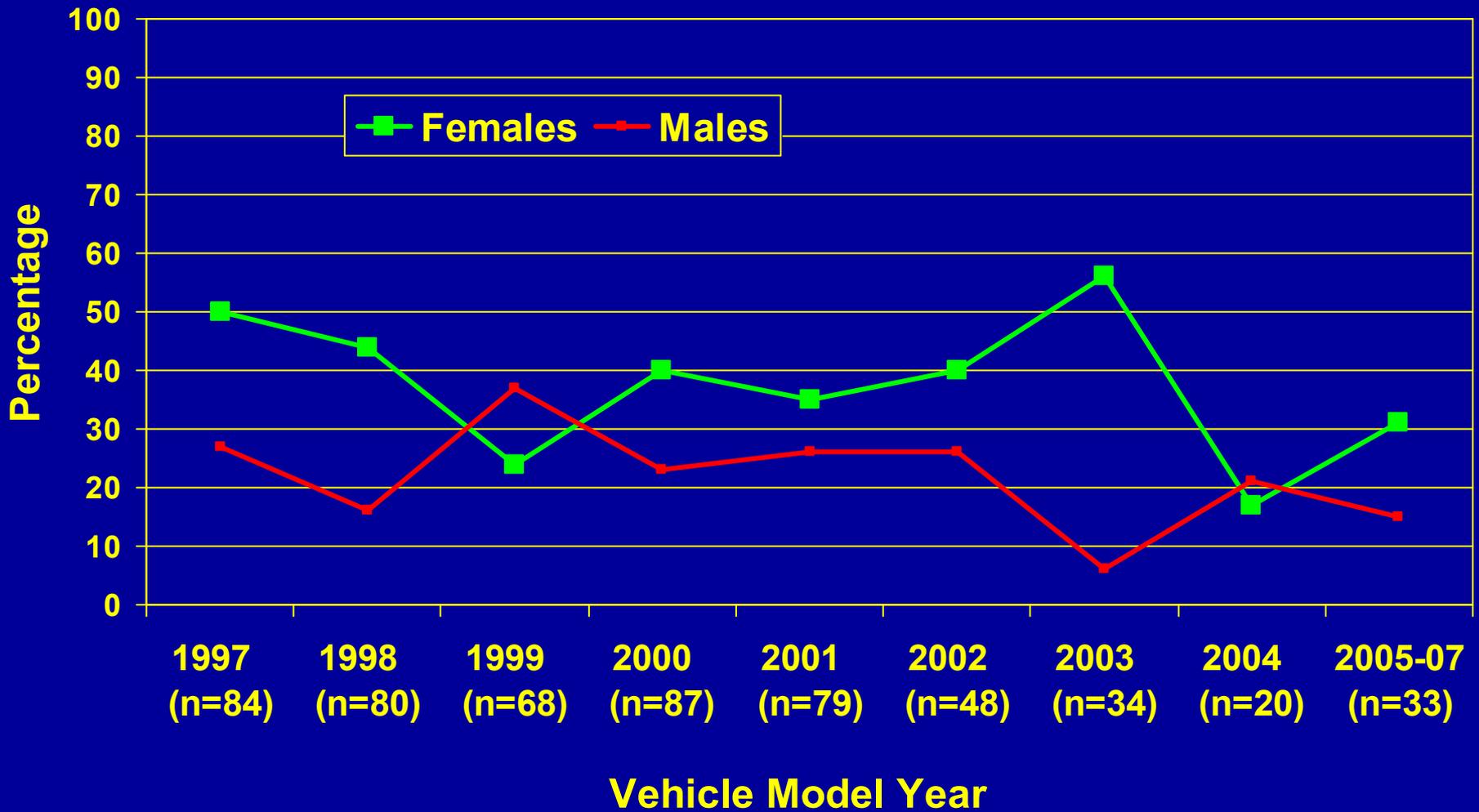
Incidence (%) of Hip, Thigh and Knee Injuries (MAIS 2+) by Model Year



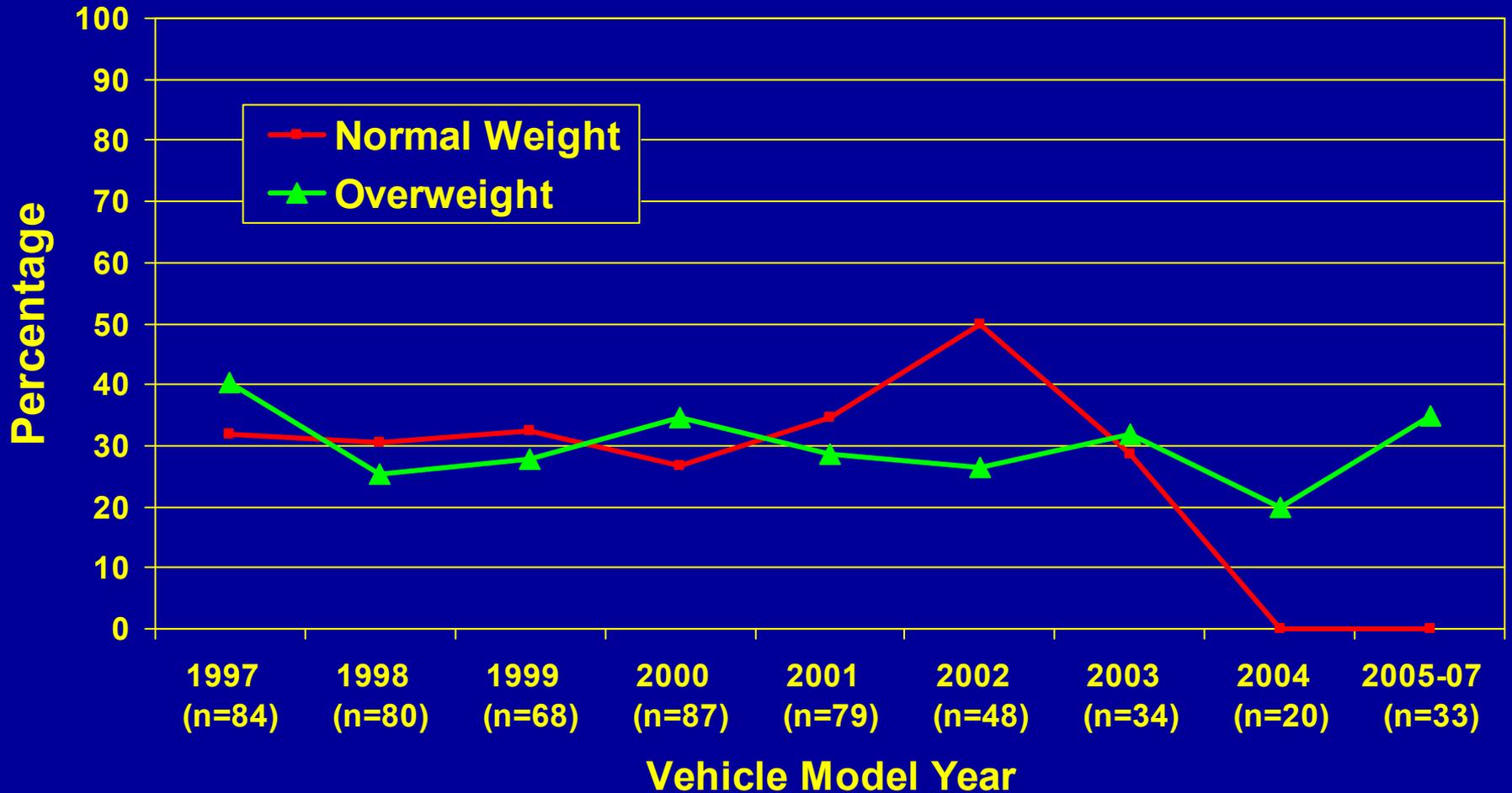
Incidence (%) of Leg, Ankle and Foot Injuries (MAIS 2+) by Model Year



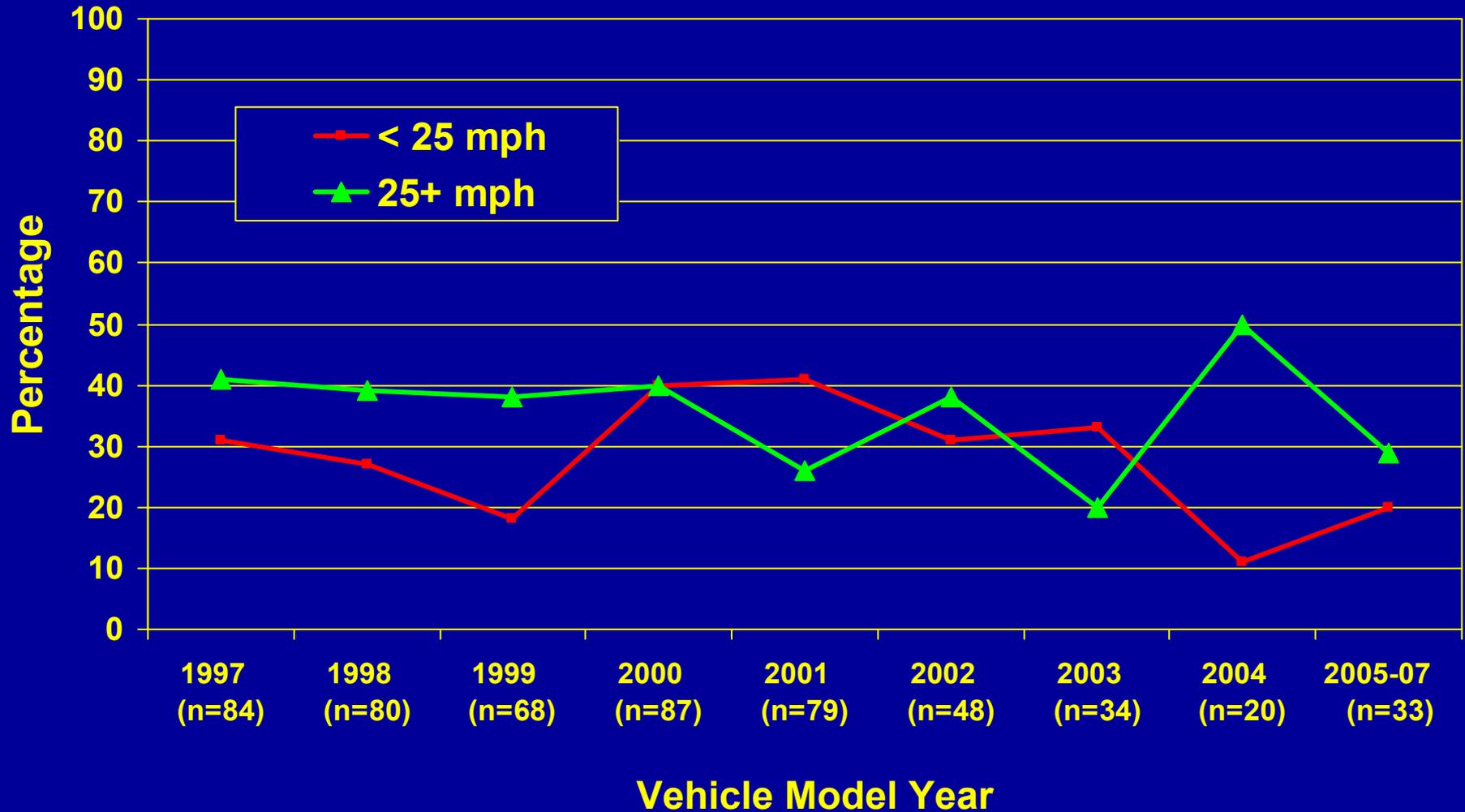
Incidence (%) of Ankle Injuries (MAIS 2+) by Gender



Incidence (%) of Ankle Injuries (MAIS 2+) by Weight Category



Incidence (%) of Ankle Injuries (MAIS 2+) by Delta V Category





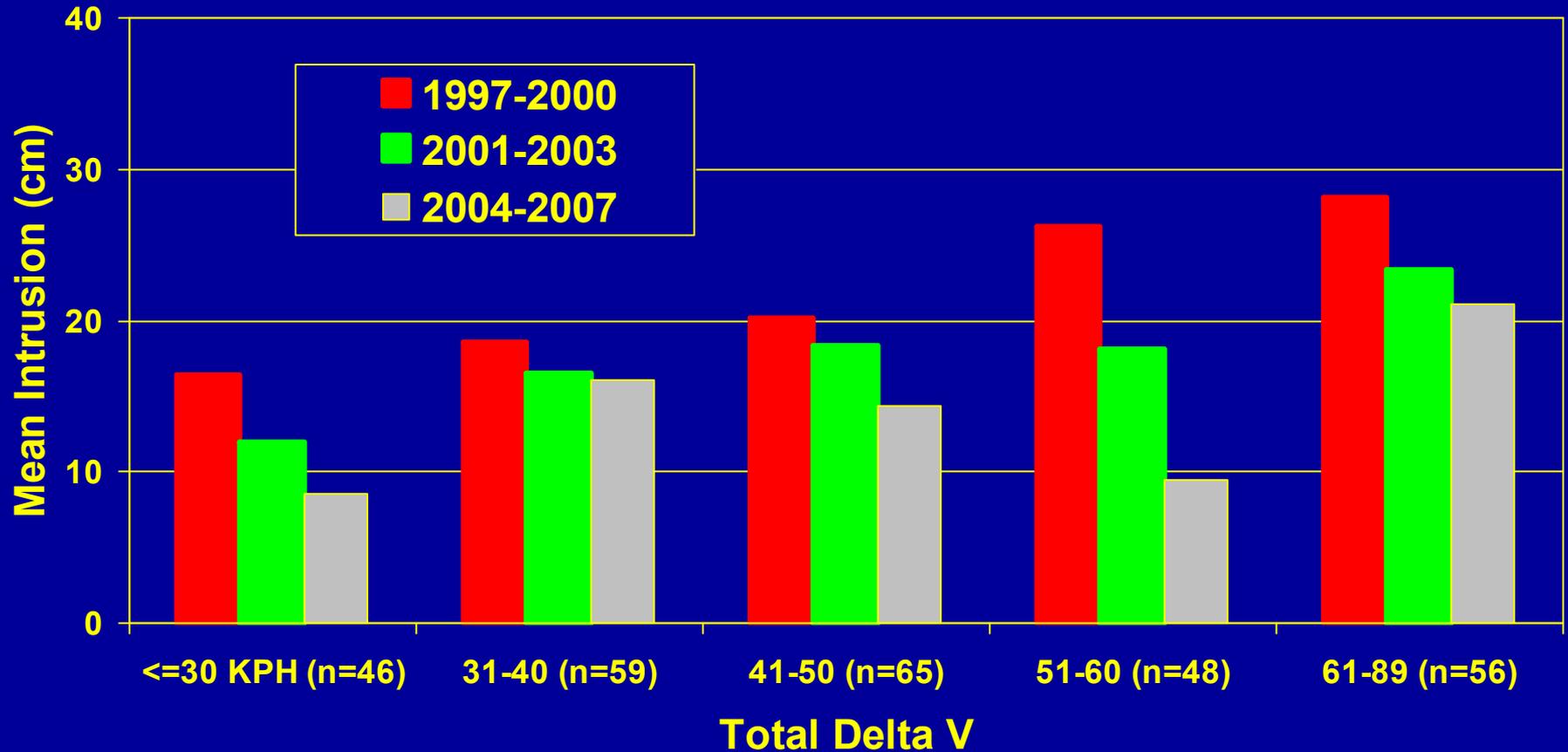
IIHS Testing Indicates Intrusion Reduction



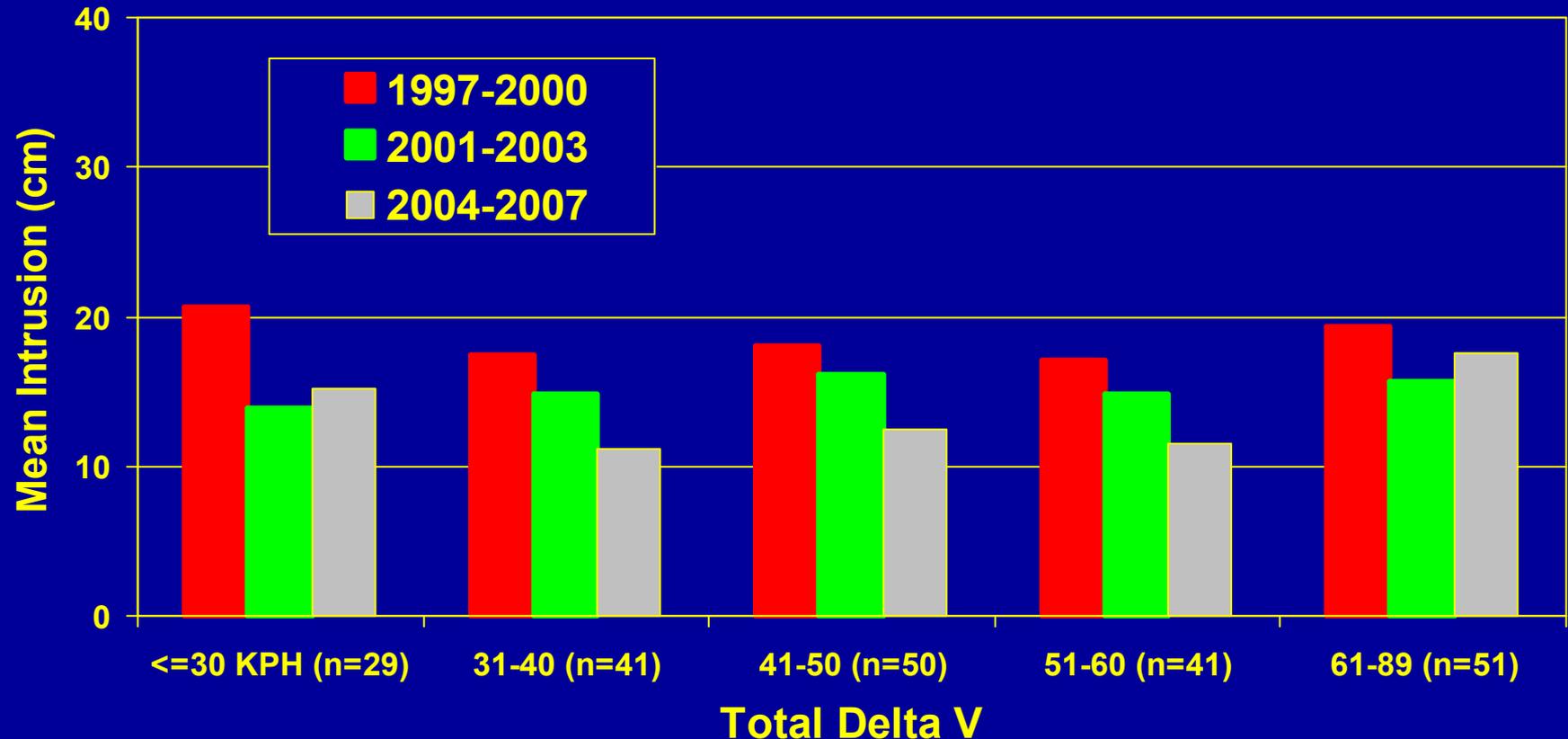
MEASURES OF OCCUPANT COMPARTMENT INTRUSION (cm), 40 MPH FRONTAL OFFSET TEST

	A-pillar Movement Rearward	Footwell Intrusion			Footrest	Brake Pedal Intrusion	Instrument Panel Movement		Steering Column Movement	
		Left	Center	Right			Left	Right	Upward	Rearward
2000 Cadillac Seville	3	17	15	16	6	9	4	3	4	2
1997 Cadillac Seville	9	31	37	31	21	31	16	16	15	11

Mean Intrusion of Toe Pan by Delta V and Model Year (n=274)



Mean Intrusion of Left Instrument Panel by Delta V and Model Year (n=212)

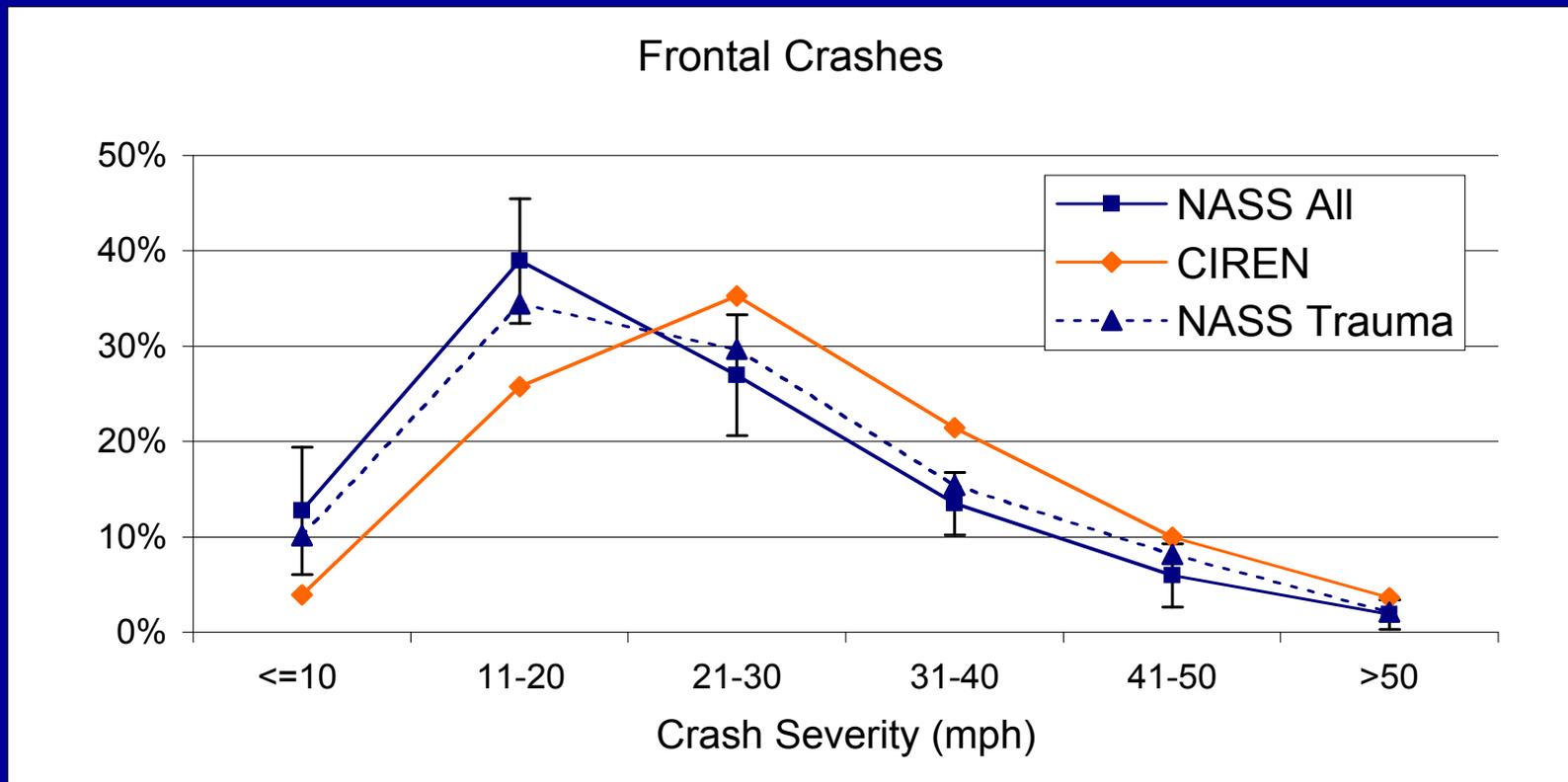


Comparison of CIREN and NASS-CDS

Higher Crash Severity in CIREN

Comparison of CIREN and NASS-CDS

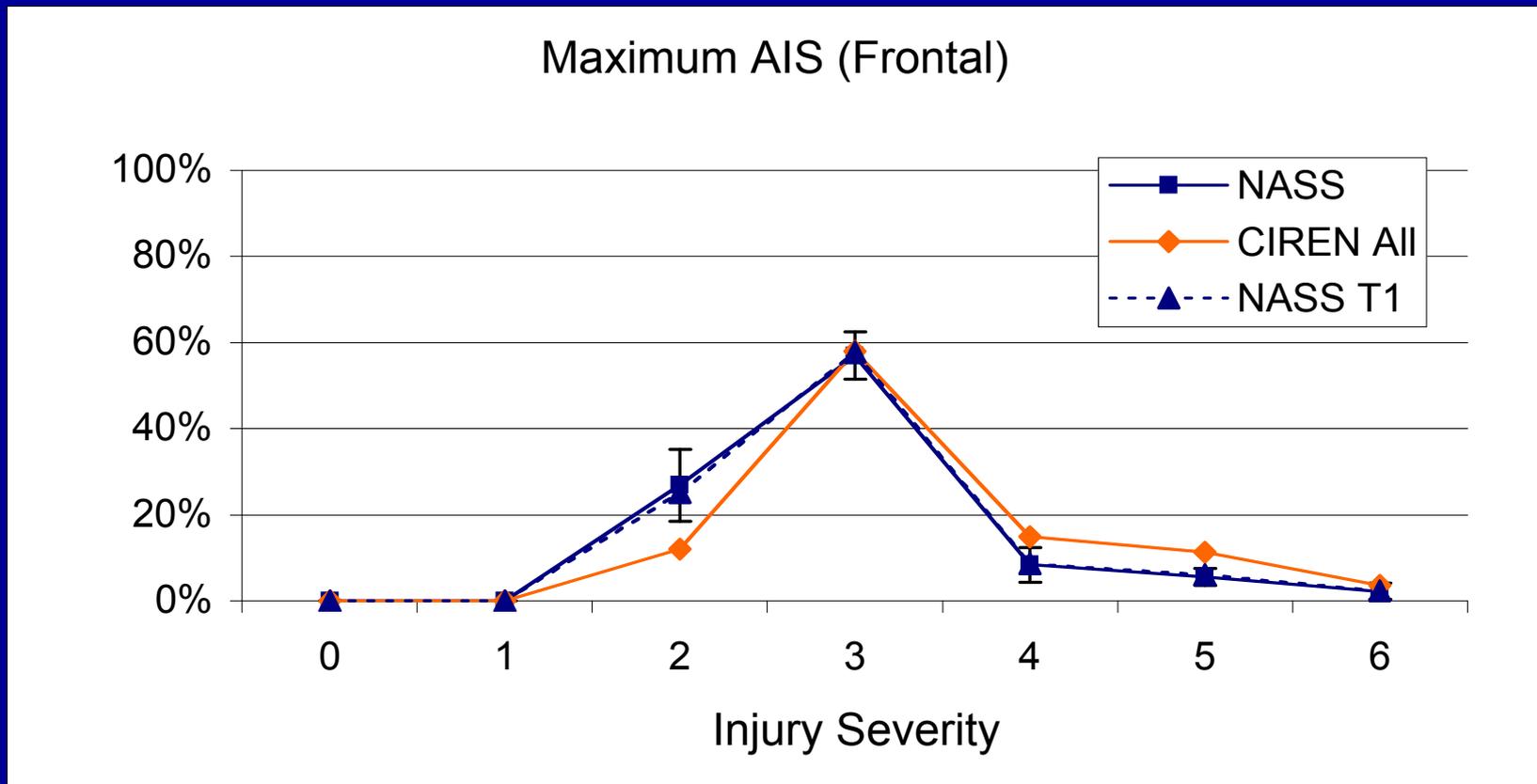
Crash-Severity Distribution



Greater Injury Levels in CIREN

Comparison of CIREN and NASS-CDS

Injury-Severity Distribution

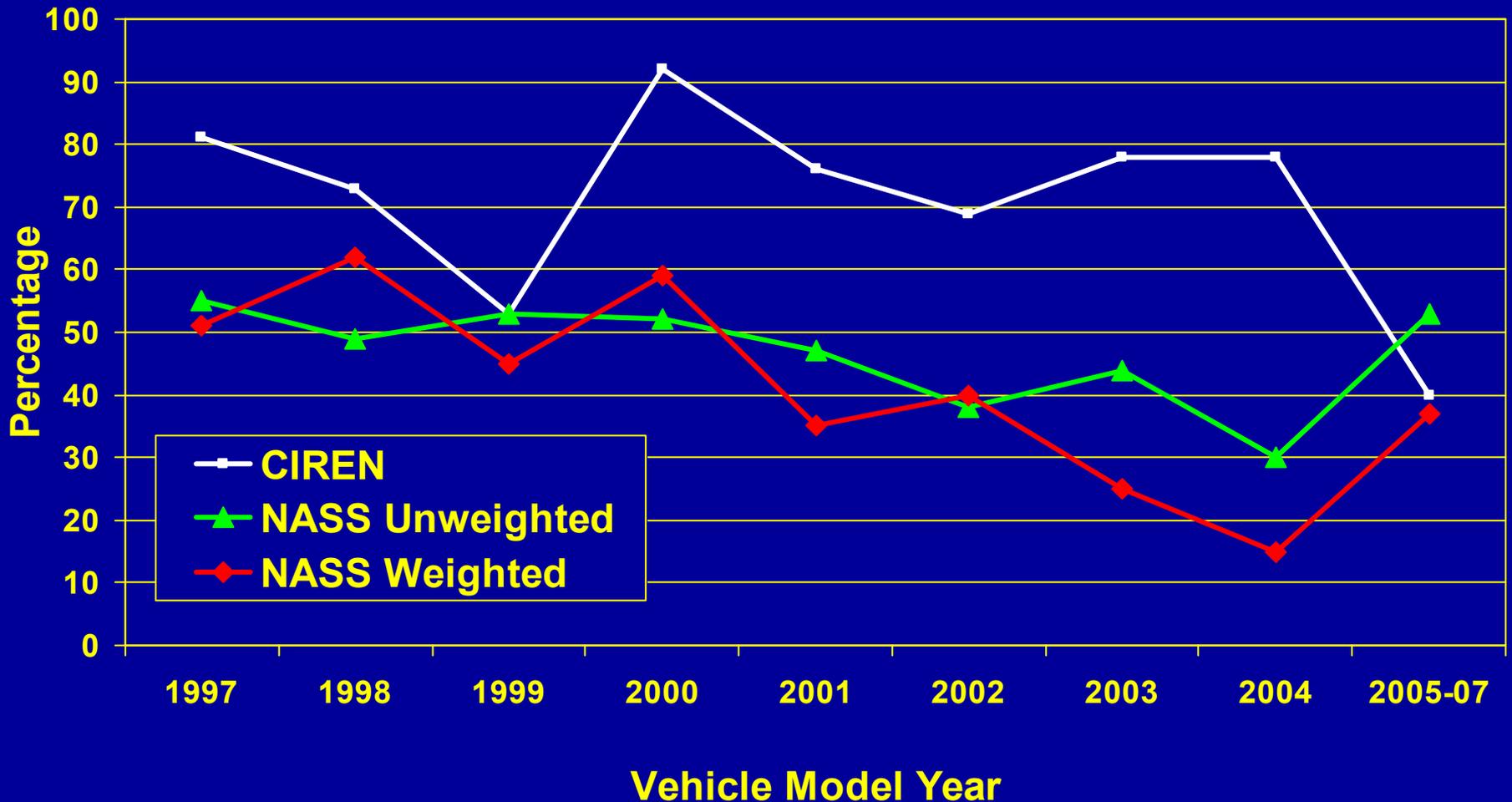


Comparison of CIREN and NASS-CDS

	CIREN	NASS-CDS (unweighted)	NASS-CDS (weighted)
N	533	838	82,715
MY 1997-2003	480	728	73,678
MY 2004-2007	53	110	9,037
%			
LEI	73%	51%	40%
Ankle injury	31%	21%	15%
$\Delta V < 25$ mph	44%	64%	74%

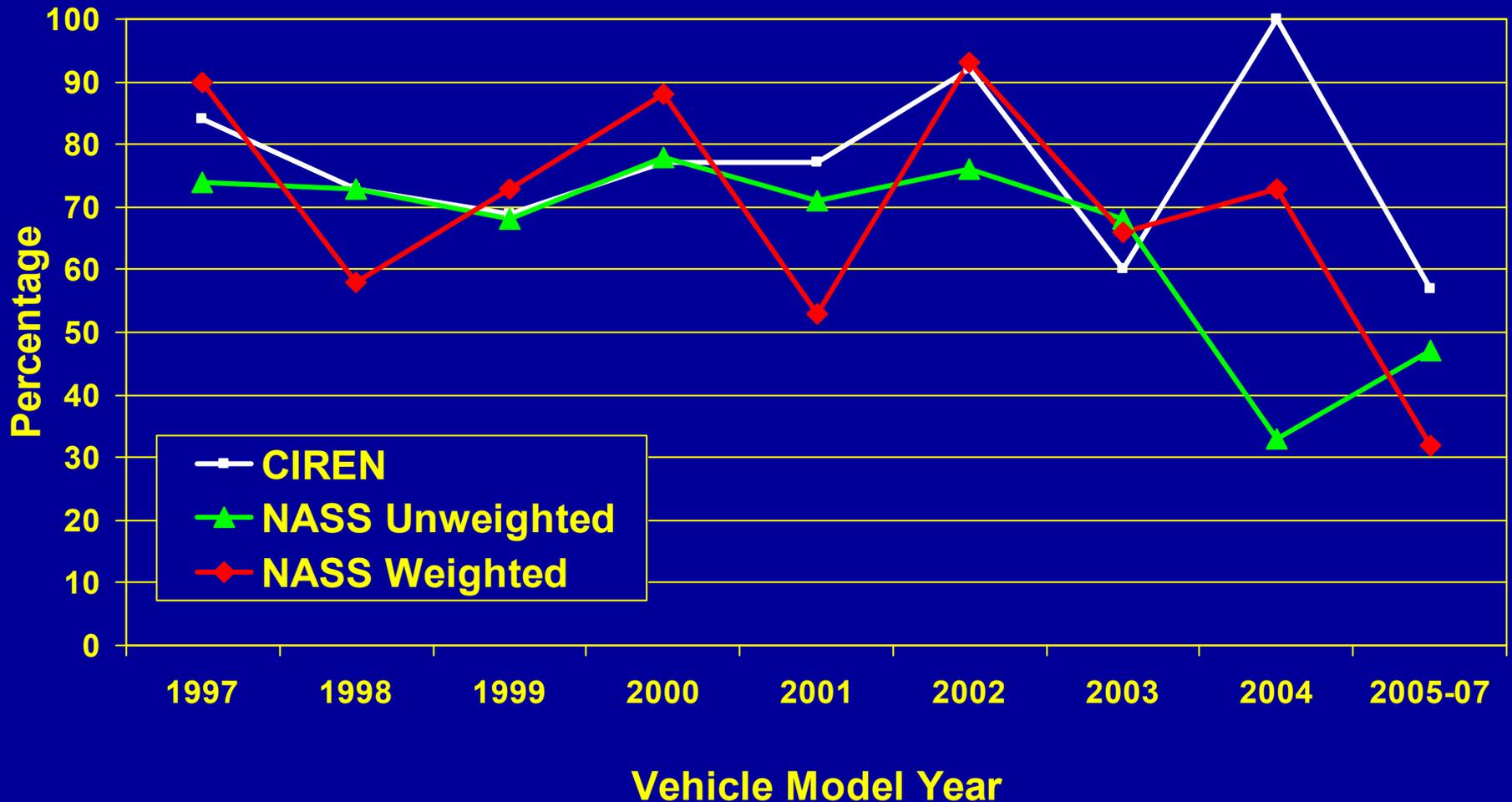
Incidence (%) of Lower Extremity Injuries (MAIS 2+)

Comparison of CIREN and NASS-CDS at $\Delta V < 25$ mph



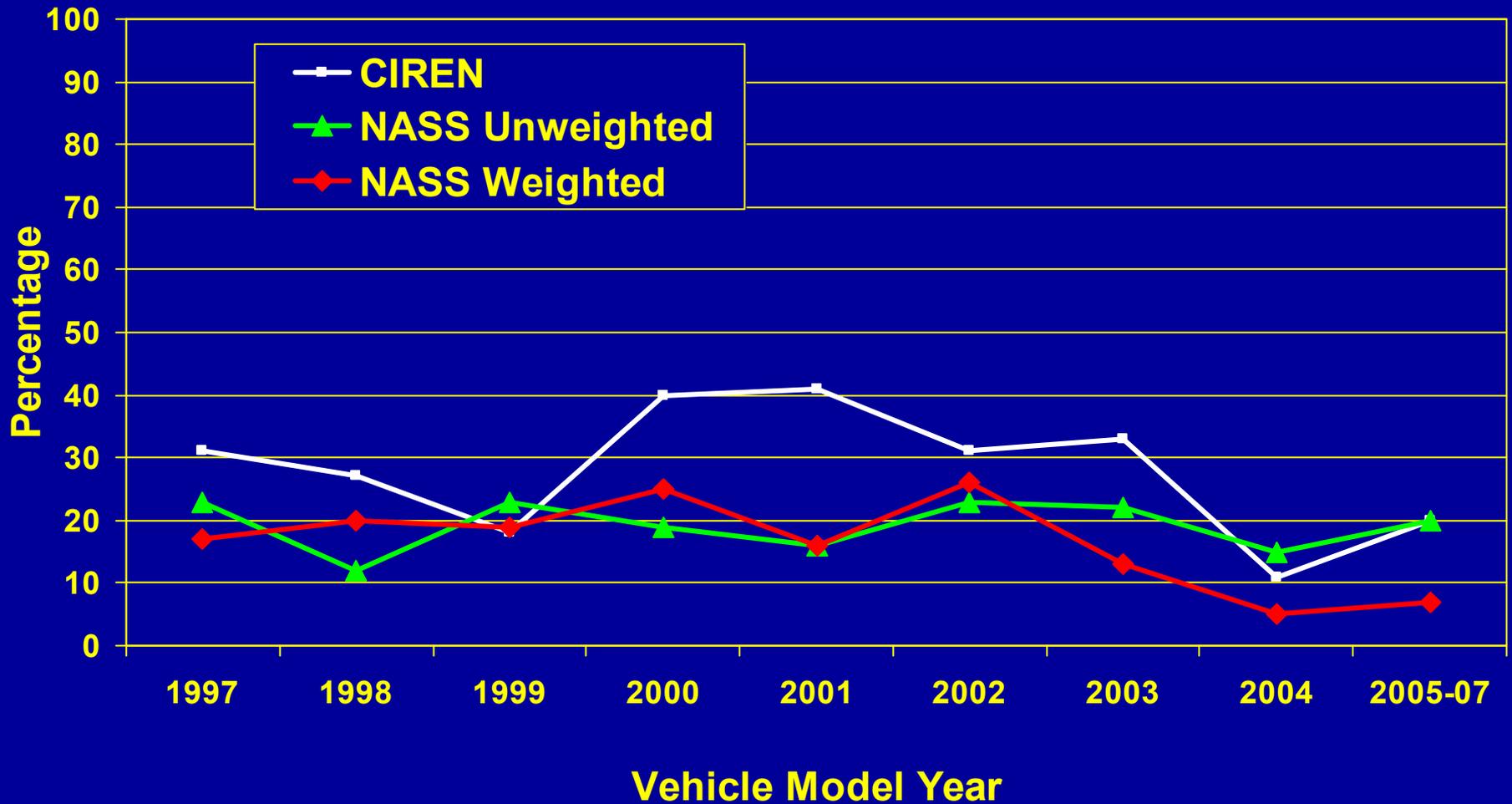
Incidence (%) of Lower Extremity Injuries (MAIS 2+)

Comparison of CIREN and NASS-CDS at $\Delta V = 25+$ mph



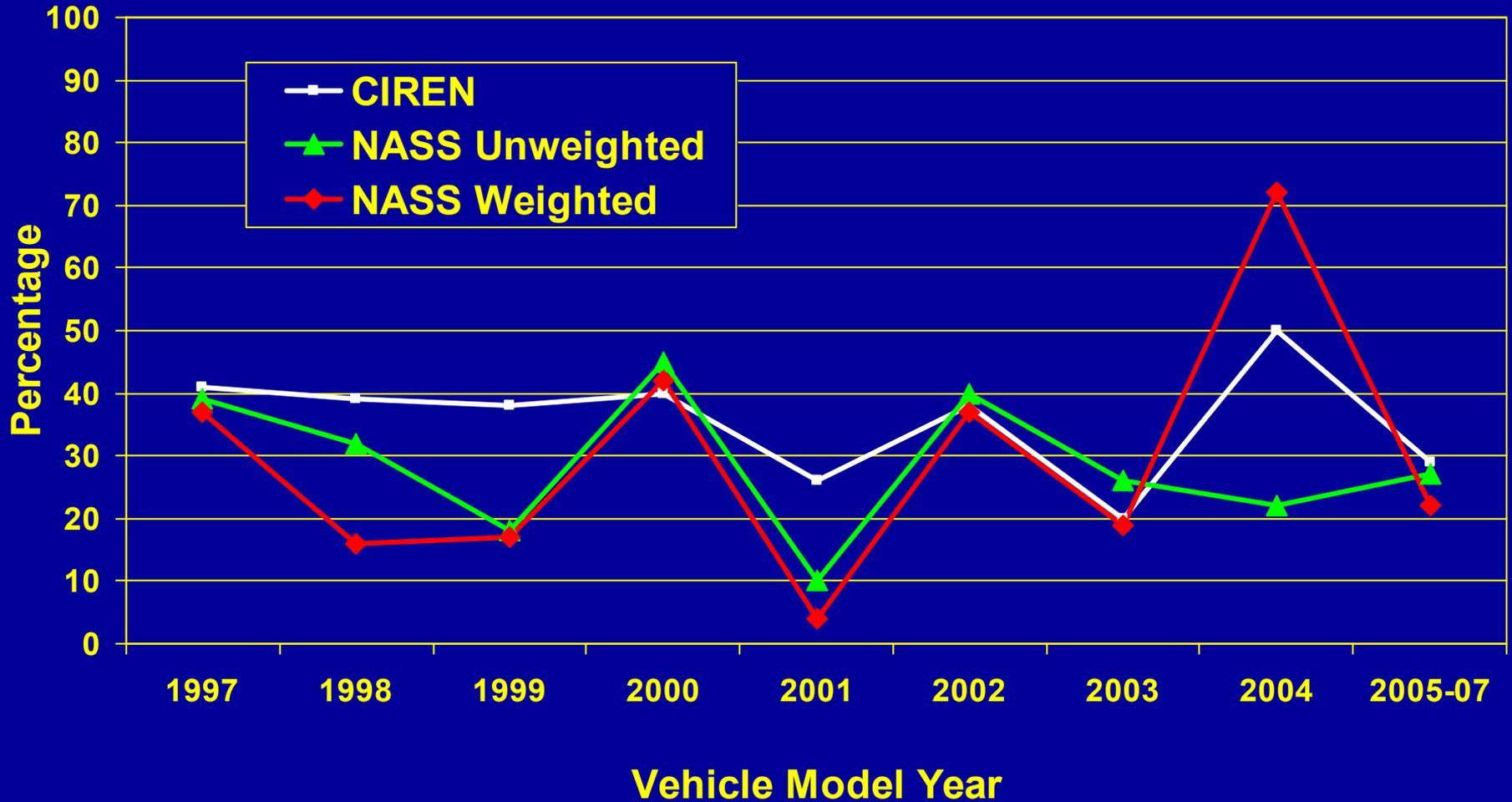
Incidence (%) of Ankle Injuries (MAIS 2+)

Comparison of CIREN and NASS-CDS at $\Delta V < 25$ mph



Incidence (%) of Ankle Injuries (MAIS 2+)

Comparison of CIREN and NASS-CDS at $\Delta V = 25+$ mph



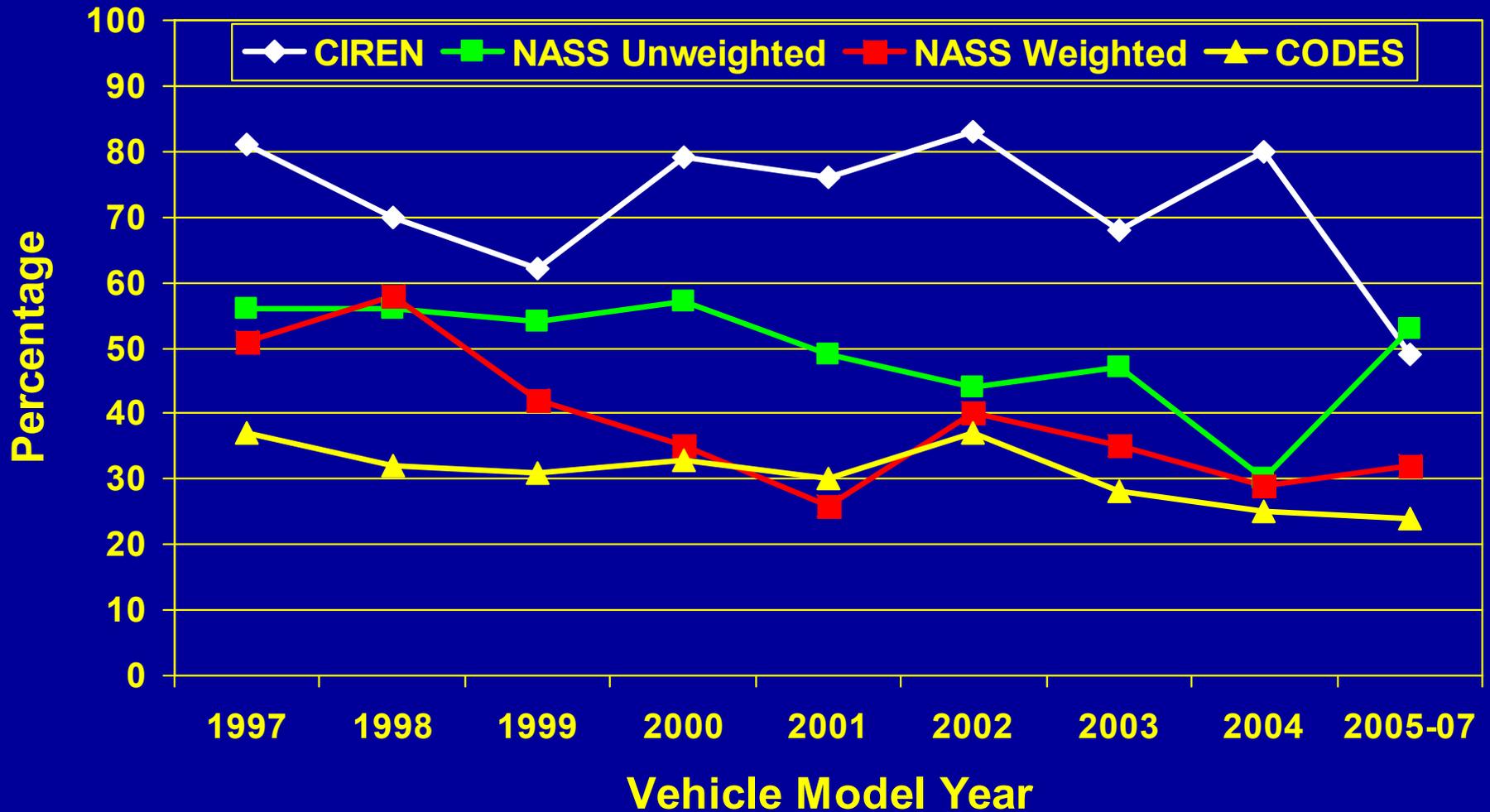
Comparison of CIREN, NASS-CDS and CODES

Comparison of CIREN, NASS-CDS and CODES

	CIREN	NASS-CDS (unweighted)	NASS-CDS (weighted)	MD CODES
N	533	838	82,715	1,905
MY 1997-2003	480	728	73,678	1,743
MY 2004-2007	53	110	9,037	162
%				
LEI	73%	51%	40%	32%
Ankle injury	31%	21%	15%	11%
$\Delta V < 25$ mph	44%	64%	74%	--

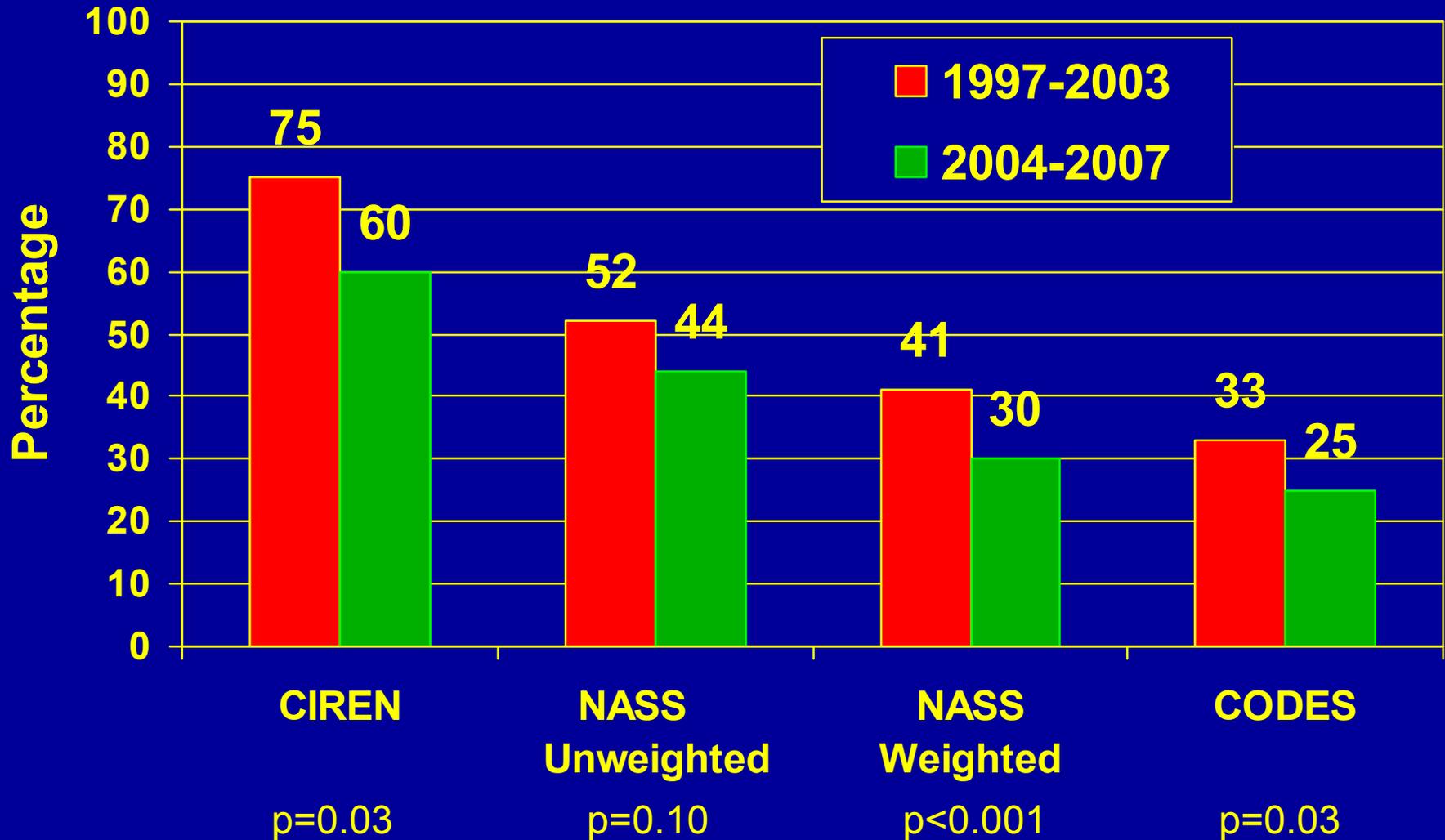
Incidence (%) of Lower Extremity Injuries

Comparison of CIREN, NASS-CDS and CODES



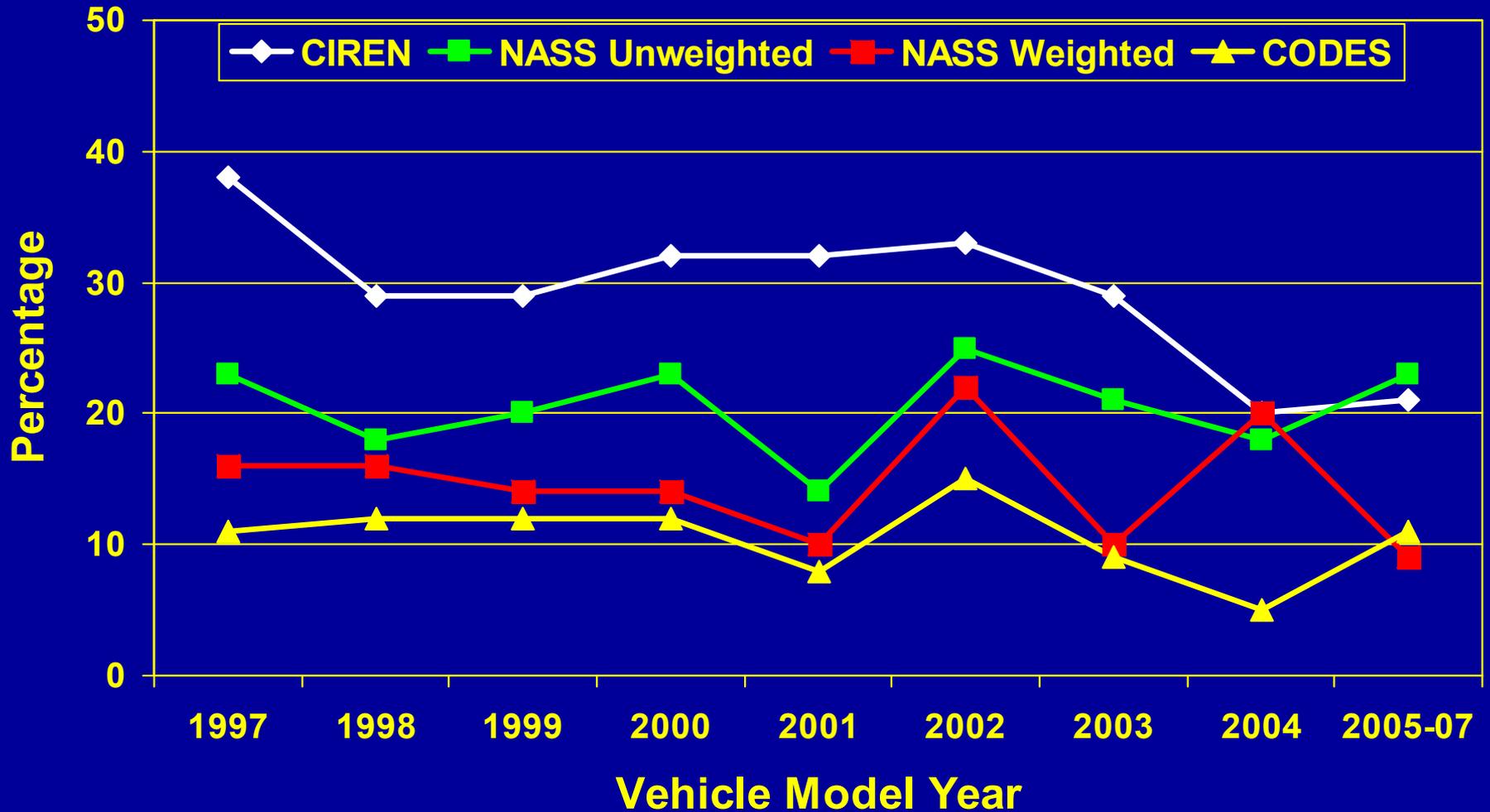
Incidence (%) of Lower Extremity Injuries

Comparison of CIREN, NASS-CDS and CODES



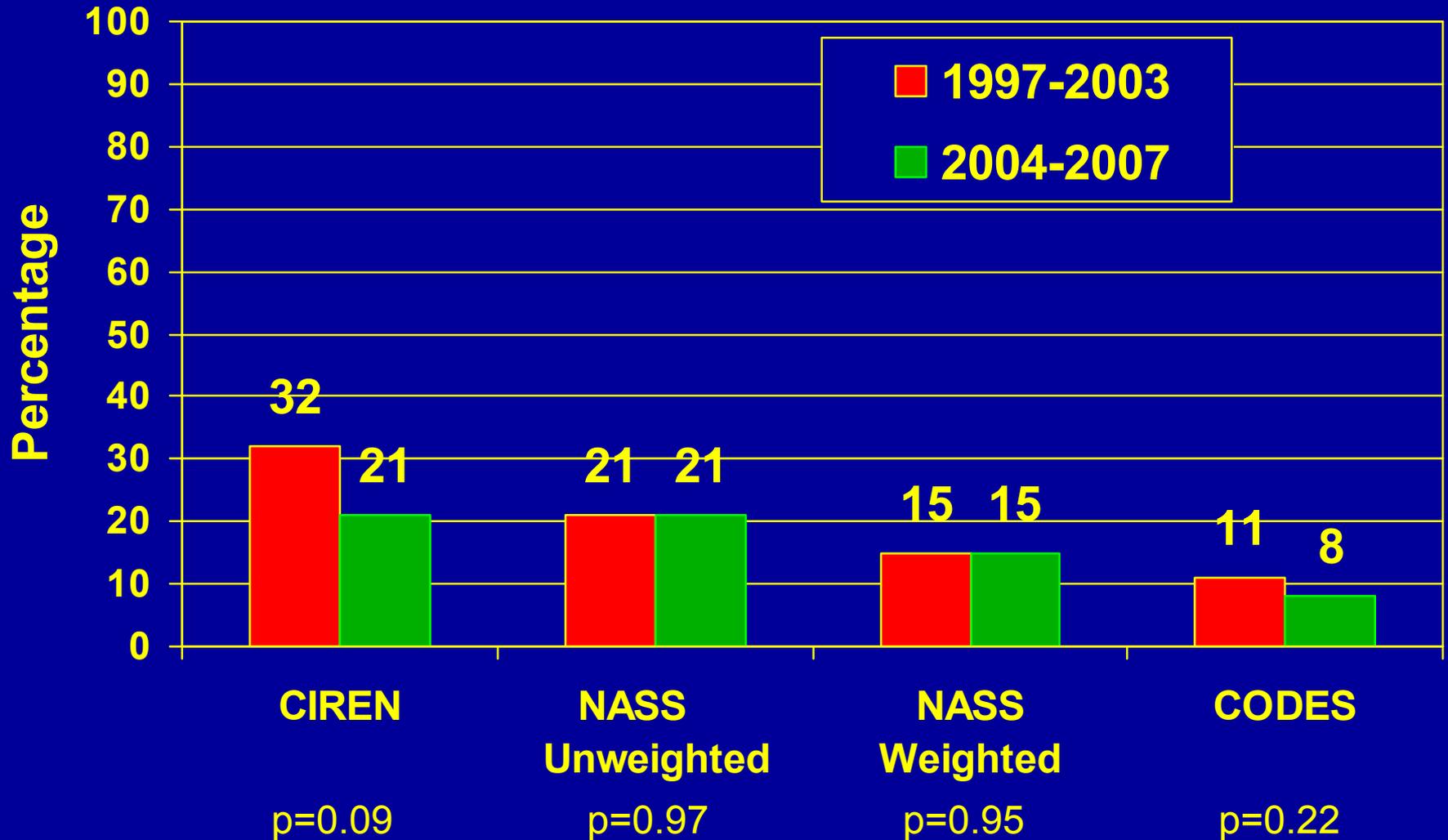
Incidence (%) of Ankle Injuries

Comparison of CIREN, NASS-CDS and CODES



Incidence (%) of Ankle Injuries

Comparison of CIREN, NASS-CDS and CODES



Summary

- Declining trend in lower extremity injuries over last 5 years noted in CIREN, CODES and NASS databases
- Ankle injuries appear to be declining in CIREN, although this trend is not as apparent for the CODES and NASS/CDS databases
- Improved NCAP ratings and decreased toe pan and knee bolster intrusion rates in recent years

Limitations

- Number of lower extremity injury cases in later model years is small
 - Need more years of data to validate trend
- Vehicles included by model year and not by specific make/model modifications (NCAP ratings)
- Injury definition varies by data source
 - AIS & ICD-9 in CIREN
 - AIS in NASS-CDS
 - ICD-9 in CODES

This study illustrates the value of CIREN:

the ability to monitor injury
trends over time in relation to changes in the
vehicle fleet

Future Research

- Repeat analyses based on NCAP ratings instead of model year
- Examine Bio-tab database for mechanisms of foot and ankle fractures
- Utilize OTA codes to see whether declines in ankle injuries reflect those affecting articular surfaces

Disclaimer

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- Views expressed are those of the authors and do not represent the views of the NHTSA

Thanks....

WE WOULD LIKE TO THANK THE
INVESTIGATORS AT THE OTHER
CIREN CENTERS FOR THEIR HARD
WORK AND DEDICATION TO THIS
PROJECT.