



Injury Severity and Causation Factors of Motorcyclists in Traffic Accidents in comparing Drivers of Motorcycle and All Kinds of Motorized Two-wheelers

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content

- Introduction of research methodology
- Analysis frame and data
- Accident and Injury situation
- Accident Causation
- Conclusions
- Improvements for more safety



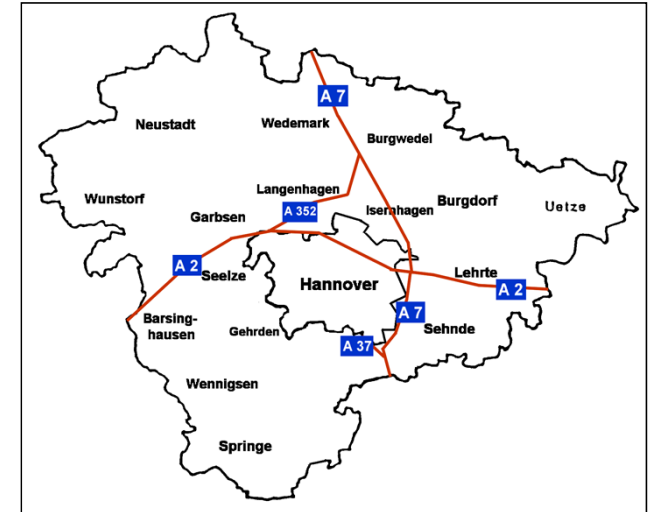
Technical University Dresden

Medical University Hannover

methodology

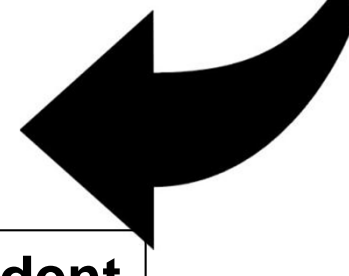
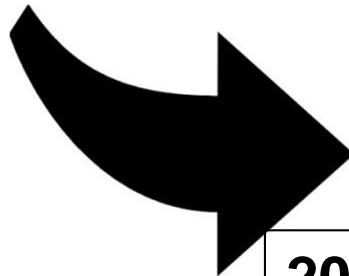


**2000
accidents
annual**



1000 accident

1000 accident



2000 accident



By order of
Federal Highway Research Institute
Automotive Research Association

BAST
FAT



Description of sampling

Representative Data Sampling on Scene

methodology

random selection

Selection criteria

Weigthing process

HELIOS

Verkehrsunfallforschung der Medizinische
Einsatzdatenübersicht

Police reported accidents

Einsatzbeginn	Anlassart(kurz)	Stadt	Ort
02.06.2004 14:06	033	Hannover	Plinkestr [01] / Ricklinger Str [10] (Linden)
02.06.2004 14:04	033-031	Hannover	Im Heidkampe [16] / Auf den Kräken [01] (Bothfeld)
02.06.2004 14:02	033-031	Hannover	Meldastr [01] / Haltenhoffstr [09] (Herrenhausen)
02.06.2004 13:46	033-031	Hannover	Goetheplatz [01] (Calenberger Neustadt)
02.06.2004 13:46	033-031	Hannover	Goetheplatz [01] (Calenberger Neustadt)
02.06.2004 10:12	033-031leicht	Hannover	Fössestr [04] / Kötnerholzweg [01] (Linden)

No personal decision for selection of case !

All kind of traffic accidents with injured person !

Comparison to national or regional statistics !



Description of sampling

methodology

What to do on scene ?





Abbreviated Injury Scale

Kind + Location + Severity AIS 2005



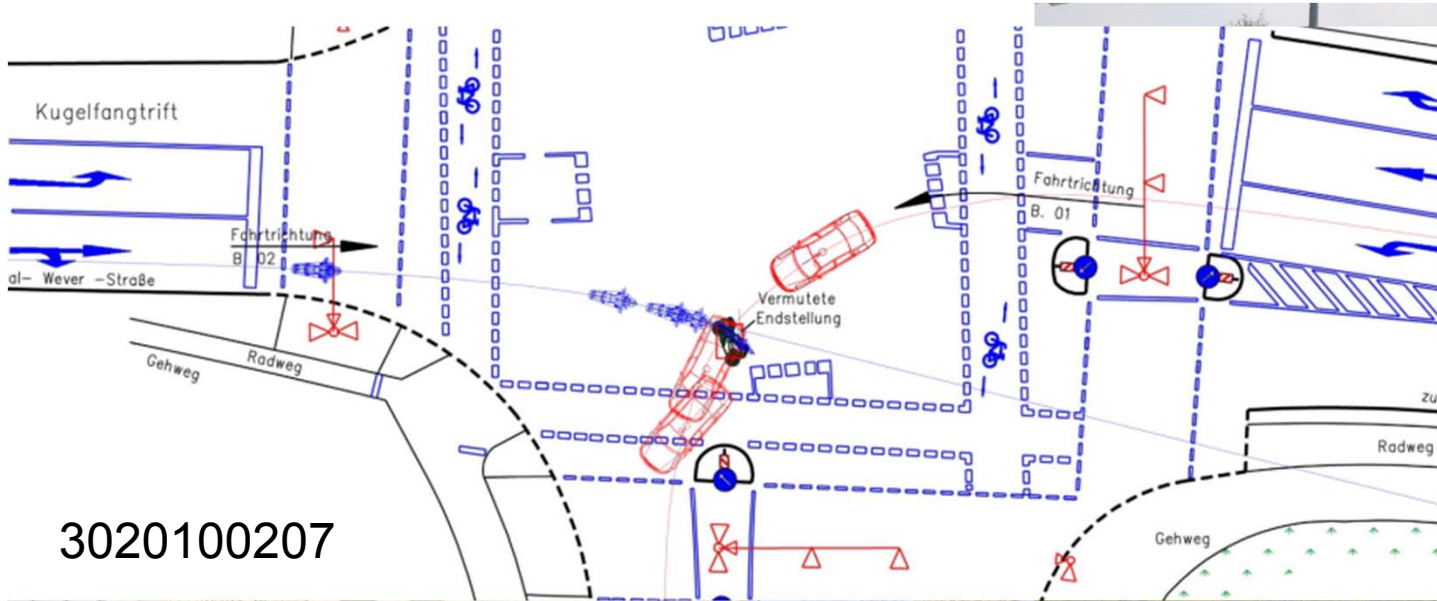
Injury documentation



MAIS 2
AIS-Head 2
AIS-Arms 2
AIS-Legs 2

- Commotio Cerebri AIS 2**
- Laceration Head right frontal AIS 1**
- Fracture of head of radius right AIS 2**
- Rupture left crucial ligament AIS 2**

methodology

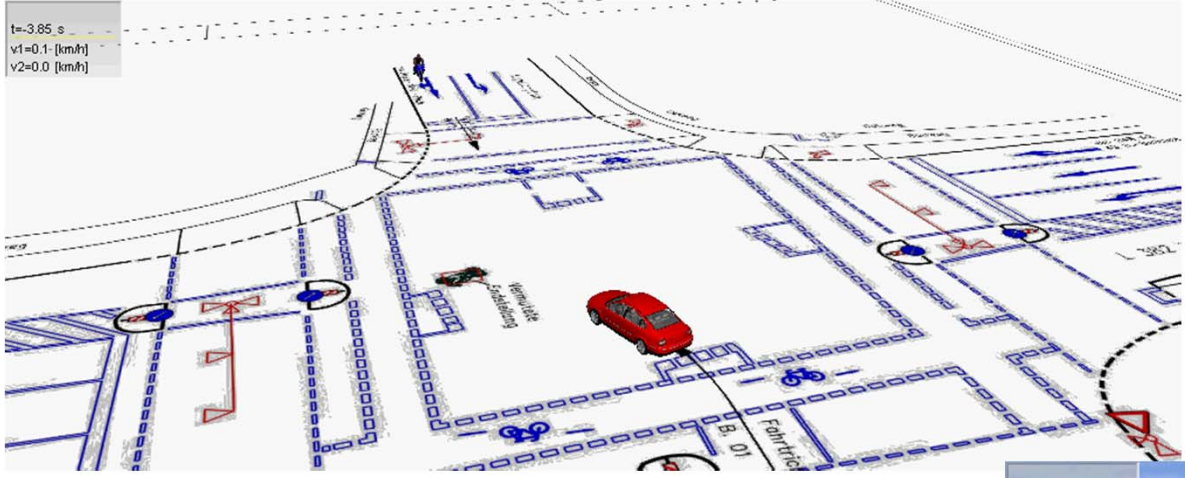


3020100207





t=-3.85 s
v1=0.1 [km/h]
v2=0.0 [km/h]



PASSAT VK 20 km/h
DUCATI VK 40 km/h
Vrel 46 km/h

MAIS 2
Motorcycle driver
38 y. m.

t=-0.52 s
v1=17.2 [km/h]



3020100207

Kompression fracture 5th thorax vertebra

Luxation Daumen right



Human # Machine # Environment

- "Human" → **Group 1**, human cause factors (Seven Steps)
- „Machine“ → **Group 2**, factors from the technical nature of the vehicle
- "Environment" → **Group 3**, factors from the range of the infrastructure and nature

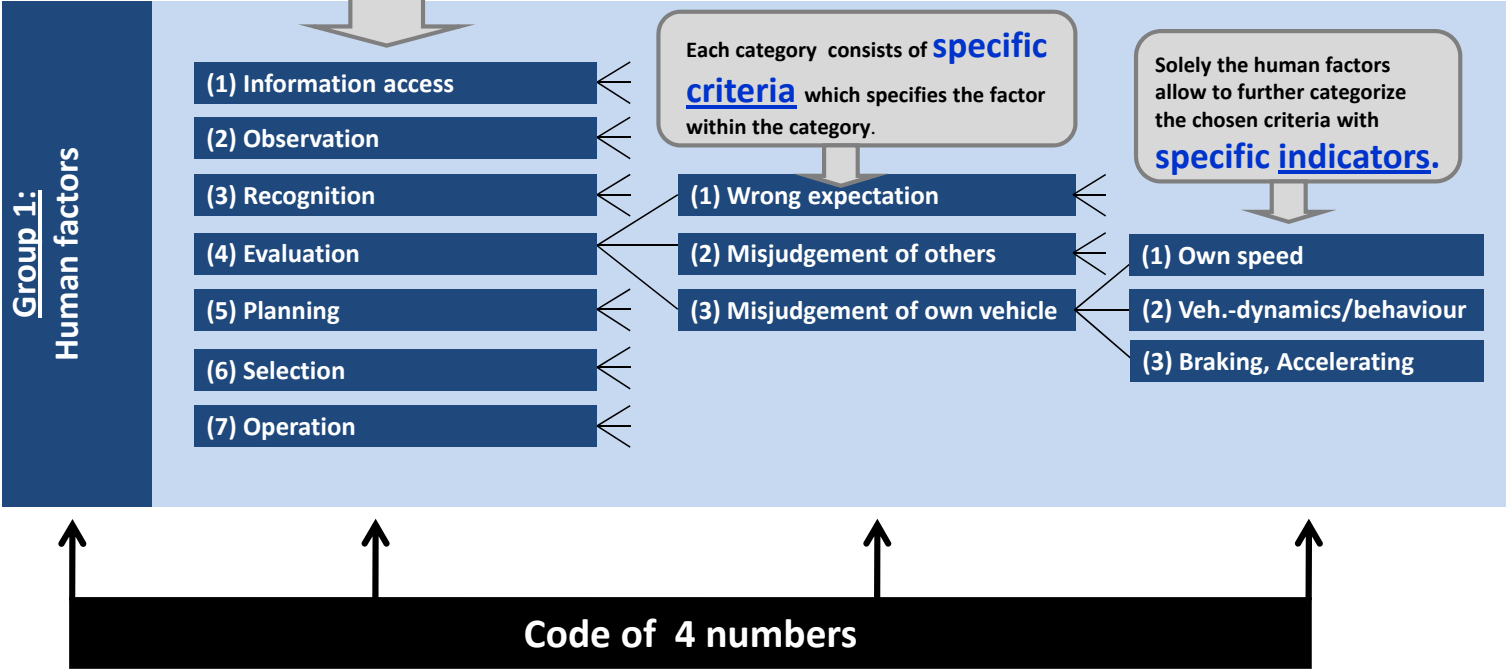
ACASS

methodology



The causes of traffic accidents can be found in three different areas: **Human factors**, **technical factors form the vehicle** and **factors from the infrastructure or environment** presented in three groups of the system.

The human factors consist **of seven categories (7 Steps)**
 Chronological sequence of basic human functions from the perception, the judgment of the perceived situation to the resulting operation.



ACASS

methodology



Multiple causation-codes for each accident participant are possible:

1st Code:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="text" value="Comments box"/>
2nd Code:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="Comments box"/>
...						
5th Code:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="Comments box"/>

Causation factors
codes possible per accident participant

Source of information
Numbers 1 to 9
how the information was obtained

Doubts concerning the reliability of the coded information

Comments to explain the selected code

ACASS

methodology

Recording of accident causation data in GIDAS



The analysis !

- Data selection
- Kind of injuries
- Frequency of injured body areas and severity grades
- Impact loads
- Accident situation and causation factors



Motorized Two Wheelers

- ***Mofa, Moped, Mokick, light motorcycle***
- ***Motorcycle, Scooter***





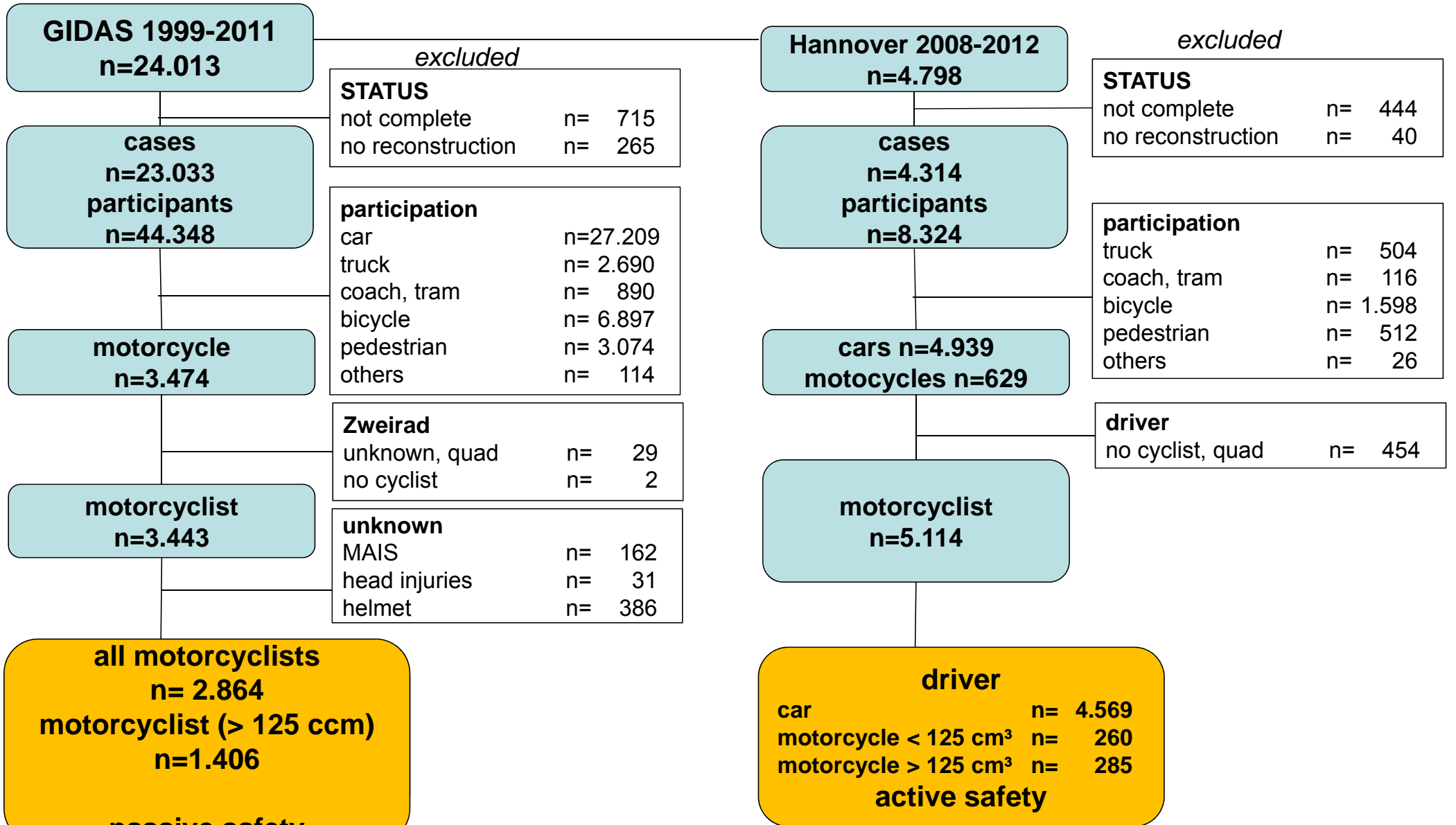
GIDAS

German In-Depth Accident Study

Passive Safety

Sample Frame

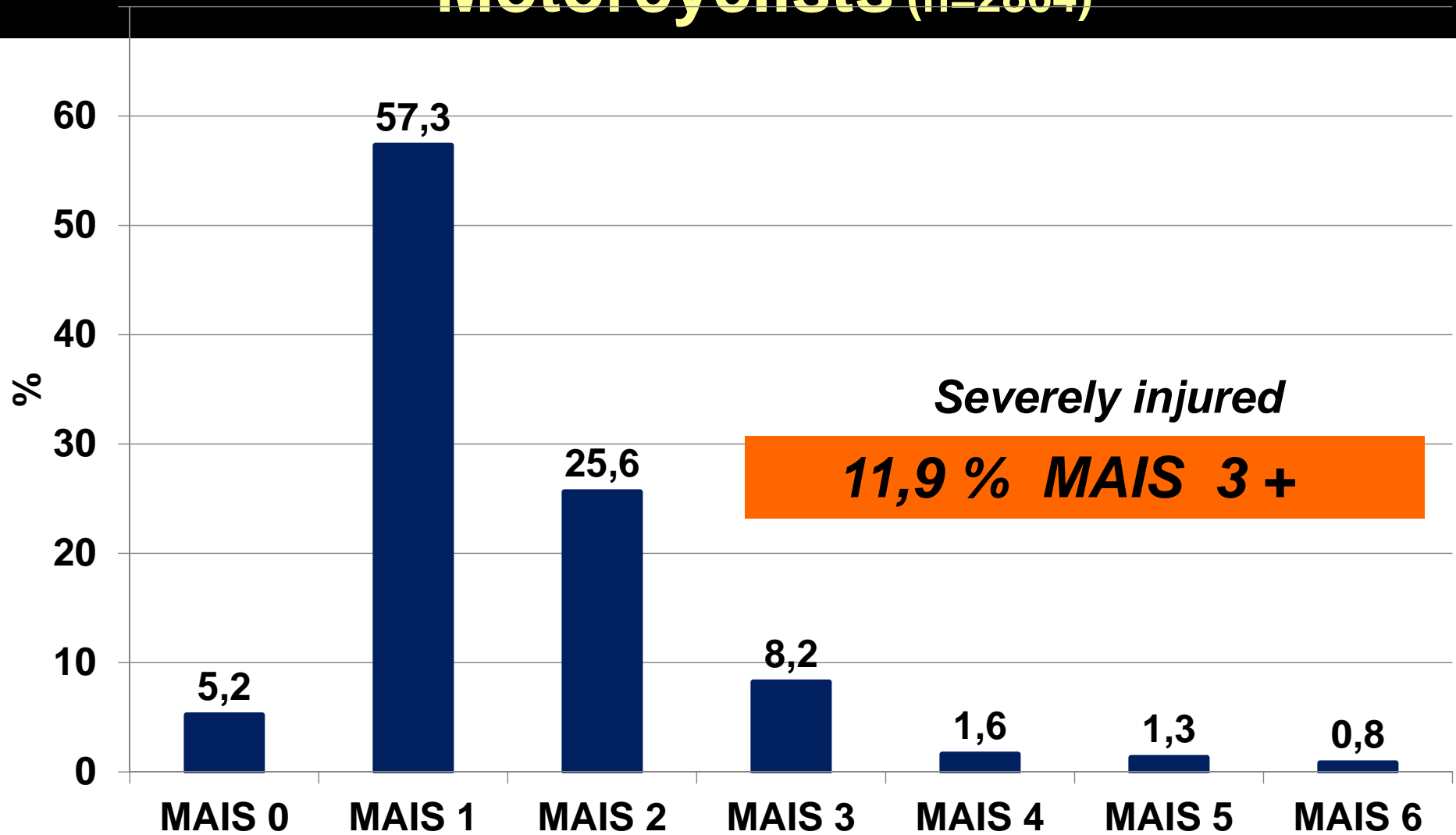
Active Safety





GIDAS German In-Depth Accident Study

The situation of Injury Severity in Germany for Motorcyclists (n=2864)

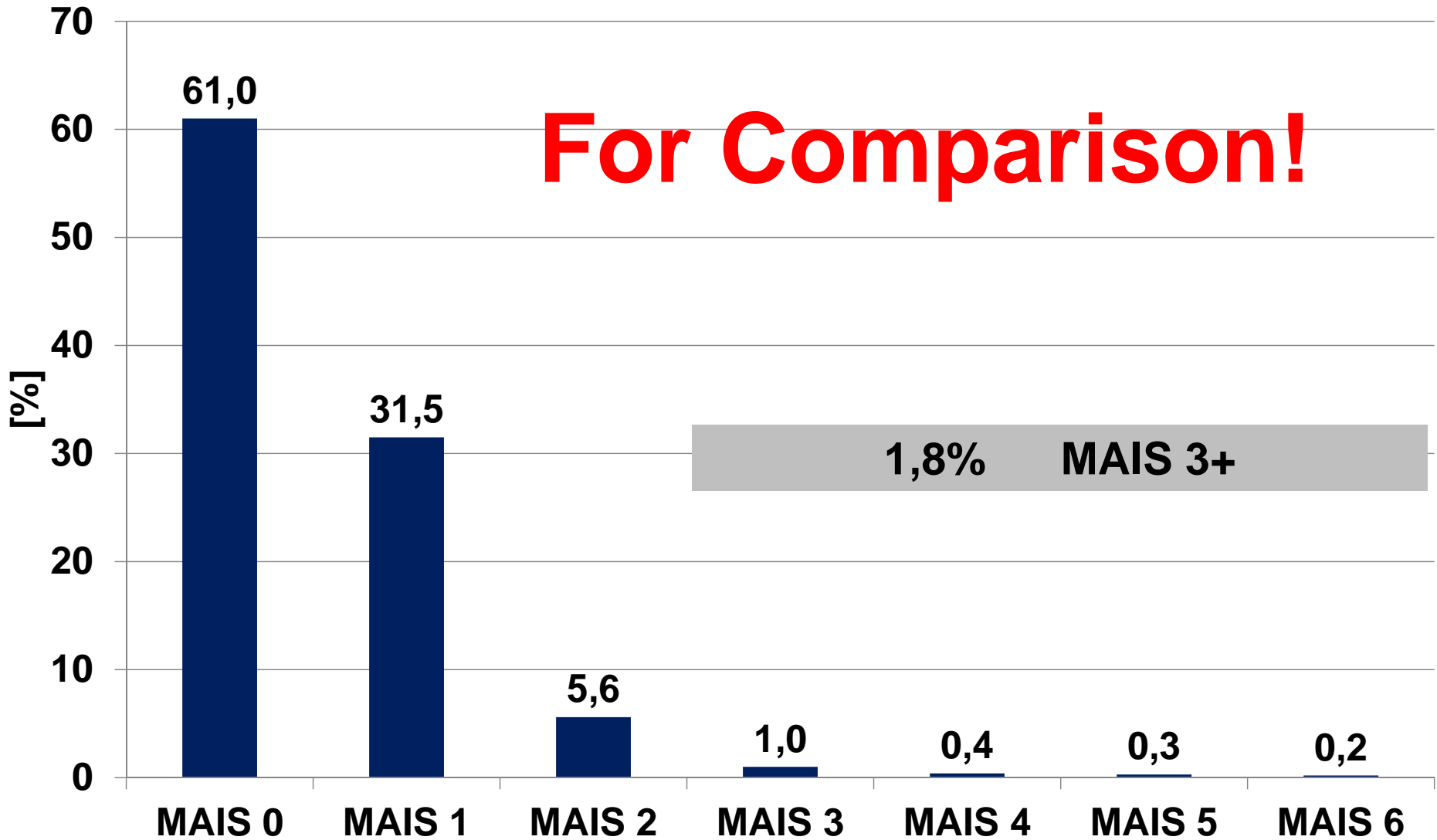




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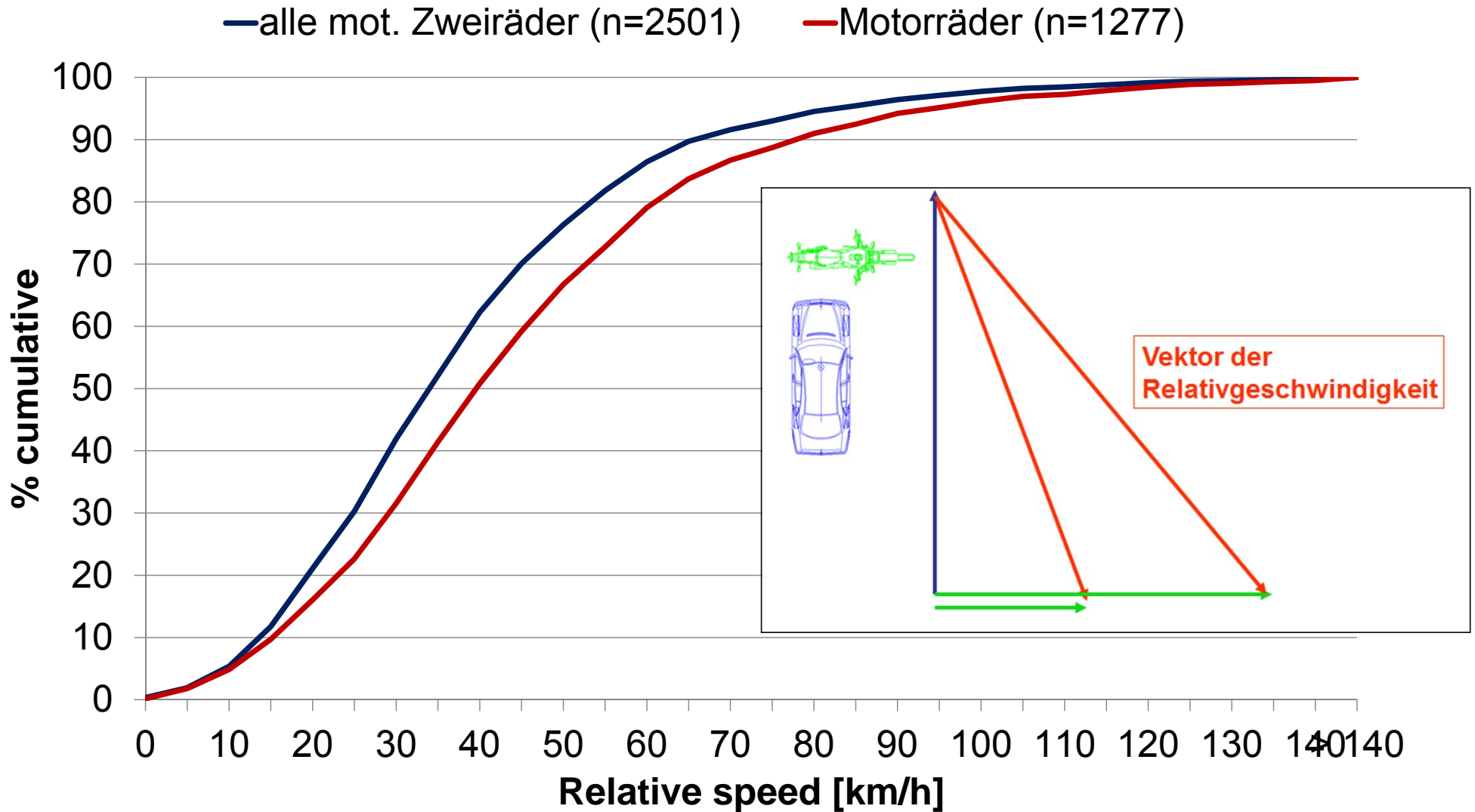
Belted Car Occupants (n=21.668)



For Comparison!

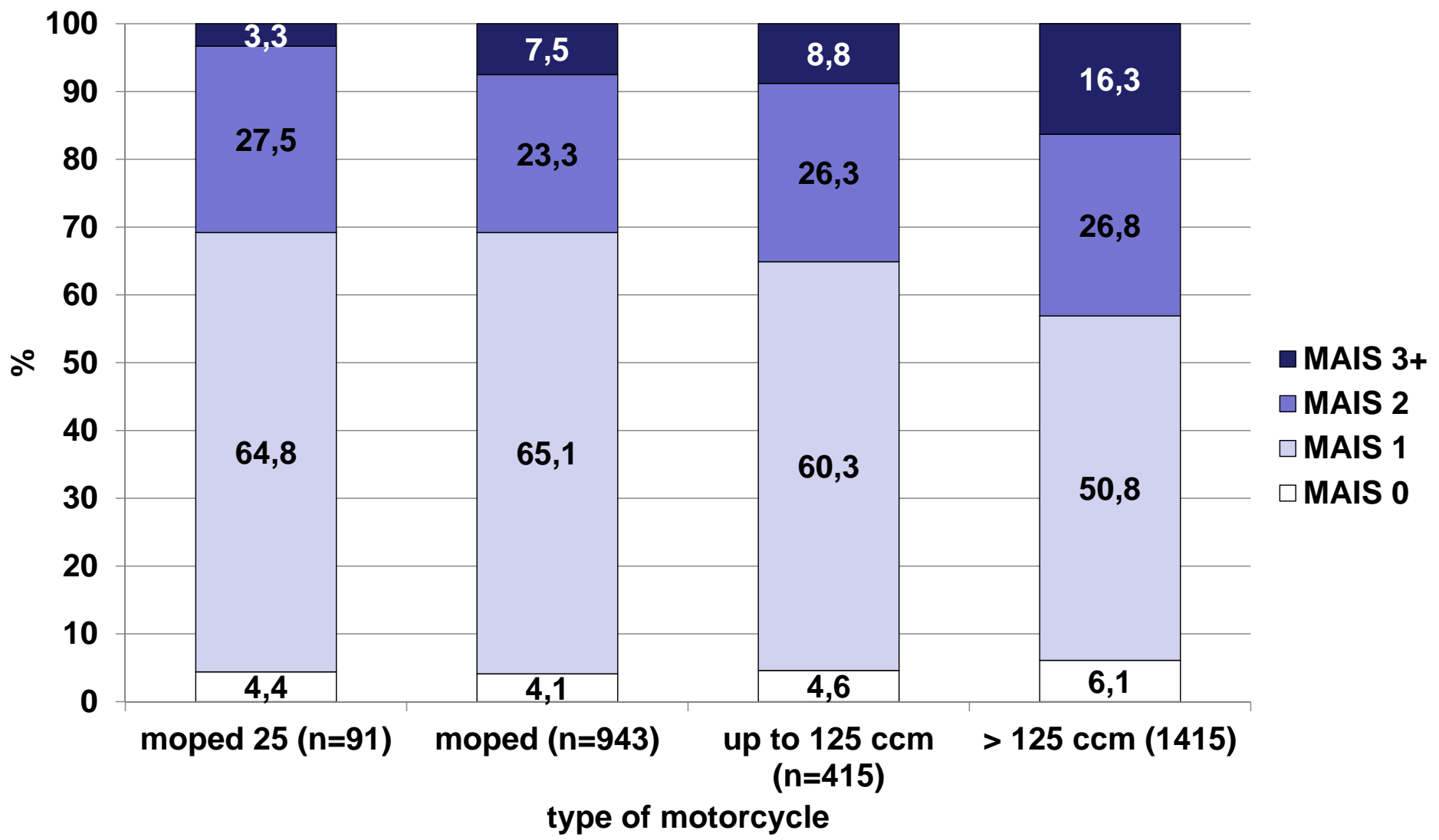


Relative Speed in motorcycle accidents





maximum injury severity grades

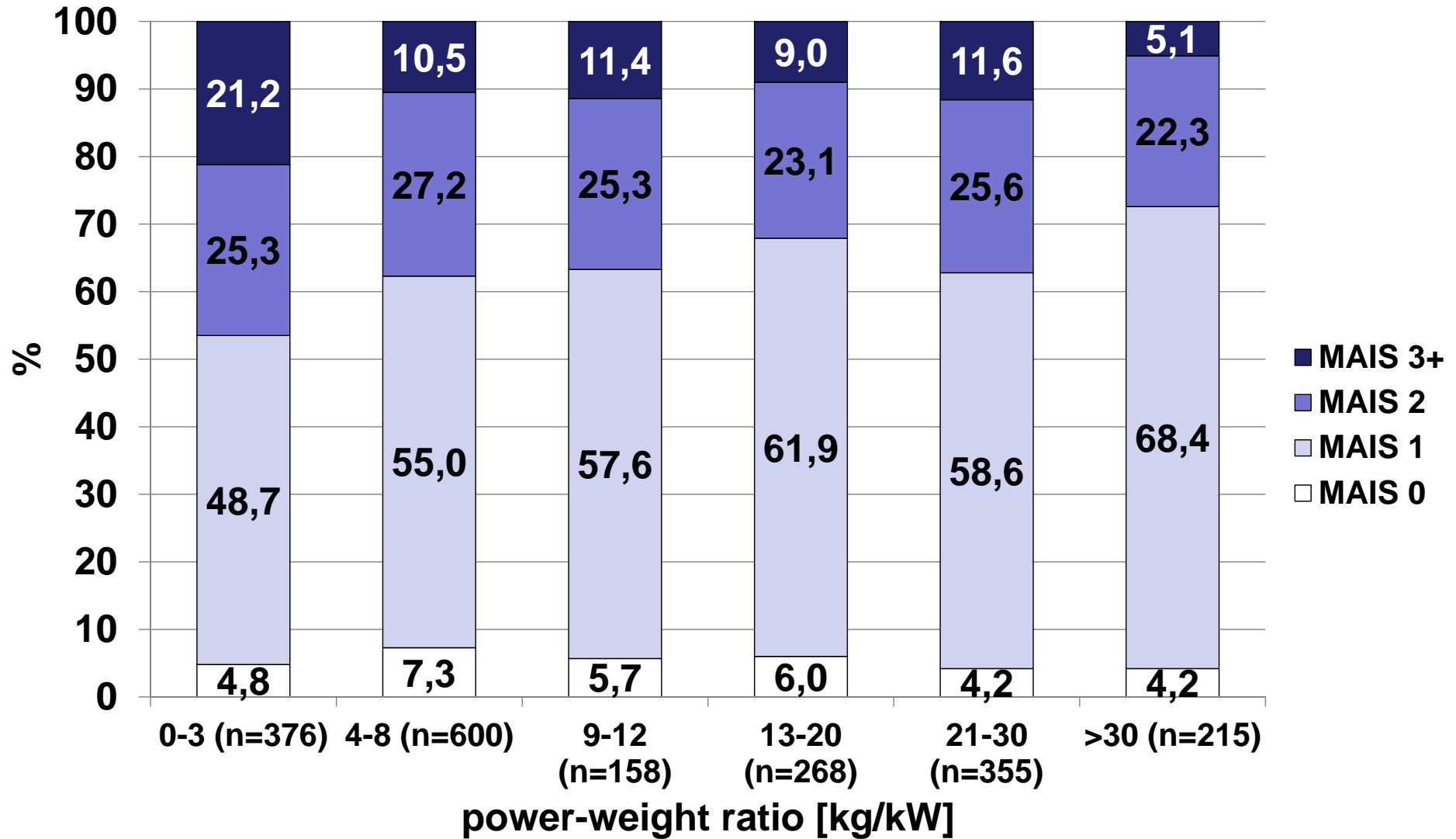




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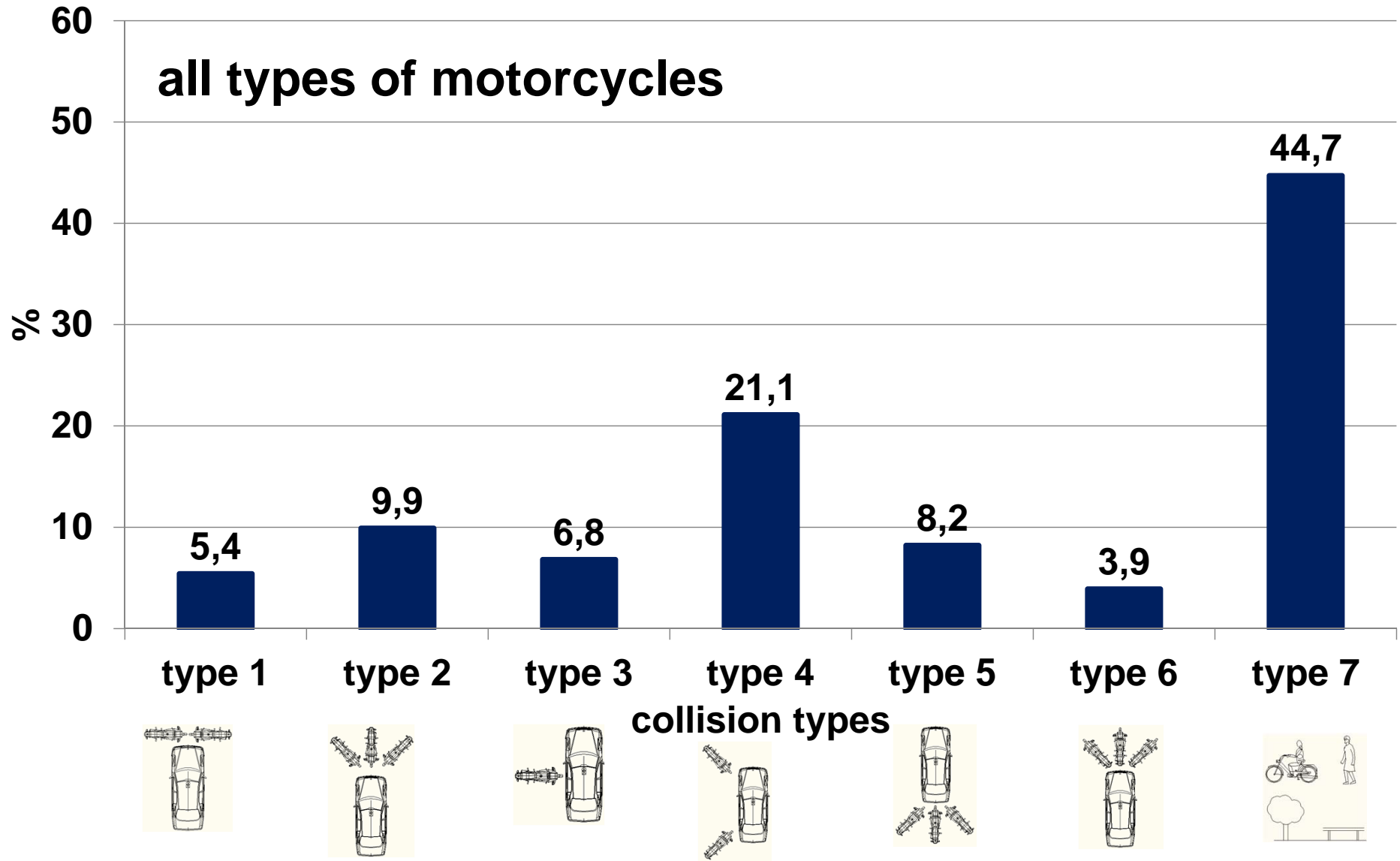
injury severity and power-weight ratio





GIDAS German In-Depth Accident Study

collision types of all motorcycles (n=2,848)



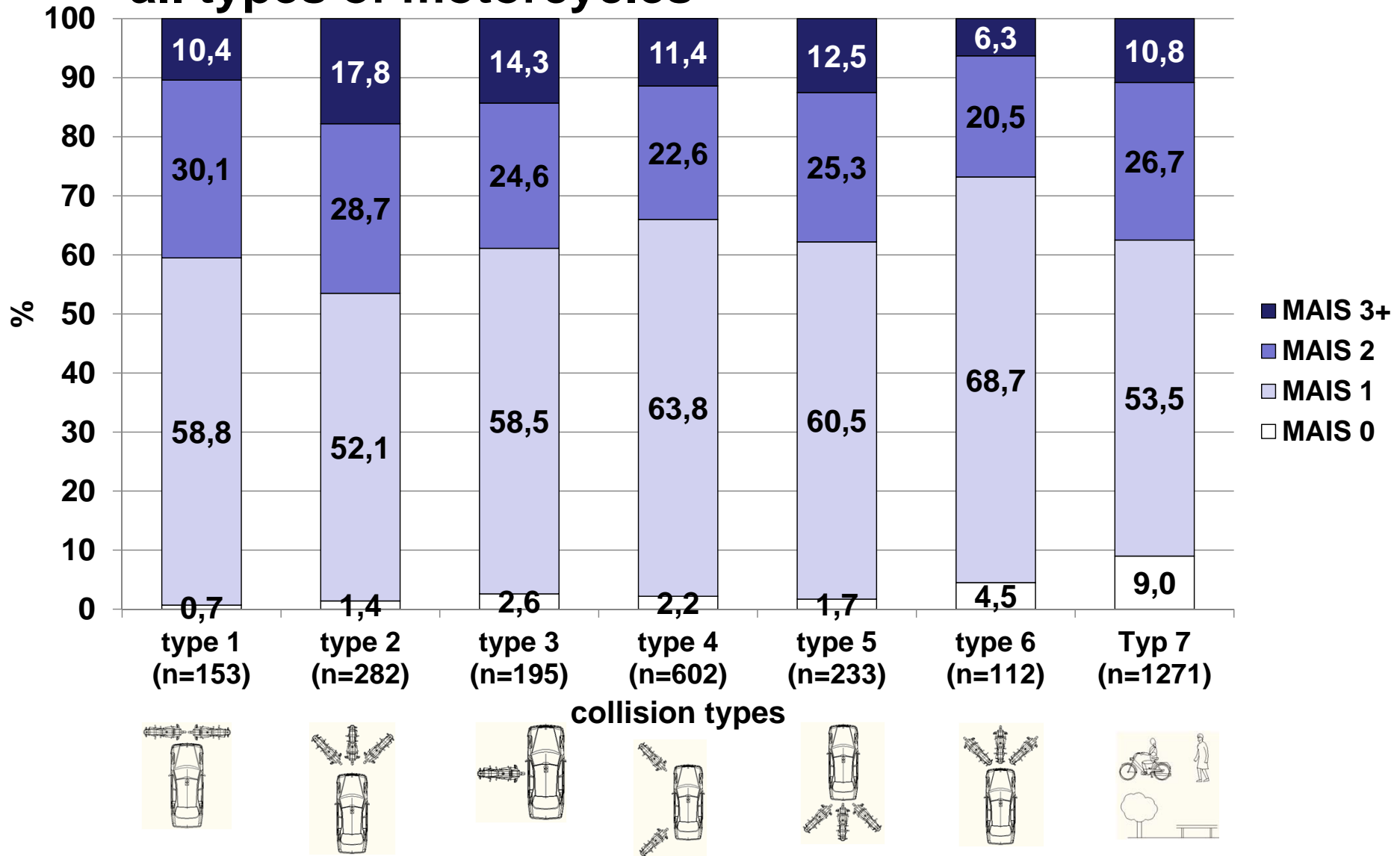


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German In-Depth Accident Study

coll.types and injury severity grade of all motorcyclists

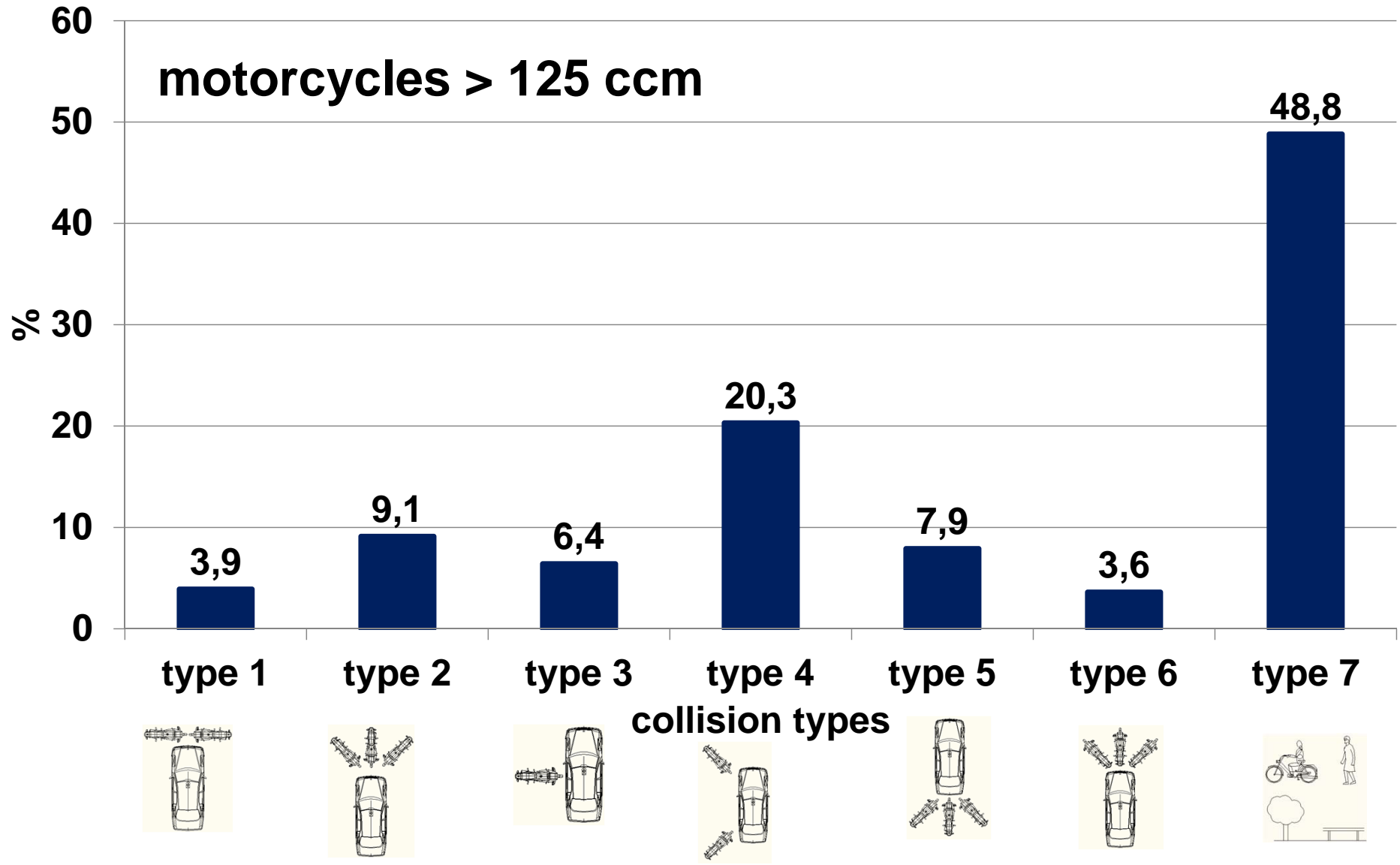
all types of motorcycles





GIDAS German In-Depth Accident Study

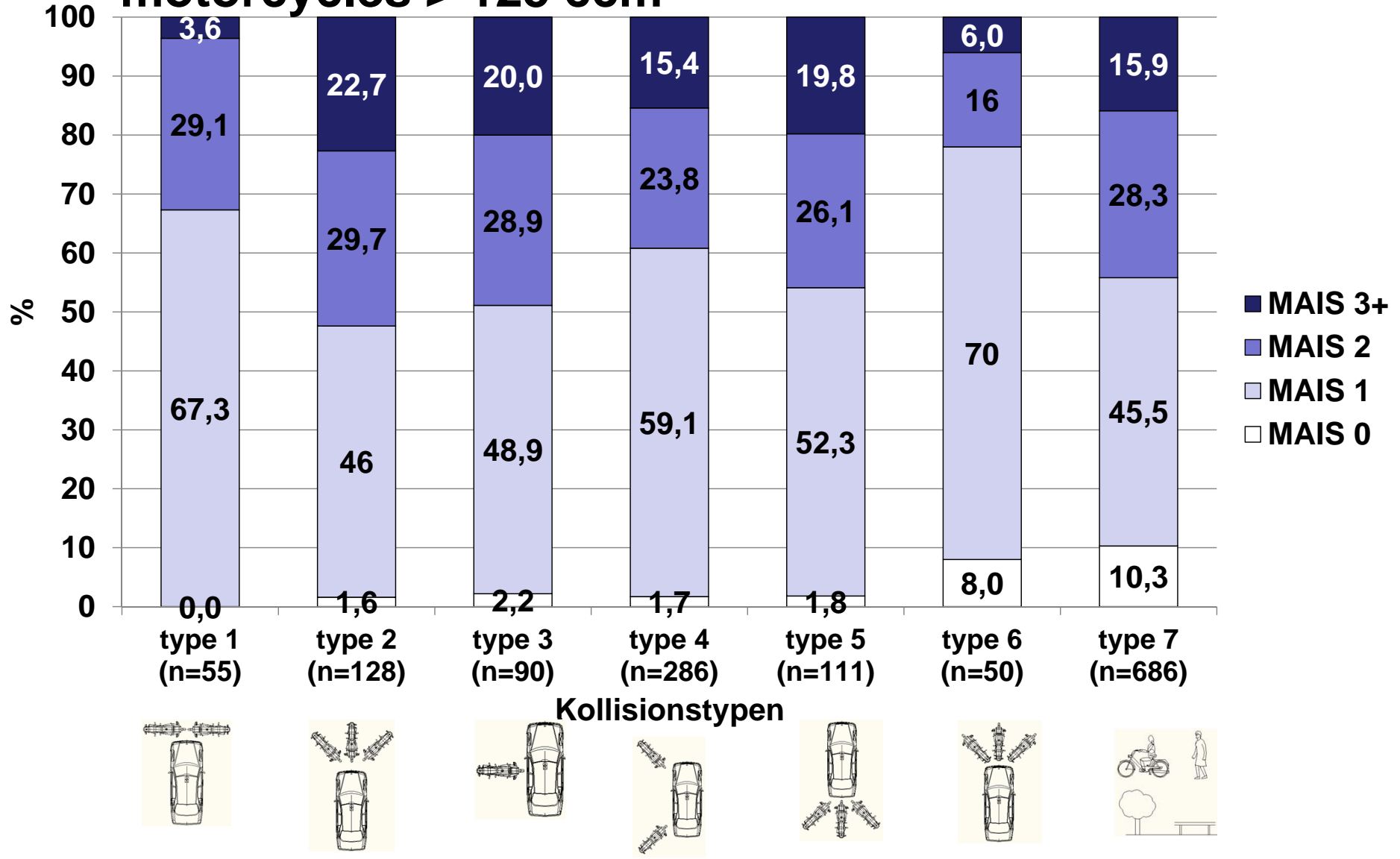
collision types motorcycles > 125 ccm (n=1,406)





Collision types and injury severity motorcyclists

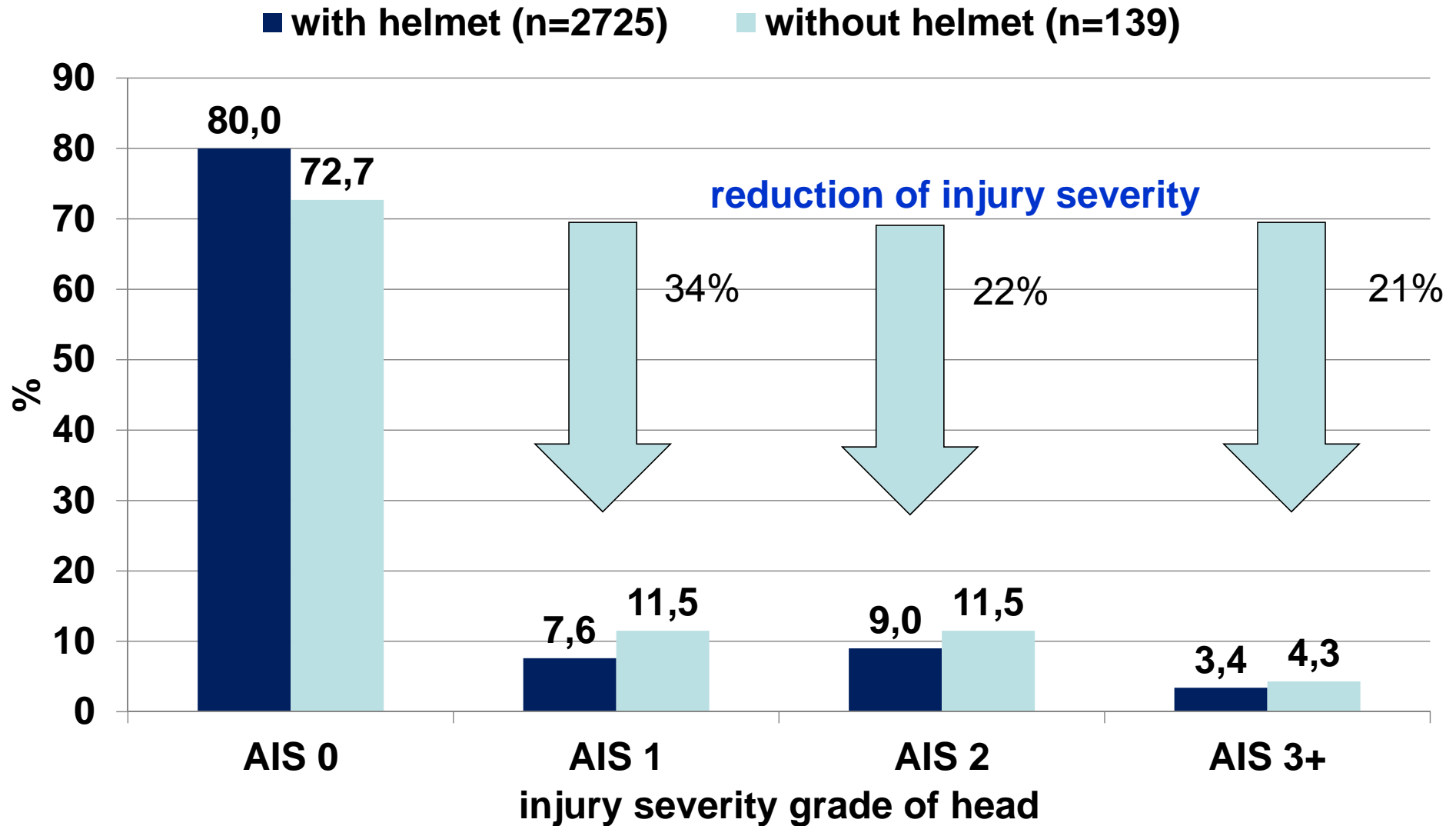
motorcycles > 125 ccm





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injury severity head with and without helmet

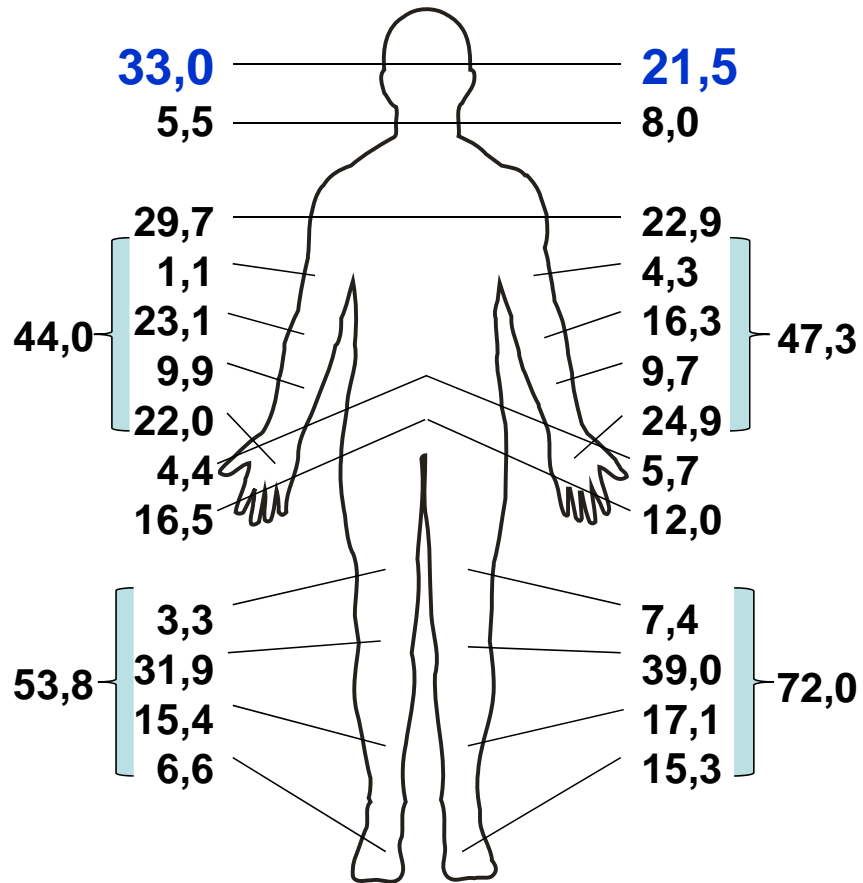




injured body regions of drivers vs. type of motorcycle

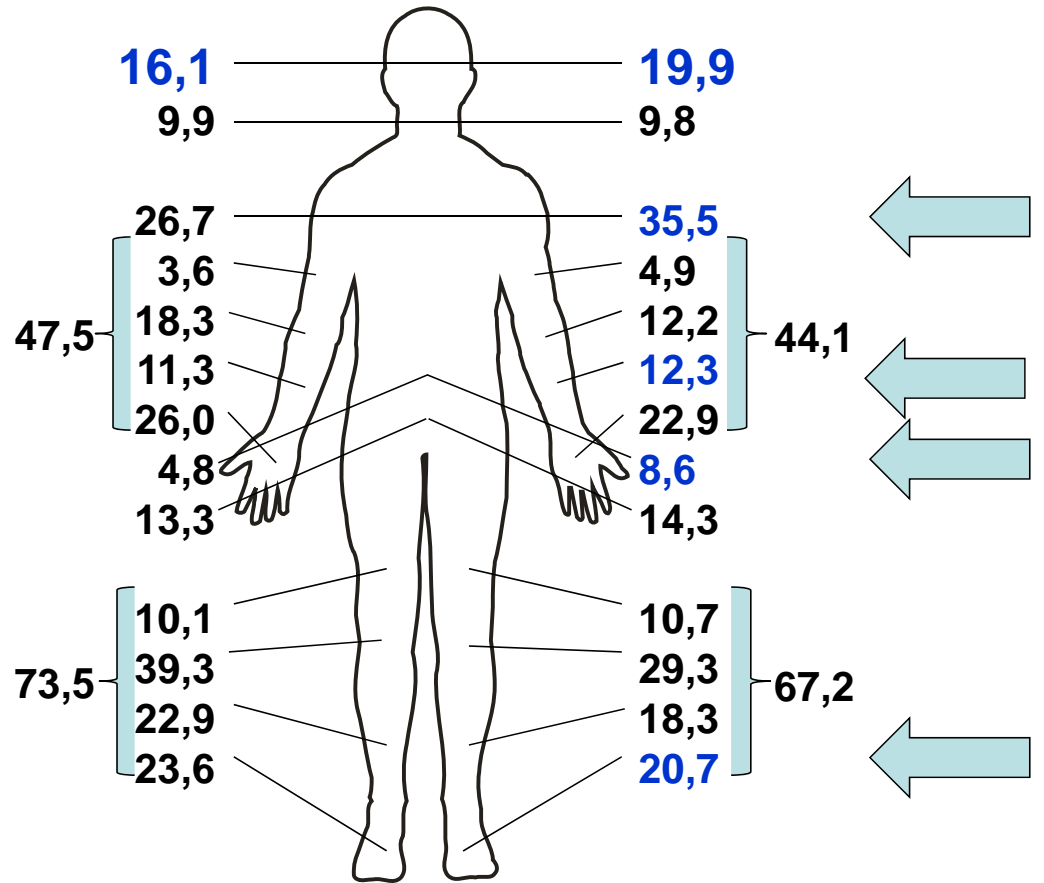
frequencies of injured body regions

frequencies of injured body regions



moped25
n=91

moped
n=943

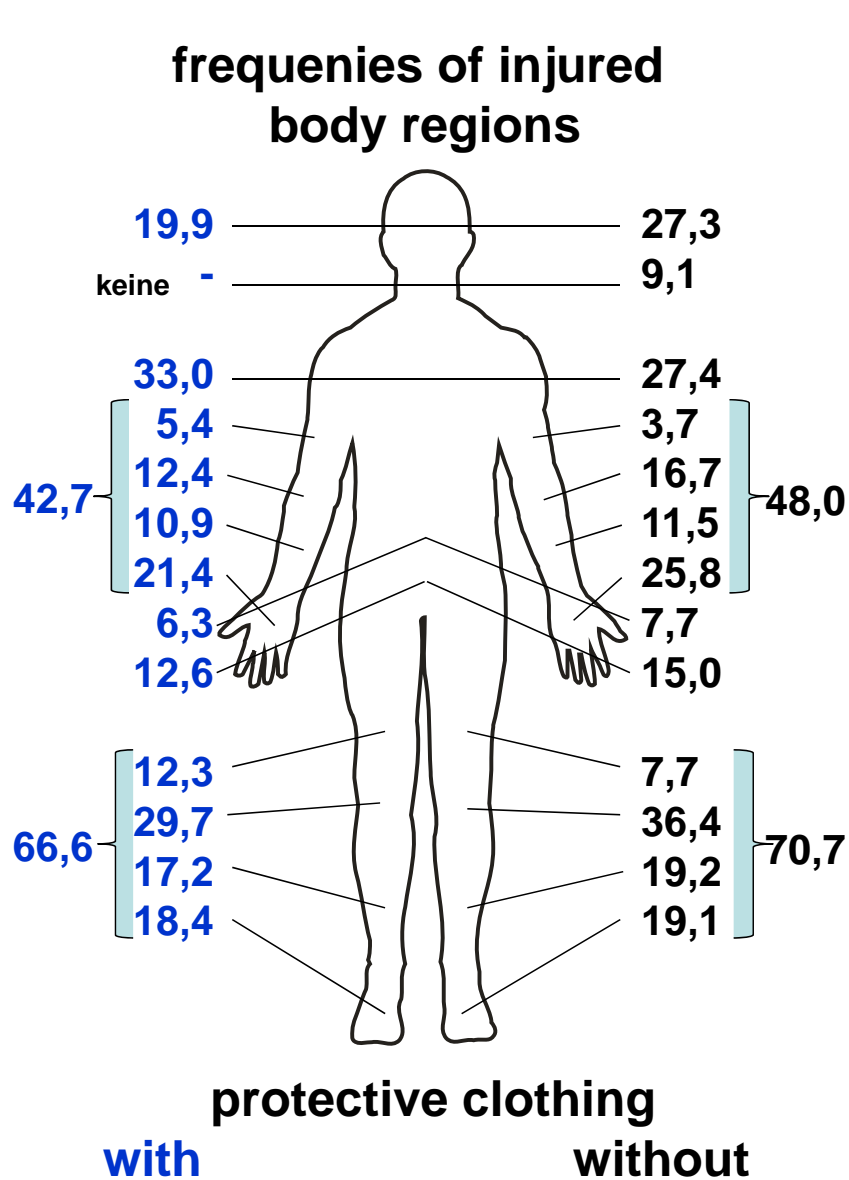


up to 125 ccm
n=415

> 125 ccm
n=1415

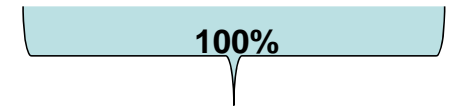
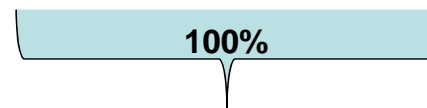


injured body regions vs. protective clothing



injured body regions only

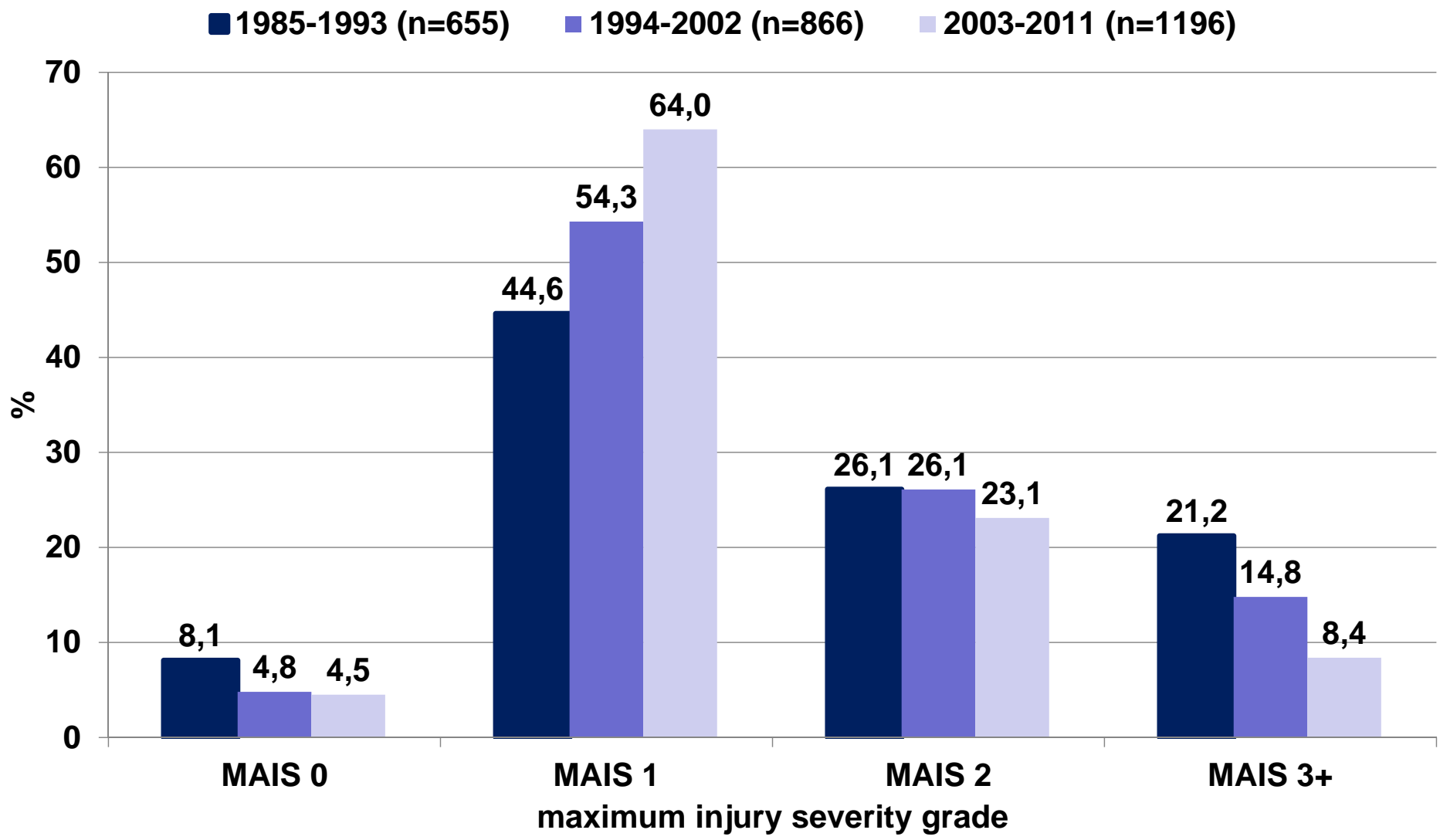
	with protective clothing			without protective clothing		
	AIS 1	AIS 2	AIS 3+	AIS 1	AIS 2	AIS 3+
head	37,6%	46,4%	16,0%	42,1%	42,1%	15,8%
neck	-	-	-	81,2%	8,8%	10,0%
thorax	58,6%	24,7%	16,7%	65,7%	22,5%	11,8%
upper extr. total	75,8%	20,9%	3,3%	81,8%	16,4%	1,8%
upper arm	47,8%	42,0%	10,1%	56,9%	43,1%	-
elbow	99,4%	0,6%	-	99,2%	0,8%	-
lower arm	42,9%	49,3%	7,9%	58,6%	34,8%	6,6%
hand,-joint	87,9%	12,1%	-	86,8%	13,0%	0,2%
abdomen	55,8%	25,0%	19,2%	67,4%	24,2%	8,4%
pelvis	75,3%	16,7%	8,0%	86,0%	11,5%	2,5%
lower extr. total	70,8%	16,8%	12,4%	78,4%	14,0%	7,6%
upper leg	41,5%	6,5%	52,0%	50,3%	4,2%	45,5%
knee	86,2%	13,4%	0,3%	90,4%	9,2%	0,4%
lower leg	59,9%	29,7%	10,4%	66,9%	22,7%	10,4%
foot, ankle joint	69,9%	27,8%	2,3%	77,9%	20,6%	1,5%





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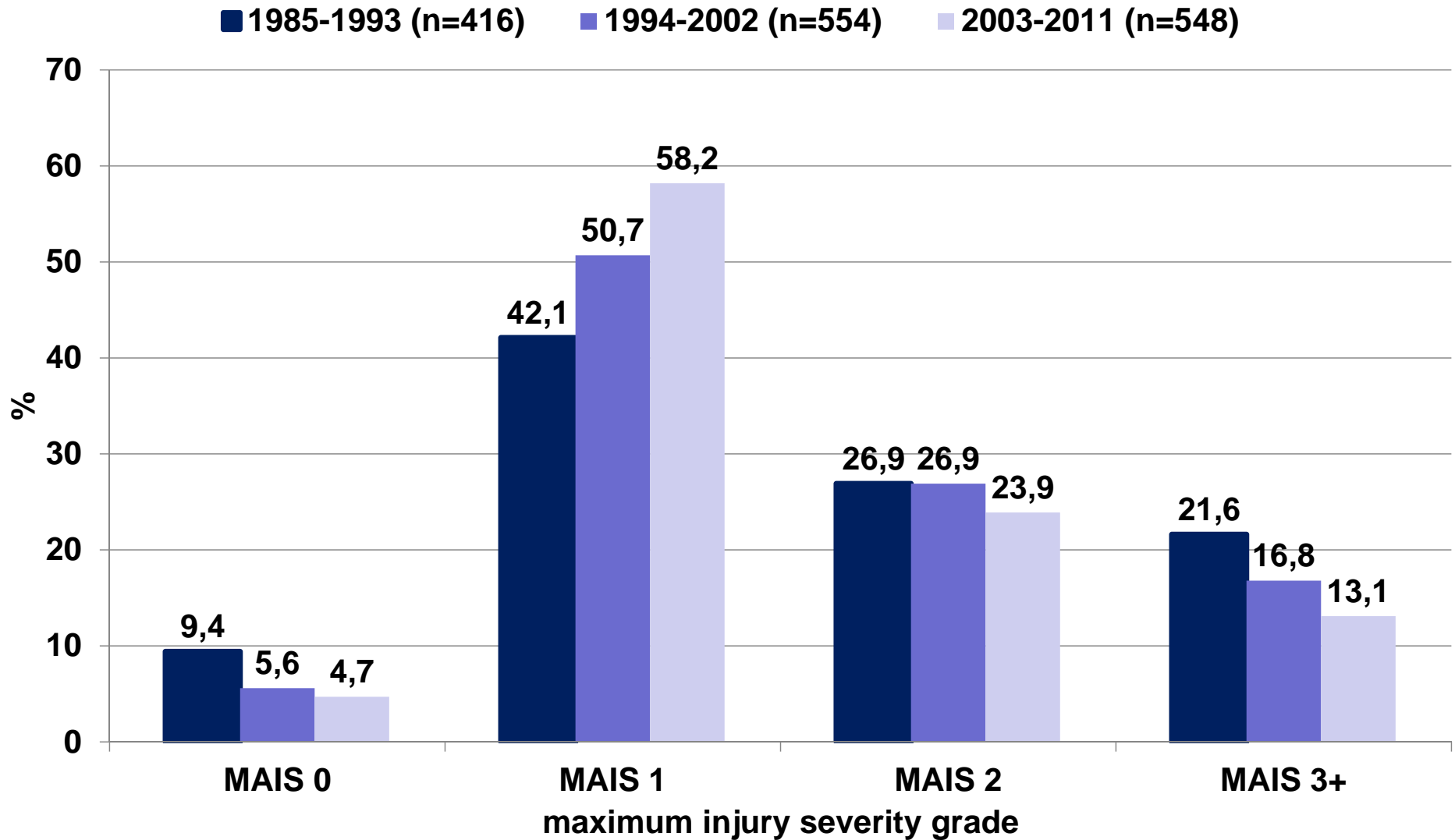
trend of injury severity grades of all motorcyclists





GIDAS German In-Depth Accident Study

injury severity grades of motorcyclists (cycle > 125 cm³)





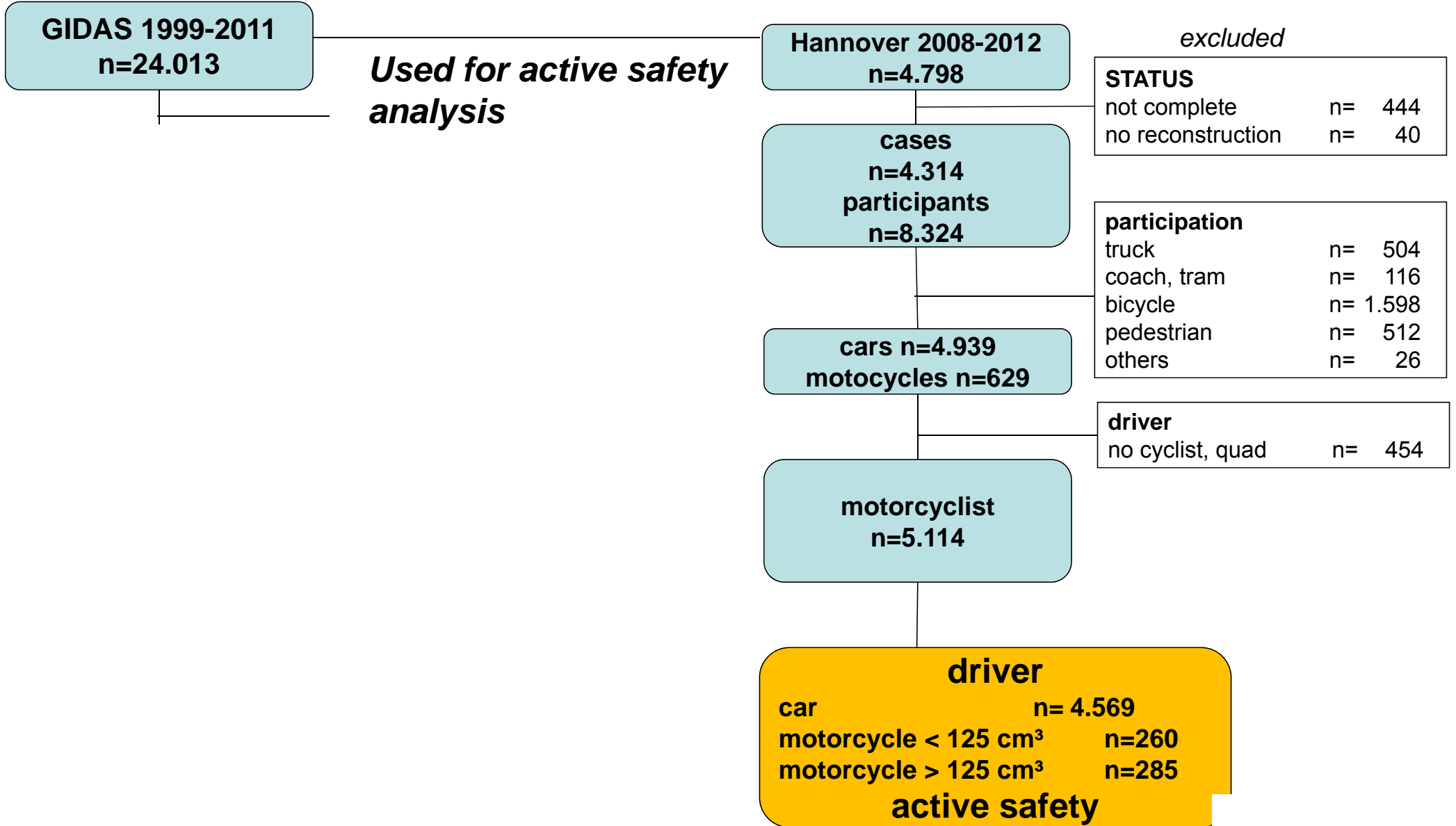
GIDAS

German In-Depth Accident Study

Passive Safety

Sample Frame

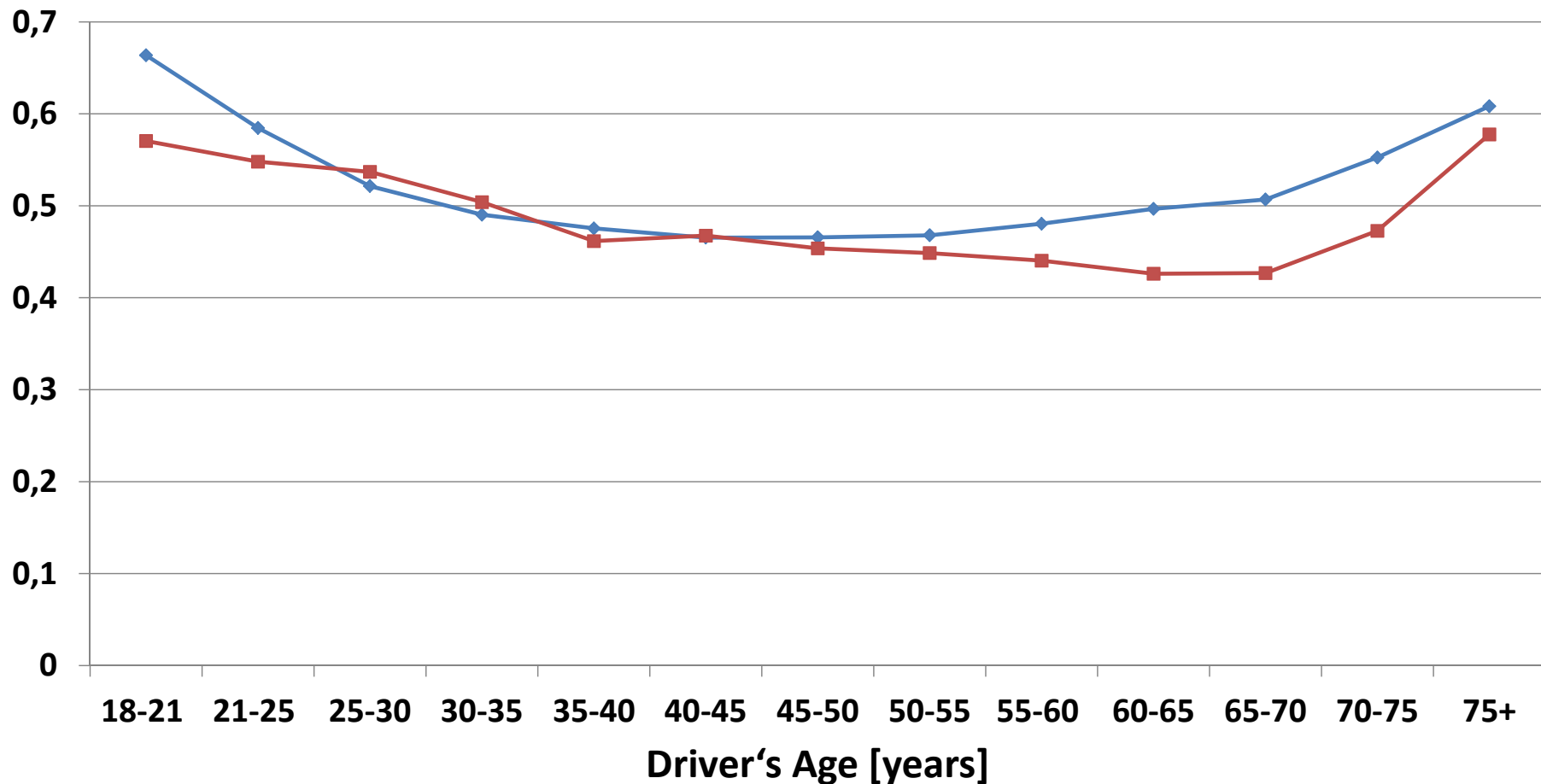
Active Safety





Quotient of „causers of accidents“ and „all accident participants“ for different types of age groups

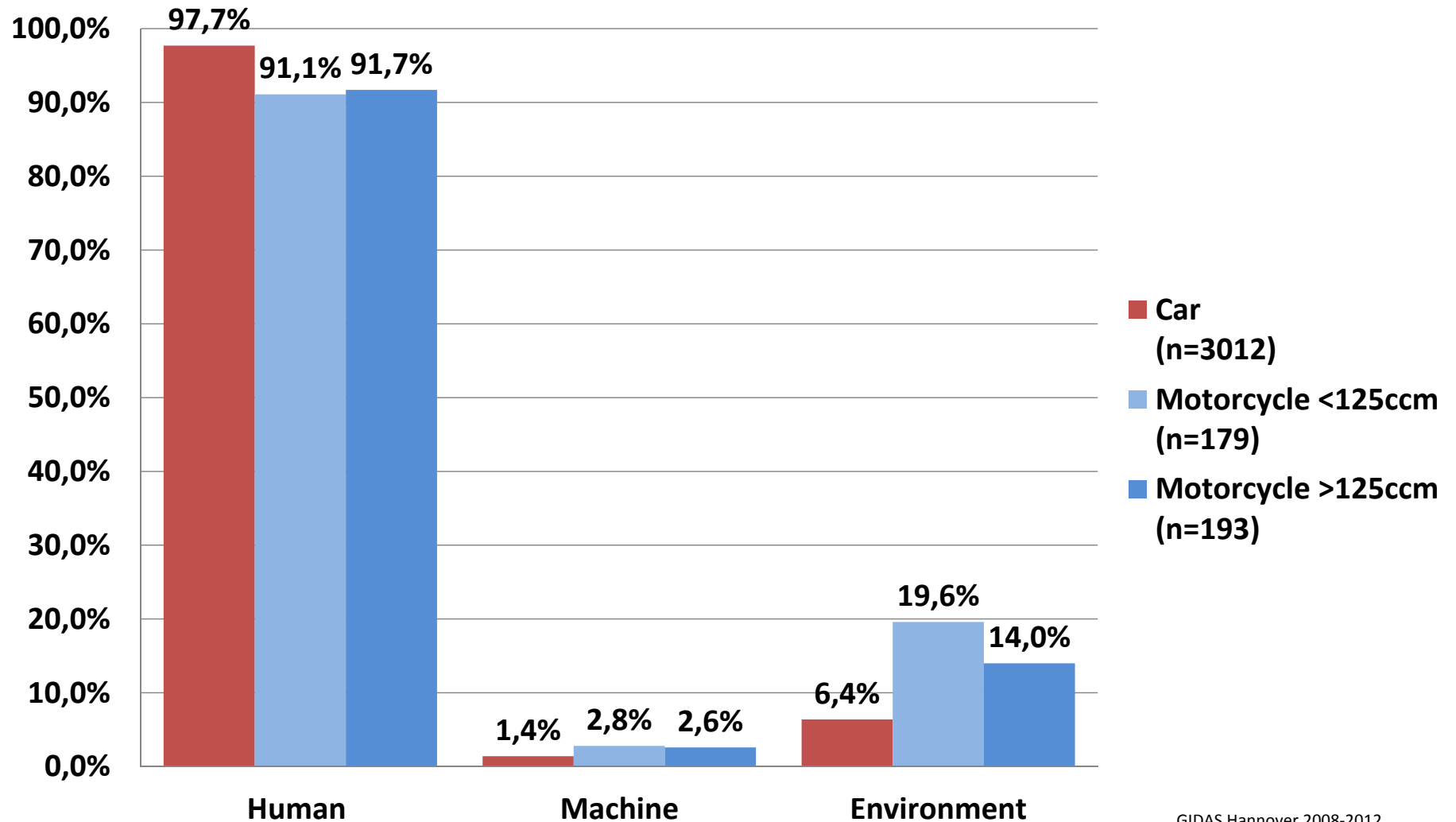
◆ All road users (n=503590) ■ Riders of powered two-wheelers (n=24039)





Distribution of accident causation groups

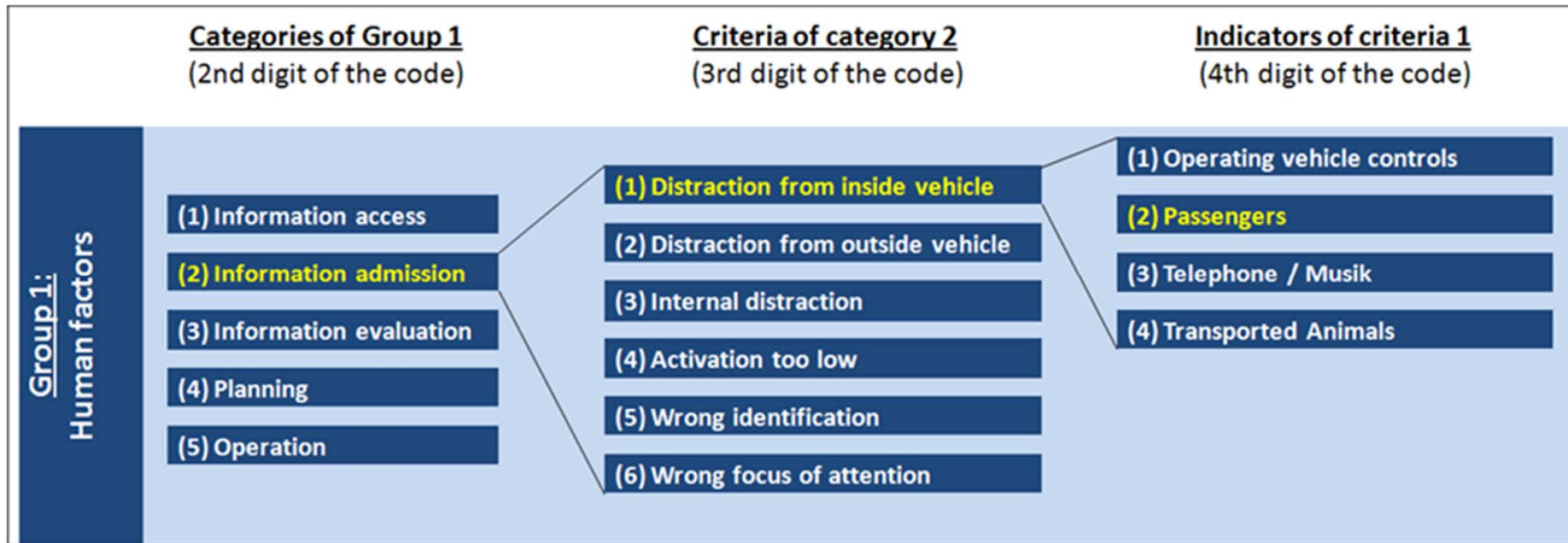
Comparing passenger cars with light and heavy motorized two-wheelers



GIDAS Hannover 2008-2012



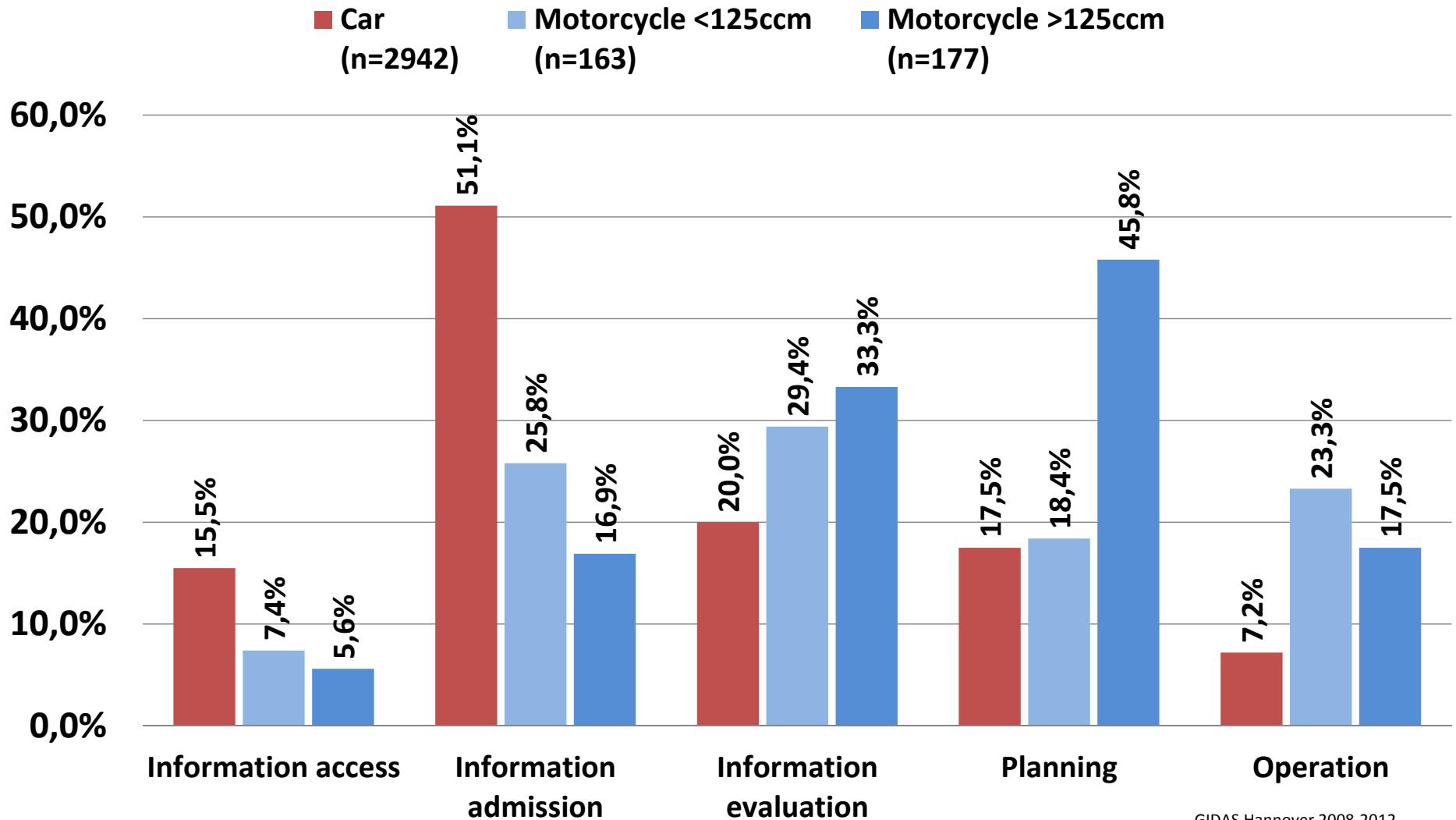
Composition of ACAS-code exemplarily for Group 1 (human factors)





Distribution of human causation categories

Comparing passenger cars with light and heavy motorized two-wheelers



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Verteilung der bewussten Regelverstöße bei mot. Zw. > 125 ccm

Beschreibung des Einflussfaktors	ACAS-Code	Häufigkeit	%-Anteil
Überhöhte Geschwindigkeit	14022	34	68%
Falsches Überholen	14023	10	20%
Falsches Abbiegen	14024	1	2%
Abstandsunterschreitung	14025	2	4%
Regelwidrige Benutzung des Verkehrsweges	14027	1	2%
Andere	14028	2	4%

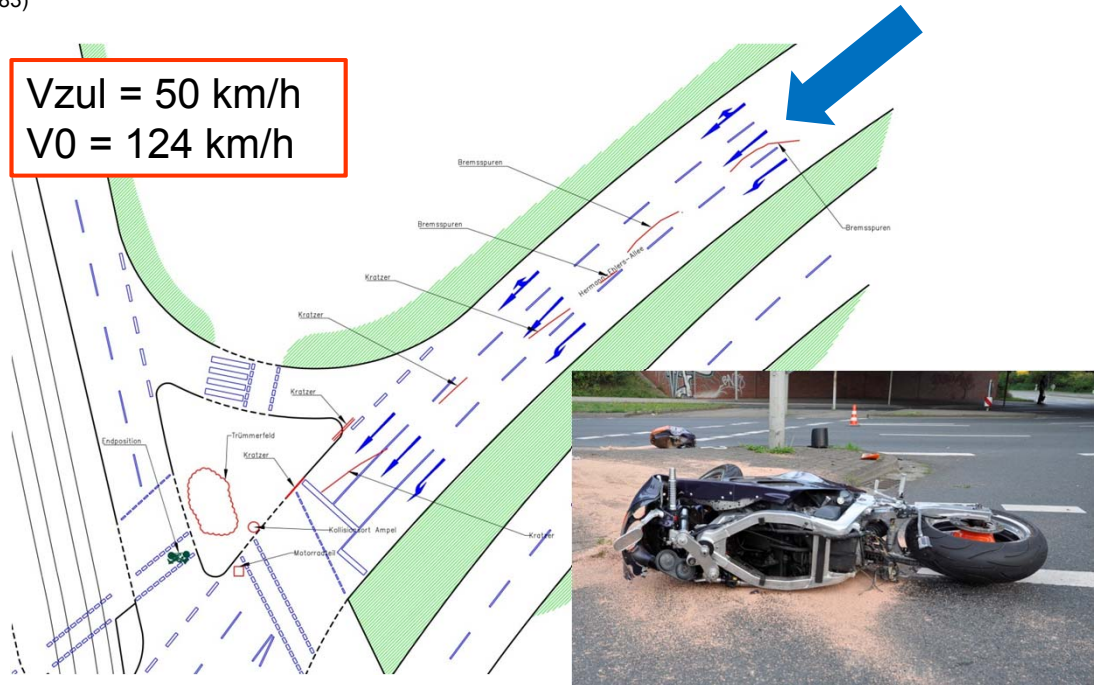


Beispiel Überhöhte Geschwindigkeit (14022) (30110683)

Motorrad: Suzuki GSX-R750

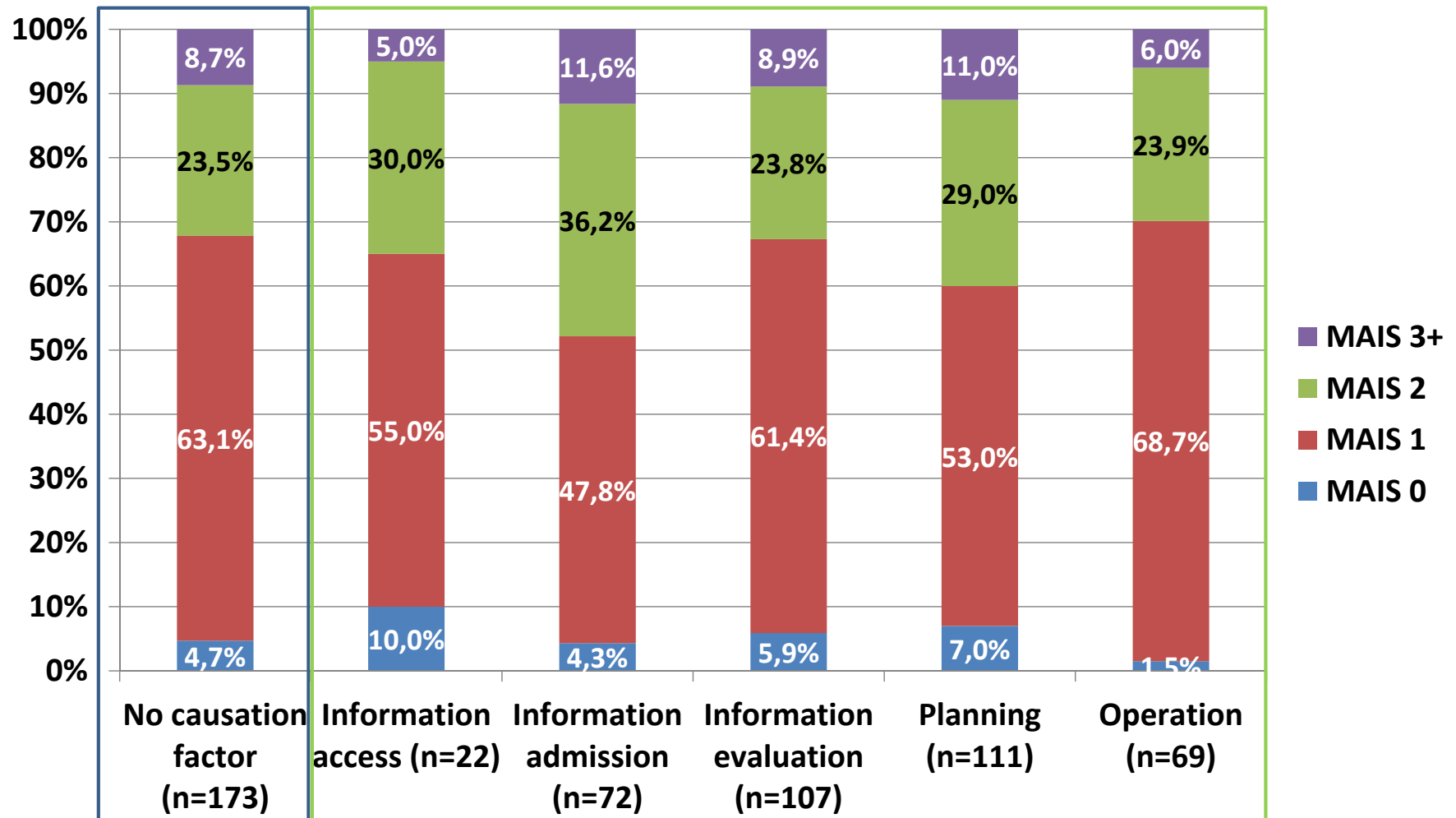
Fahrer: Männl., 29 Jahre, Schwerverletzt MAIS 3

Der Motorradfahrer befuhr die Straße "Hermann-Ehlers-Allee" mit hoher Geschwindigkeit. Er wollte bremsen, da die LZA auf Rot stand, dabei verlor er die Kontrolle über sein Krad und rutschte gegen die LZA und verletzte sich schwer



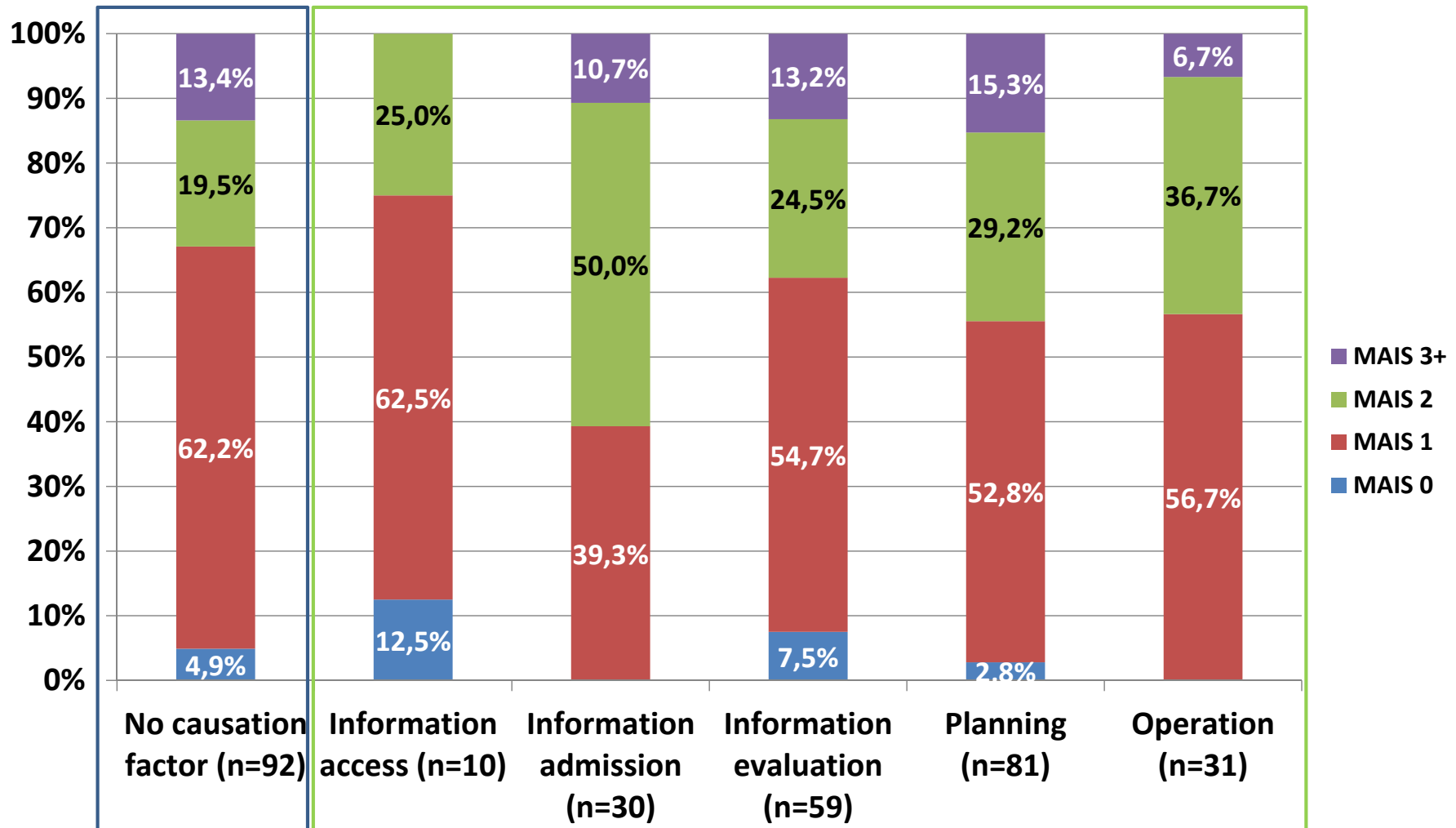


Injury severity distribution for different categories of human causation factors of PTW riders





Injury severity distribution for different categories of human causation factors for riders of motorcycles (>=125 ccm)





Conclusions

- Motorcyclists highly protected
- MAIS 1 of 60 to 65%
- Wearing helmets motorcyclists only 19.9% suffered head injuries.
- effectiveness of the helmet confirmed
- reduction of head injuries AIS 1 to minus 34% and AIS 2 to minus 22% and severe head injuries AIS 3+ to minus 21%.



Conclusions

- Severe injuries AIS 3+ are particularly often in association with a high risk of bone injuries of the cervical spine and the lower extremities.

useful solution

- usage of protective clothing with protectors
- use of padded machines
- development of special leg protectors (Otte, 2002)



- reduction of severely injured motorcyclists of nearly 50% over the time period of more than 20 years

Accidents caused by a failure of information admission (e.g. the rider misses to see a relevant road user due to a wrong focus of attention) of the rider of a PTW resulted in visibly higher shares of MAIS 2 had MAIS 3+ injuries than failures from the other categories



- failures in the Information evaluation related to a misjudgment of the behavior or speed of the own vehicle (in about 20% of the cases).
- PTW have a high incidence of accident causes from the subcategory of intentional breach of rules.
- riders of motorcycles (≥ 125 ccm) have an incidence of over 40% from the subcategory which is mostly related to excessive driving speed.
- Another source of accident causes which is specifically high with PTW (23.3% for light motorcycles, 17.5% for motorcycles but only 7.2% for cars) is the handling failures, in wrong braking or over braking



Parameter analysis

Influence on injury severity AIS

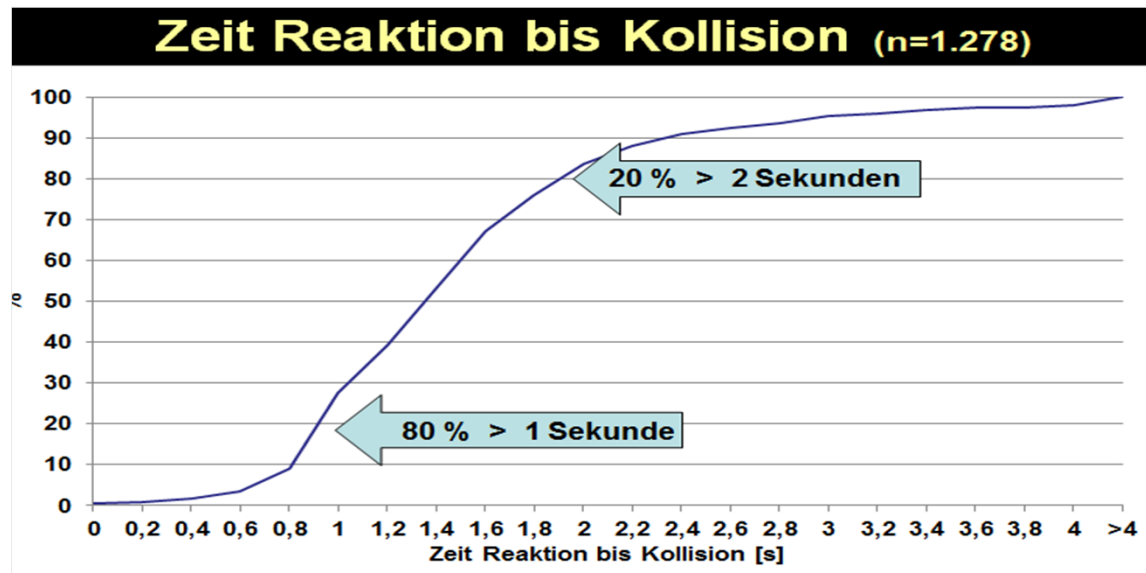
Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
Relative speed	1	50.9341	<.0001
age	1	8.8486	0.0029
Crash weight	1	3.9641	0.0465
Driving kilometer	8	7.4723	0.4866
Information access	1	4.5625	0.0327
Information adaption	1	6.2102	0.0127
Information process	1	0.0822	0.7743
Task of driving	1	0.0369	0.8477
handling	1	0.3300	0.5657
Kind of cycle	1	4.9166	0.0266



Improvements

- Speed reduction helps avoidance of accidents and reduction of injury severity!
- Earlier Information of oncoming conflict-situation helps for avoidance strategies





- ***High safety standard is given for motorcyclists***
- ***The acceptance of safety measures is not so much existing for others PTW***
- ***Helmet is shown high effectiveness, if using the integral helmet design***
- ***Protective clothes gives effectiveness against soft tissue injuries, higher using rate should be realized***





- ***motorcycle drivers should be better educated and trained***
- ***More attention for driving assistance especially for older drivers***
- ***Information on special behavior of PTW as education of other traffic participants i.e. car-truck-drivers***

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-





- ***Thank you very much
for your attention***

