MAIDS Workshop

01 April 2009

Road Safety: the Industry Strategy

- Improve the knowledge
- Safety Plan for Action: Integrated approach
  - Act on the product
  - Act on the human factor
  - Act on the infrastructure
- Cooperate with institutions and stakeholders

Motorcycle Accidents In-Depth Study

Agenda

- PRESENTATION OF THE STUDY – HIGHLIGHTS
- COMPARISON L1/L3 VEHICLES
- FOCUS ON 125cc
- MULTIVARIATE ANALYSIS ON FATAL ACCIDENTS
- MAIDS COOPERATION & FURTHER RESEARCH
- DISCUSSION

Presentation of the study – Highlights
Overview

Decision

- To provide the scientific basis for the discussion of MC accidents in Europe:
  - ACEM organised the Motorcycle Accident In-Depth Study (MAIDS);
  - Created a Consortium of partners, namely:
    - DG TREN of the European Commission, who co-financed the project.
    - Other partners: BMF, CEA, CIECA, FEMA, FIM.

bmf better biking

CEA

CIECA

FEMA Federation of European Motorcyclists Associations

FIM

Who and Where?

- For data collection
  - France — CEESAR
    Centre Européen d'Etudes de Sécurité et d'Analyse des Risques
  - Germany — MUH
    Medical University of Hanover
  - Italy — Uni Pavia
    University of Pavia
  - Netherlands — TNO
    Nederland's Organization for applied scientific research
  - Spain — REGES
    Investigación y reconstrucción de accidentes de tráfico
- For statistical analysis
  - Uni Pavia (Italy)

MAIDS Main Features

In-Depth investigation of motorcycle accidents

- OECD methodology
- Basic parameters of accidents
- In-depth data on human, vehicle and roadside factors (about 2000 variables per case)
- Data on collision dynamics
- Data on injury types and severity
- Data on accident causation

Main Features

All 921 accident cases reconstructed

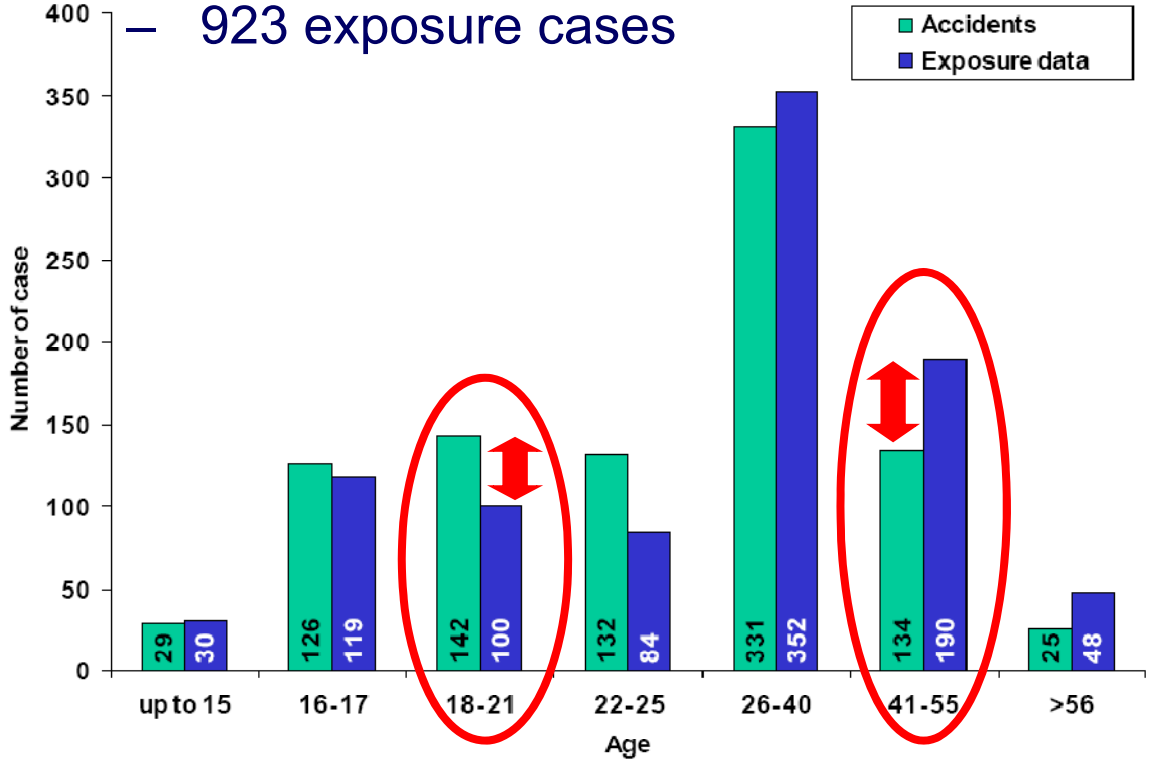
- Allowing MAIDS teams to identify

Accident Contributing Factors

- For each case
  - One single **primary** accident contributing factor
  - Four **additional** accident contributing factors
  - Attributed to
    - Human
    - Vehicle
    - Environment

Main Features

- Exposure data
  - Essential for comparison purpose and risk evaluation
  - 923 exposure cases



Presentation of the study – Highlights

Vehicle factors

Primary Accident Contributing Factors

- Vehicle factors: 0,3% of all cases

	Frequency	Percent
Vehicle	3	0.3
Total	921	100.0

Additional Accident Contributing Factors

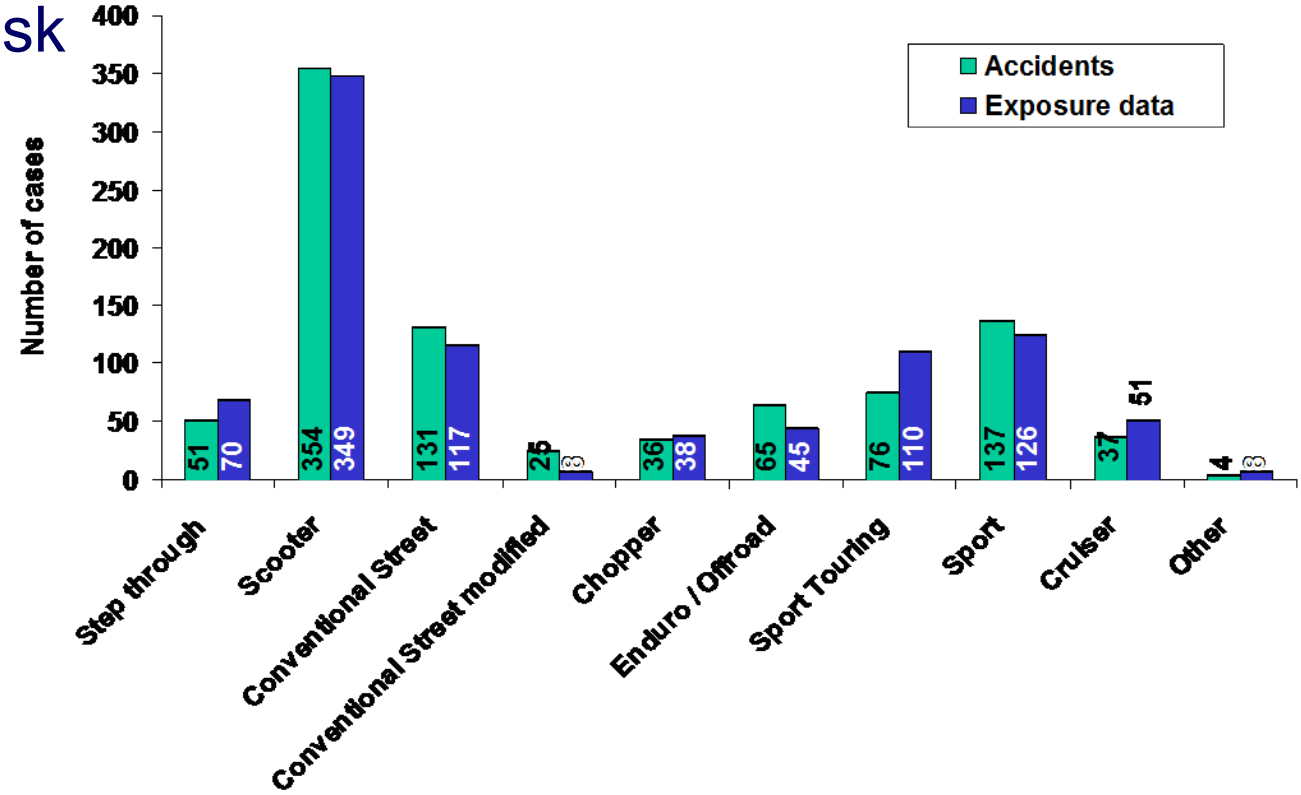
- Vehicle factors:
  - PTWs: 1,6 % of all cases
  - OVs: 0,5 %

	Frequency	Percent
PTW technical failure	32	1.6
OV technical failure	10	0.5
Total	2059	100.0

  - 5% of all contributing factors
    72% of all PTW vehicle failures were related to the tyre
    11 related to brakes problems (1.2%)

PTW Style

- Frequency
  - Scooters: 38 %
  - Conventional street: 14 %
- No associated risk



PTW Engine Displacement

- Frequency
  - 50 cc: 43 %
  - 501 - 750 cc: 22 % of all cases
- No associated risk
- Except for the over 1001 cc category under-represented

Engine displacement

	Accident data		Exposure data	
	Frequency	Percent	Frequency	Percent
up to 50 cc	394	42.7	367	39.8
51 to 125 cc	89	9.7	86	9.3
126 to 250 cc	37	4.0	32	3.5
251 to 500 cc	56	6.1	50	5.4
501 to 750 cc	206	22.4	193	20.9
751 to 1000 cc	80	8.7	107	11.6
1001 or more	58	6.3	88	9.5
Unknown	1	0.1	0.0	0.0
Total	921	100.0	923	100.0

Braking Systems

- Few cases with Advanced Braking Systems (not statistically significant)
- Exposure data biased

	Accident data		Exposure data	
	Frequency	Percent	Frequency	Percent
No ABS, CBS	893	97.0	869	94.2
CBS only, no ABS	20	2.2	26	2.8
ABS	4	0.4	22	2.4
ABS and CBS	2	0.2	5	0.5
Unknown	2	0.2	1	0.1
Total	921	100.0	923	100.0

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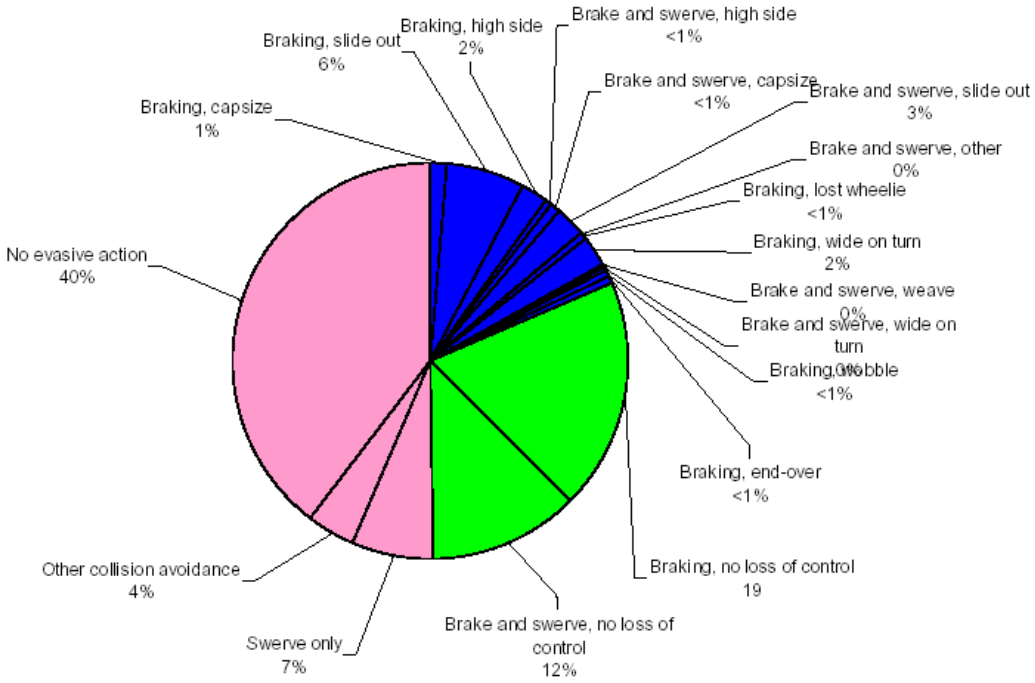
The nature of motorcycle accidents



•ABS effectiveness is limited by the relatively large number of accidents (i.e., 80 to 87%) in which there is no braking, sub-limit braking, or swerve-and-brake, for which ABS will not have an effect

Presentation of the study – Highlights

Environment factors

Primary accident causation factor

- Environmental factors: 8 %

	Frequency	Percent
Environmental	71	7.7
Total	921	100.0

  - Weather 2 %
  - Road maintenance defect 2 %
  - Road design defect 1 %
  - Traffic hazard 1 %

Additional Accident Contributing Factors

- From the road environment: 15%

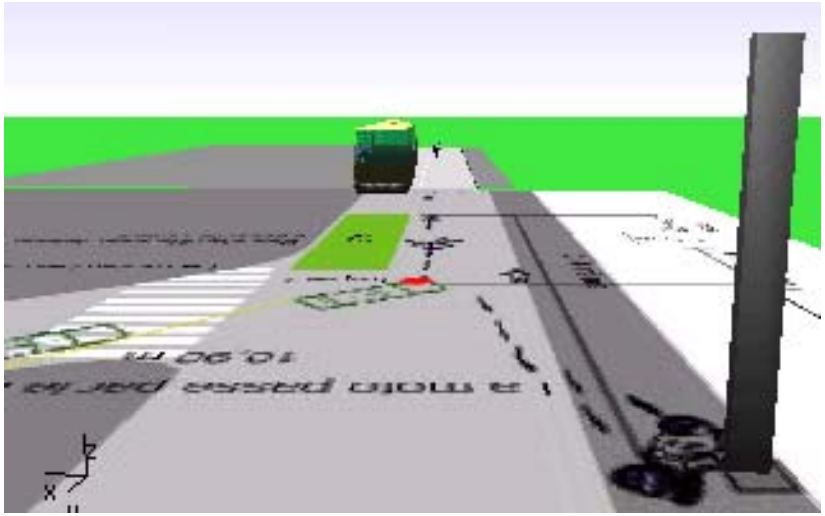
	Frequency	Percent
Environmental cause	300	14.6
Total	2059	100.0

  - Weather 5 %
  - Road Maintenance defect 1 %
  - Road design defect 2 %
  - Traffic hazard 2 %

Worsening Factors

- Roadway and fixed objects: second collision partner with 17 % of MAIDS cases
  - L1 = 9 %
  - L3 = 23 %

Fixed object	74	8.0
Roadway	83	9.0



Presentation of the study – Highlights

Human factors

Primary Accident Contributing Factors

- Human factors: 88 % of all cases

	Frequency	%
Human-PTW rider failure	344	37,4
Human-OV driver failure	465	50,5
Total	809	87,9

- OV drivers: largely responsible for PTW crashes
  - 50 % of all MAIDS cases (L1 = L3)
  - 61 % of the multi-vehicle accidents
- PTW riders: responsible of 37 % of PTW crashes
  - L1 = 39 %
  - L3 = 36 %

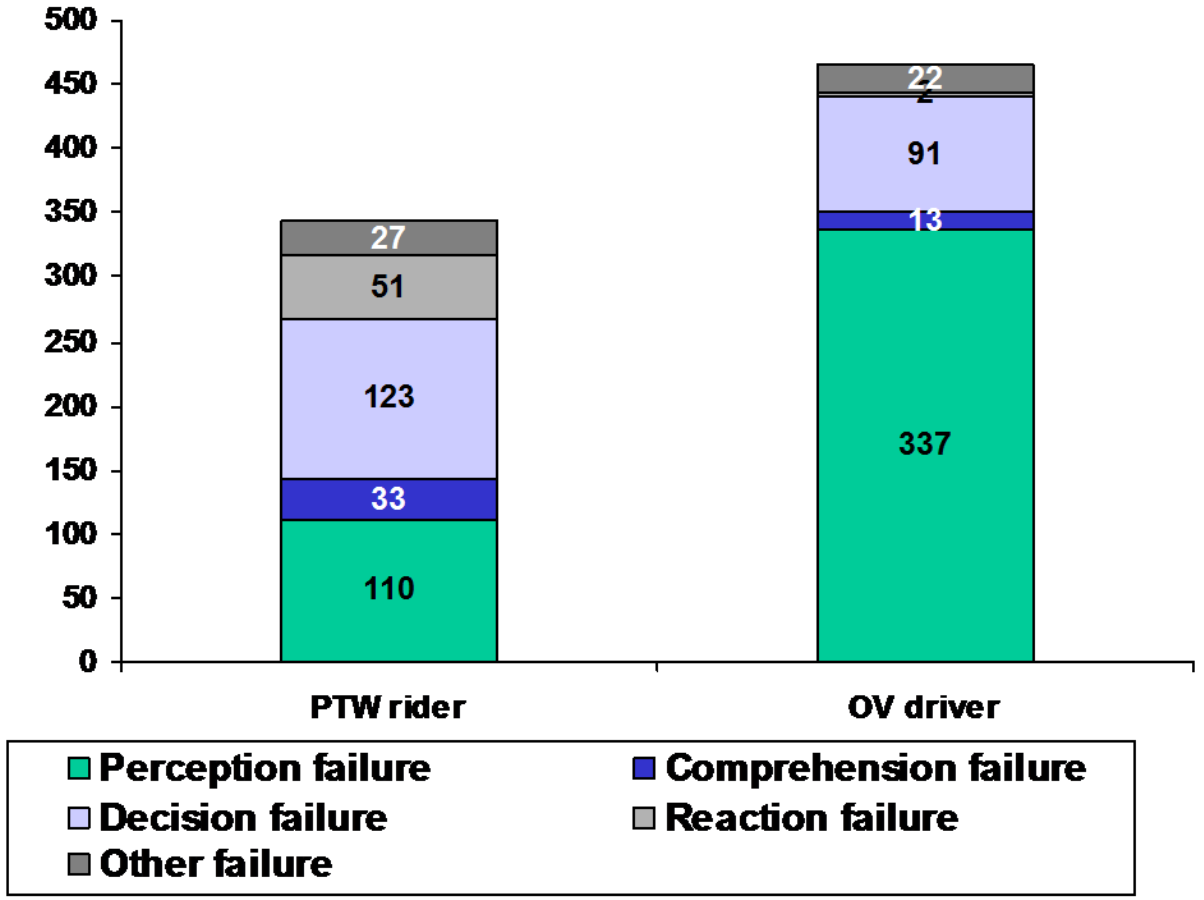
Primary Accident Contributing Factors
Fatal Cases

- Human factors: 86 % of all cases

	Frequency	%
Human-PTW rider failure	54	52,4
Human-OV driver failure	34	33,3
Total	88	85,7

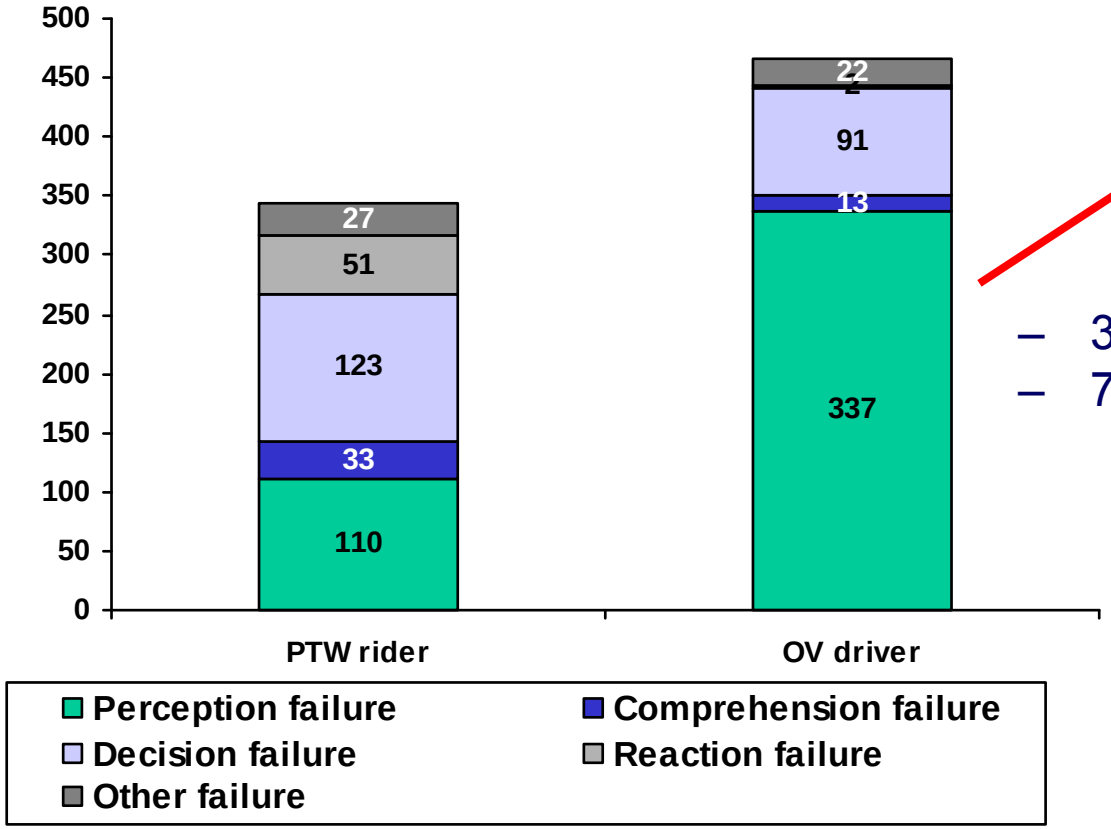
- PTW riders: largely responsible for PTW fatal accidents
  - 52 % of MAIDS fatal cases
- OV drivers: responsible of
  - 33 % of all MAIDS fatal cases
  - 44 % of the multi-vehicle fatal accidents

Primary Accident Contributing Factors



Primary Accident Contributing Factors

- The most frequent : perception failure by the OV drivers



Perception

- 37% of all MAIDS cases
- 72 % of the drivers' failures
  - L1 = 77%
  - L3 = 69%

Primary Accident Contributing Factors

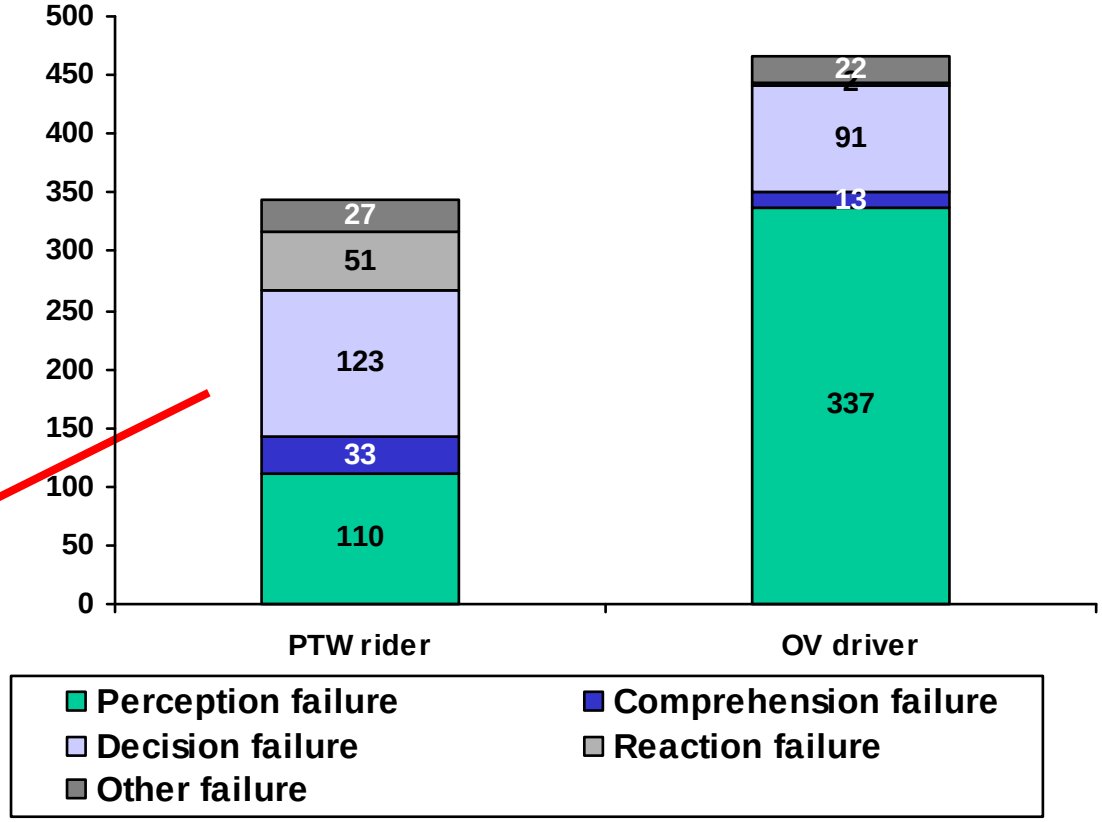
- The second most frequent attributable to PTW riders

– Decision failure

13% of all MAIDS cases
35 % of riders' failures

➢ L1 = L3

Decision



Primary Accident Contributing Factors

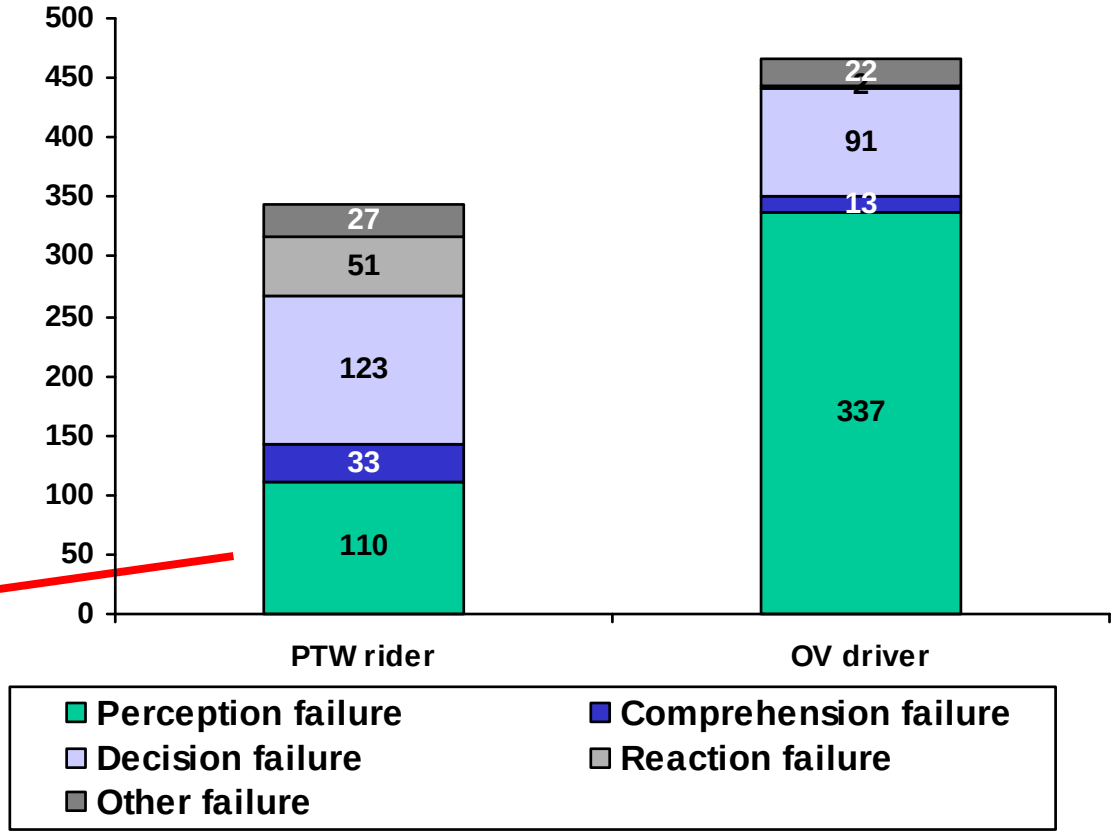
- The third most frequent attributable to PTW riders

– Perception failure

12% of all MAIDS cases
32 % of riders' failures

- L1 = 17 %
- L3 = 8 %

Perception



Additional Accident Contributing Factors

- Human factors: 72% of all cases

	Frequency	Percent
PTW rider	900	43.7
OV driver	589	28.6
Total	2059	100.0

- PTW riders: major contributors to crashes
  - 44% of all additional contributing factors
    - L1 = 47 %
    - L3 = 31 %

What does MAIDS tell us?

- Human factors are predominant in accident causations
  - Perception failures from OV drivers
  - Decision and perception failures from PTW riders
  - Additional accident contributing factors from PTW riders
- Environmental factors
  - Are more worsening than contributing factors (excluding weather conditions)
  - An entry point to engage with national/local authorities in PTW integration
  - Can potentially help riders and drivers (better decision, better perception)
- Vehicles factors
  - Marginal accident causation
  - More significant in accident contribution
  - Linked to maintenance defect

Comparison L1/L3 vehicles
General accident characteristics

MAIDS Main Figures

In-Depth investigation of motorcycle accidents

- Distribution of cases according to category
  - L1 mofas = 28
  - L1 mopeds = 370
  - L1 total = 398 L3 motorcycles = 523

Main Figures

- Distribution of cases and controls according to category

Table 3.3: PTW legal category

	Accident data		Exposure data	
	Frequency	Percent	Frequency	Percent
L1 vehicle - mofa	28	3.0	49	5.3
L1 vehicle - other	370	40.2	324	35.1
L3 vehicle	523	56.8	550	59.6
Total	921	100.0	923	100.0

  - L1 = 40 %, over-represented (moped only)
  - L3 = 57 %, no over-representation

Main Figures

- Distribution of fatal and non-fatal cases

Table 3.2: Number of fatal cases

	Fatal	Not fatal	Total
University of Pavia (Italy)	11	189	200
TNO (Netherlands)	15	185	200
REGES (Spain)	12	109	121
ARU-MUH (Germany)	49	201	250
CEESAR (France)	16	134	150
Total	103	818	921

  - Fatal 11 %
    - L1 = 24 %, under-represented
    - L3 = 76 %, over-represented
  - Non-fatal 89 %

Main Figures

- L1/L3 accident characteristics
  - L1
    - Multivehicle 91%
    - Urban 86%
    - Intersection 62%
  - L3: effect of single accidents in rural areas (20% of L3)
    - Less multivehicle 79%
    - Less urban 62%
    - Less intersection 48%

Rationale for Action

1 - Primary Accident Contributing Factors

- PTW riders: responsible of 37 % of PTW crashes

	Frequency	%
Human-PTW rider failure	344	37,4
Human-OV driver failure	465	50,5
Total	809	87,9

- No significant difference in proportion of failures but
  - L1 = 39 % riders failed more in perceiving the hazard
  - L3 = 36 %, riders tended to make more decision failures (including speeding as contributor to the accident)

2 - Additional Accident Contributing Factors

- Human factors: 72% of all cases

	Frequency	Percent
PTW rider	900	43.7
OV driver	589	28.6
Total	2059	100.0

- PTW riders: major contributors to crashes
  - 44% of all additional contributing factors
    - L1 = perception and reaction failures
    - L3 = reaction and decision failures

3 - Alcohol and Drug

- Alcohol and drug use by the PTW rider: 5% of all cases
- Over-represented
  - L1 = 3 % (7 % of L1)
  - L3 = 2 % (3 % of L3)
  - OV= 3 %

Table 7.9: Alcohol/ drug use by PTW rider

	Accident data		Exposure data	
	Frequency	Percent	Frequency	Percent
None	853	92.6	902	97.8
Alcohol	36	3.9	14	1.5
Drug	5	0.5	2	0.2
Alcohol+drug	2	0.2	2	0.2
Unknown	25	2.7	3	0.3
Total	921	100.0	923	100.0

Note: drug use is defined as the use of illegal, non-prescription drugs (e.g., cocaine).

4 - PTW Rider Licence

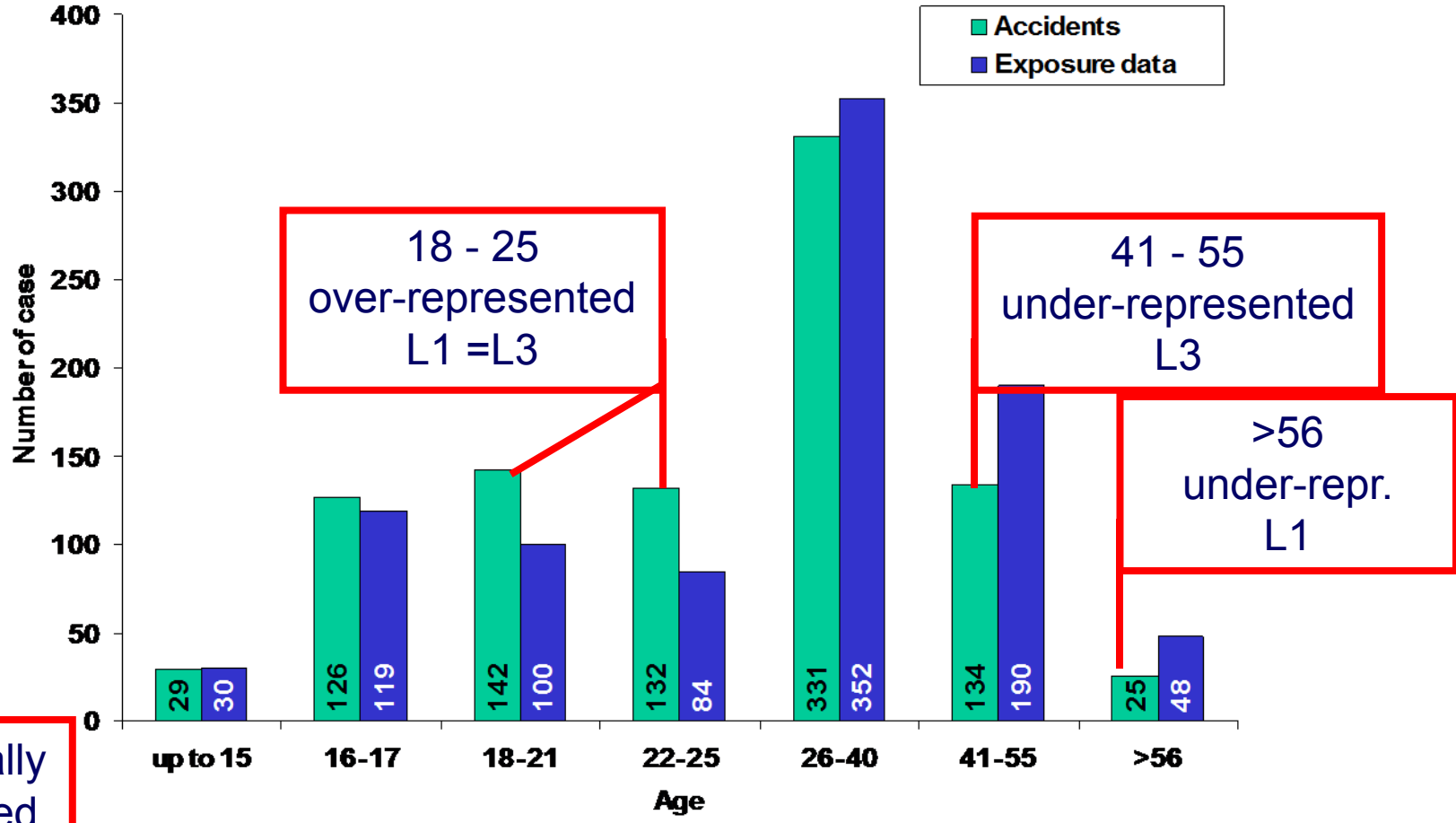
- 5 % without licence (required)!
  - L1 = 11 %
  - L3 = 1 %
- 13% with a licence, but for vehicles other than a PTW (equivalence)
- 11 % licence was not required to operate the vehicle (mopeds)

Riders without licence are over-represented

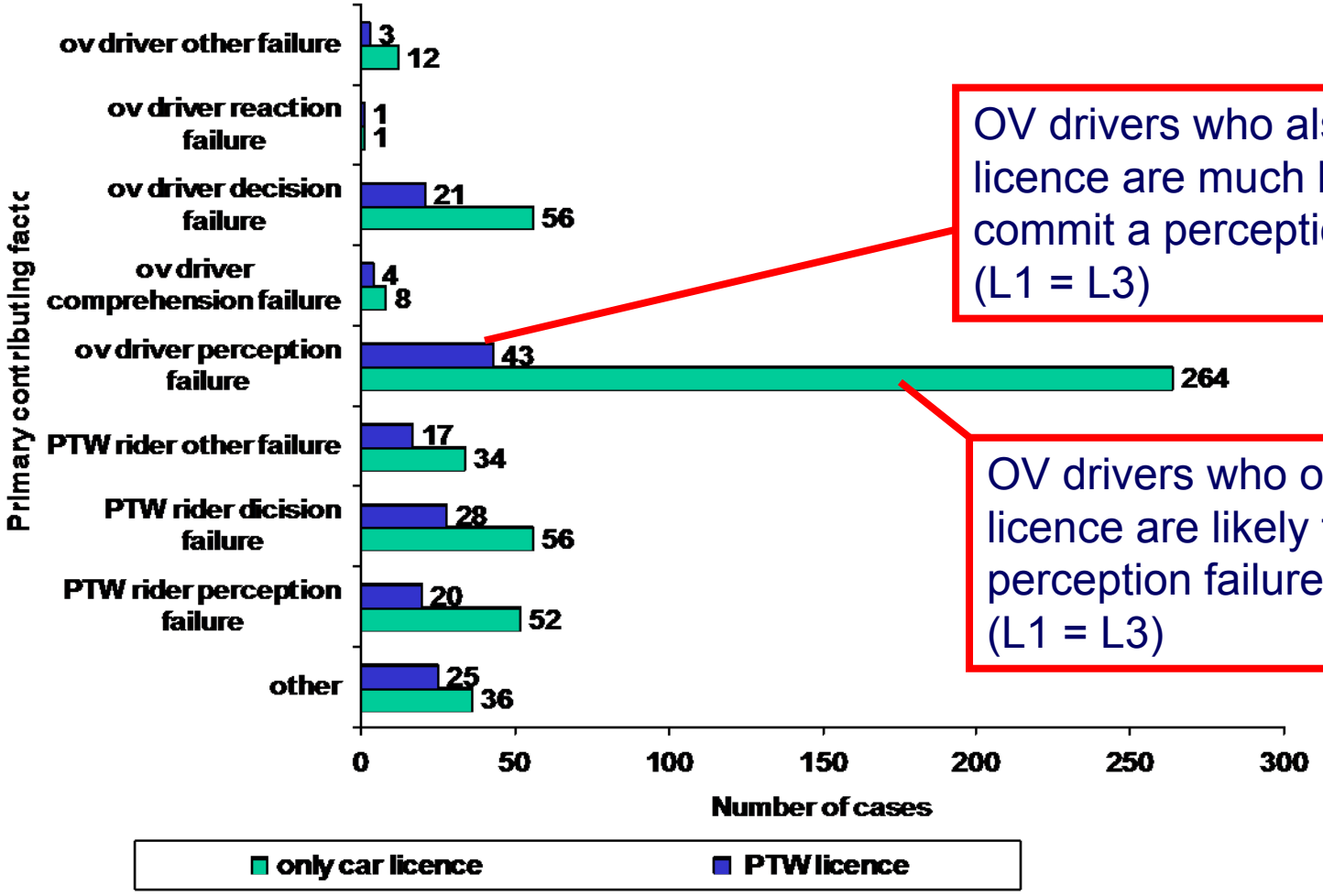
PTW licence qualification

	Accident data		Exposure data	
	Frequency	Percent	Frequency	Percent
None, but licence was required	47	5.1	13	1.4
Learner's permit only	4	0.4	1	0.1
PTW licence	608	66.0	697	75.6
Only licence for OVs other than PTW	125	13.6	125	13.5
Not required	104	11.3	86	9.3
Unknown	33	3.6	1	0.1
Total	921	100.0	923	100.0

5 & 6 - Rider Age


Accidents
Exposure data
Number of case
400
350
300
250
200
150
100
50
0
29
30
126
119
142
100
132
84
331
352
134
190
25
48
up to 15
16-17
18-21
22-25
26-40
41-55
>56
Age
18 - 25
over-represented
L1 =L3
41 - 55
under-represented
L3
>56
under-repr.
L1
< 17 equally
represented
L1

8 - Other Vehicle Licence

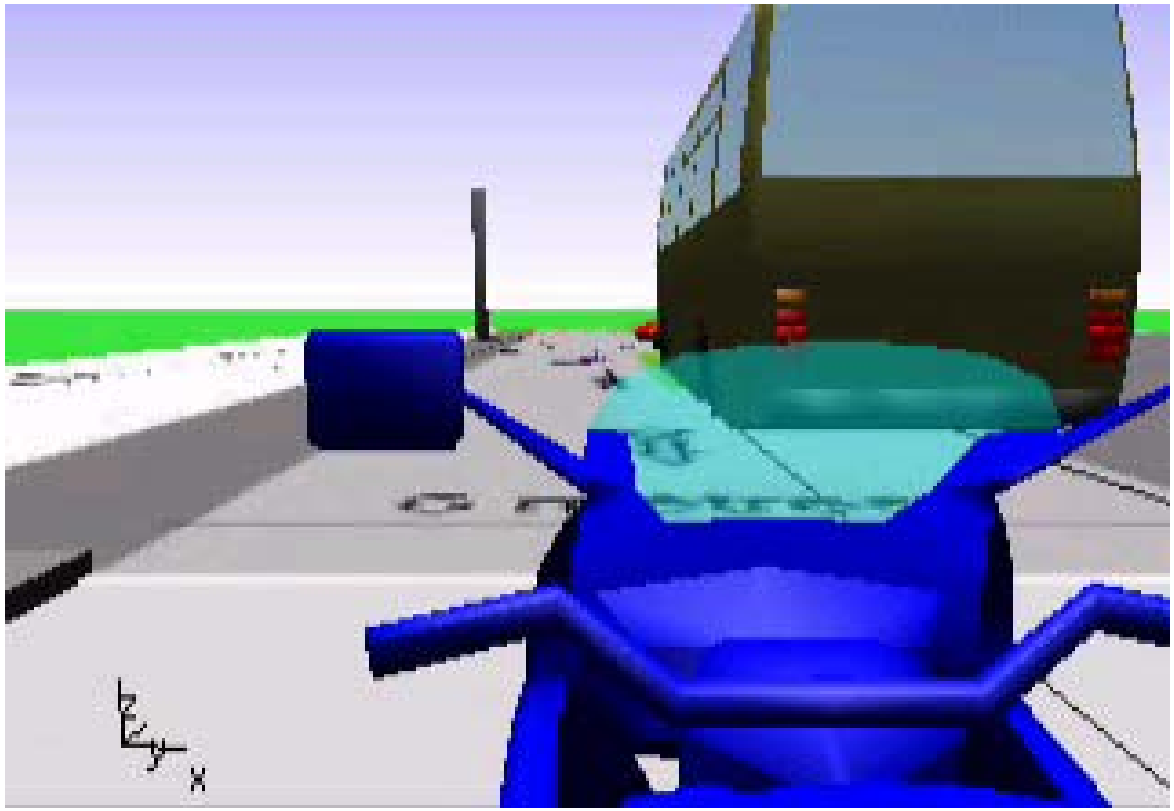


OV drivers who also have a PTW licence are much less likely to commit a perception failure (L1 = L3)

OV drivers who only have a car licence are likely to commit a perception failure (L1 = L3)

9 – Neglect Visual Obstruction

- Present in about 1/3 of accidents
  - L1 = 35 %
  - L3 = 24 %
  - OV=16 %



10 - Traffic Control Violation

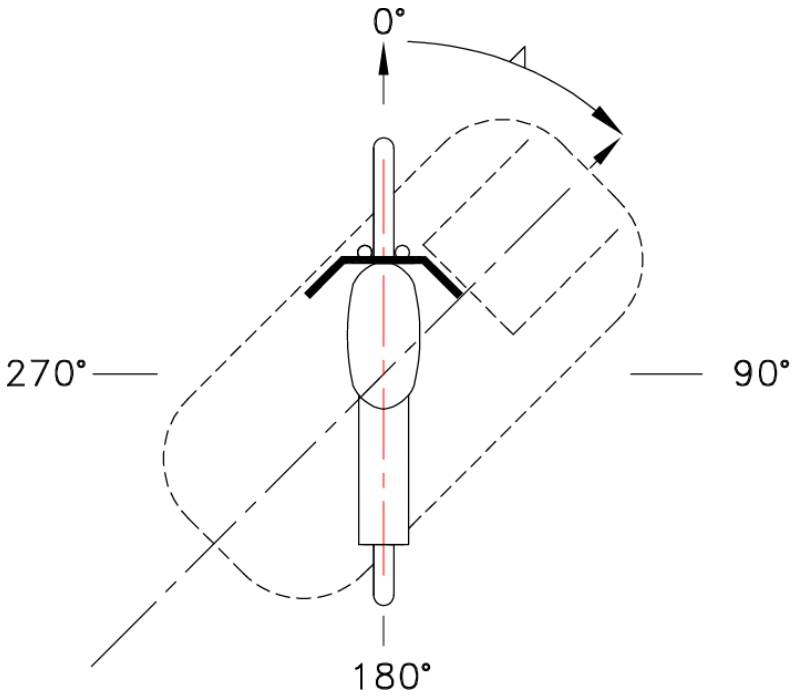
- PTW riders: 24 % of cases when traffic control present
  - L1 = 15 %
  - L3 = 9 %

Traffic control violated by PTW rider	Frequency	Percent
No	235	25.6
Yes	73	7.9
Unknown if traffic control was present or if traffic control was violated	17	1.8
Not applicable, no traffic control present	596	64.7
Total	921	100.0

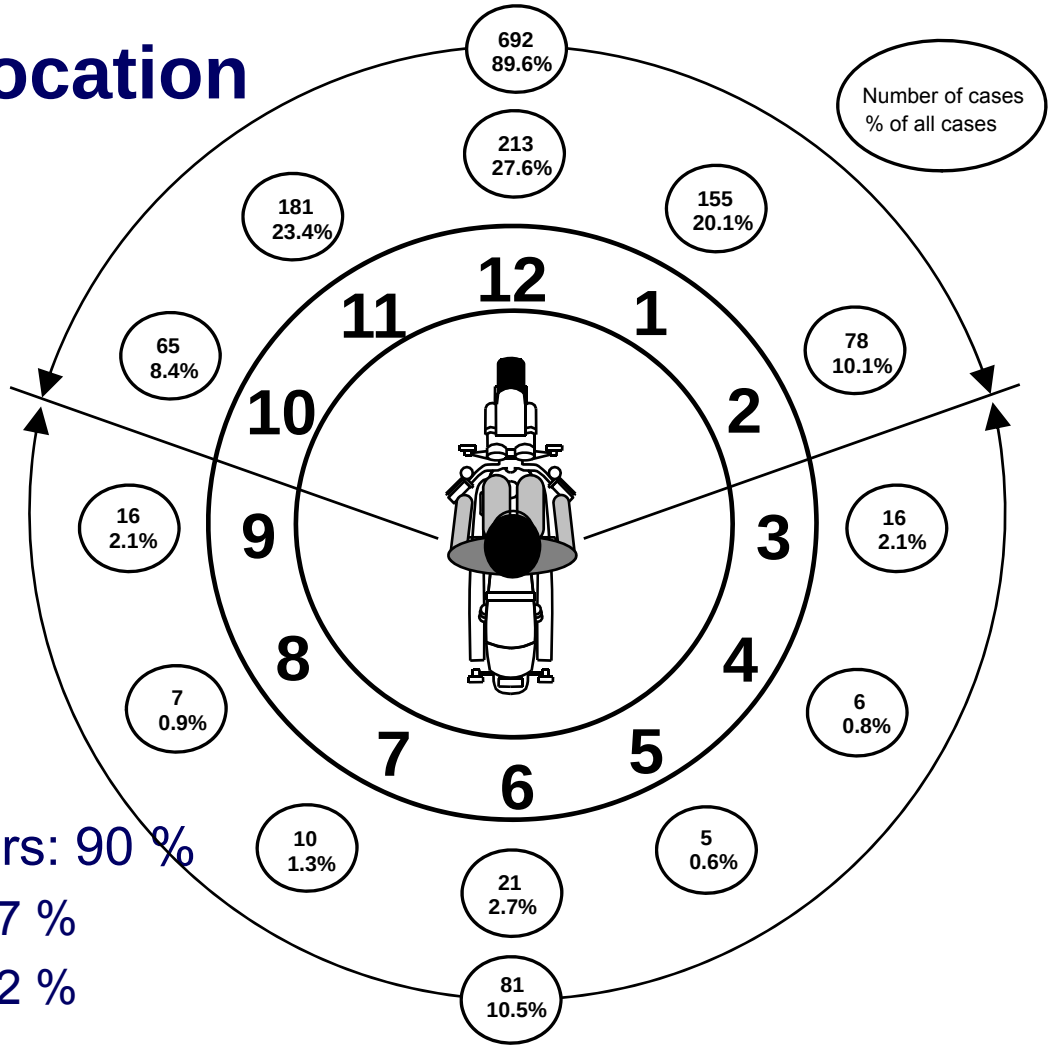
- OV drivers: 41 % of cases when traffic control was present

11 – Accident configurations

- Wide diversity, no specific accident configurations
  - L1 = L3



12 – Risk location

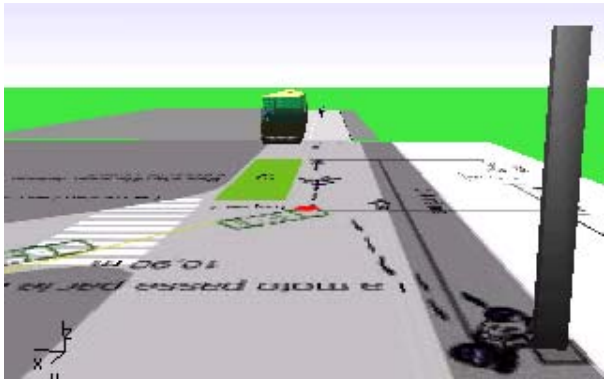


- In front of riders: 90 %
  - L1 = 87 %
  - L3 = 92 %

14 - Collision partners

- OV first collision partner
  - L1 = 85 %
  - L3 = 71 %

- Roadway and fixed objects: second collision partner with 17 % of MAIDS cases
  - L1 = 9 %
  - L3 = 23 %



15 - Tampering

- L1 only (visual inspection)
  - Accident cases = 18 % > Over-represented
  - Exposure cases = 12 %

- Other indication
  - 40% L1 fatal accidents occur at travel speeds greater than 50 km/h

18 - PTW Impact speed

- 75 % of PTW crashes occurred at speeds below 50 km/h
  - L1 = 95 %
  - L3 = 62 %
- Only 5.4% of impacts were at speeds of 100 km/h or higher
  - L3 = 9 %

PTW impact speed (all accidents)

	Frequency	Percent
0 km/h	14	1.5
10 km/h	44	4.8
20 km/h	124	13.4
30 km/h	194	21.1
40 km/h	185	20.1
50 km/h	128	13.9
60 km/h	70	7.6
70 km/h	45	4.9
80 km/h	40	4.3
90 km/h	25	2.7
100 km/h or higher	50	5.4
Unknown	2	0.2
Total	921	100.0

19 - Unusual Travelling Speed

- PTW 18 %
  - L1 = 14 %
  - L3 = 21 %
- OV 5 %

Speed compared to surrounding traffic (PTW)

	L1 vehicles		L3 vehicles		Total	
	Frequency	Percent of L1	Frequency	Percent of L3	Frequency	Percent
Speed unusual but no contribution	35	8.8	39	7.5	74	8.1
Speed difference contributed to accident	57	14.3	109	20.8	166	18.0
No unusual speed or no other traffic (not applicable)	305	76.6	375	71.7	680	73.8
Unknown	1	0.3	0	0.0	1	0.1
Total	398	100.0	523	100.0	921	100.0

20 - Collision avoidance manoeuvre

- 62% of all PTW riders attempted some form of collision avoidance
- 31% experienced some type of loss of control during the manoeuvre
  - L1 = 52 % attempted, 16% lost control
  - L3 = 70 % attempted, 44 % lost control

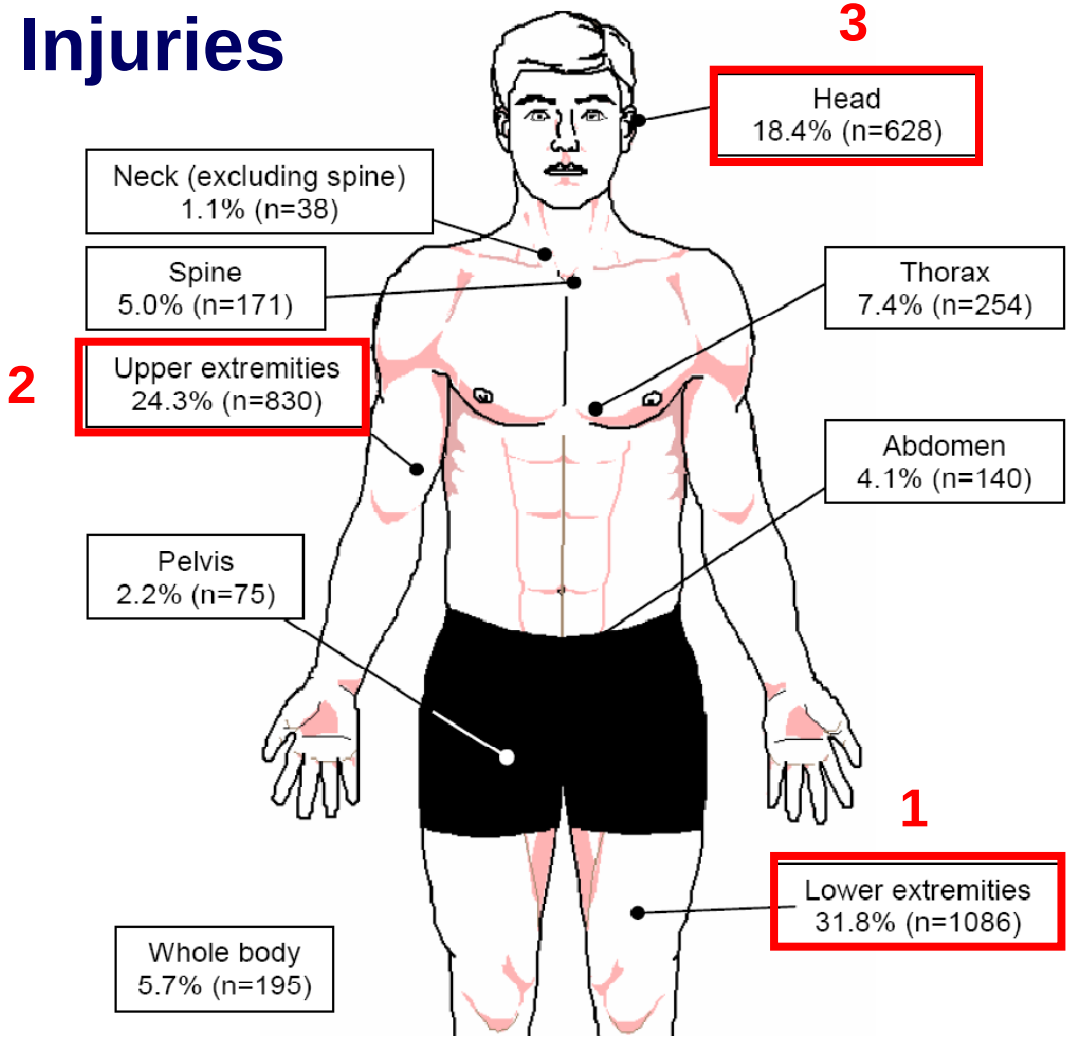
21 - Helmet Wearing

- 90.4% of the PTW riders wore helmets
- 9.1% of these helmets came off during accident
  - L1 = 80% worn, 10% off
  - L3 = 99 % worn, 2 % off

22 - Injuries

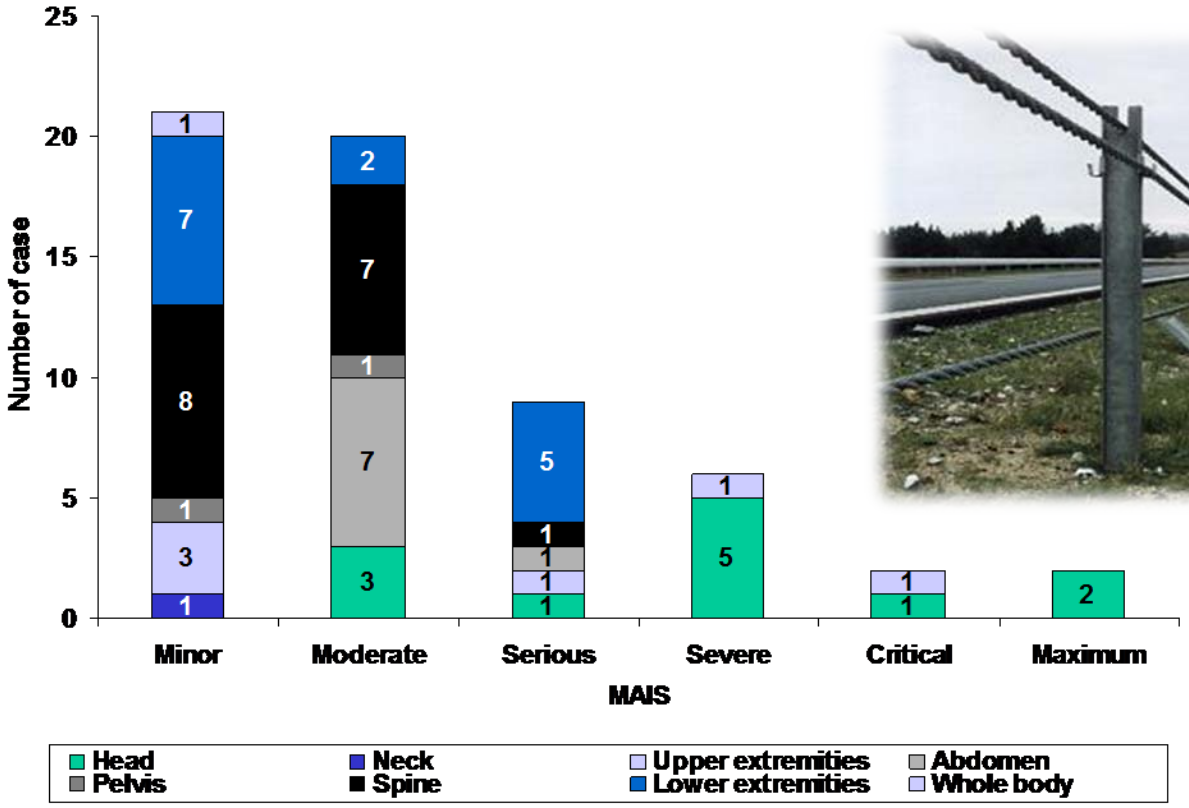
- 921 accidents
- 3417 injuries

- L1 = L3



23 - Crash Barriers

- 60 L3 rider injuries were associated with barrier contact (6.5%)



24 – Road Maintenance Defects

- Cause or contributing factor : 4 %
  - L1 = L3

25 – Traffic hazard

- Cause or contributing factor : 4 %
  - L1 = 4 %
  - L3 = 3 %

26 – Weather

- Cause or contributing factor : 7 %
  - L1 = 4 %
  - L3 = 10 %

Conclusion

L1 (moped + mofa)

- Accident characteristics
  - In urban areas,
  - At intersections
  - Involvement of a passenger car
  - Commuting use
- Riders characteristics
  - 18/25 years over-represented
  - Over 56 less involved

L3 (motorcycle)

- Accident characteristics
  - In urban and rural areas
  - Intersections = non intersection
  - Impact passenger car + environment (4 X / L1) + single
  - Commuting & leisure use
- Riders characteristics
  - 18/25 years over-represented
  - 41/55 years under-represented

Conclusion

L1 (moped + mofa)

- Riders behaviour
  - More unsafe acts:
    - Not having a license
    - Neglecting some view obstructions
    - Violating traffic controls
    - Lower rate of helmet wearing
    - More alcohol or drugs impairment
  - Main mistakes
    - Perception failure
    - 40% of cases the rider did not attempt any kind of reaction to avoid the hazard

L3 (motorcycle)

- Riders behaviour
  - Unsafe act:
    - Neglecting some view obstructions
    - Less violating traffic controls
    - Less alcohol or drug impairment
  - Main mistakes
    - Decision failure (more unusual speed & high speed)
    - Avoidance manoeuvre but many loss of control 44 %

Focus on 125cc

Background

- The B-A1 equivalence option available to MS under the 2DLD 3DLD confirmed this possibility for MS
- The B-A1 equivalence currently accounts for a large part of A1 use (and market)
- A1 vehicles largely used for urban mobility needs
- 3DLD will progressively refocus the PTW market towards smaller capacity vehicles, A1 light motorcycle licence category being harmonised across the EU.

Data distribution

		Case/Control		
		Case	Control	Total
Type of license held	None	6	0	6
		6.7%	.0%	3.4%
	Car license only	27	21	48
		30.3%	24.7%	27.6%
	MC license only	33	15	48
		37.1%	17.6%	27.6%
	Car and MC license	22	49	71
		24.7%	57.6%	40.8%
	Unknown	1	0	1
		1.1%	.0%	.6%
Total		89	85	174
		100.0%	100.0%	100.0%

- Both A1 riders having only a car license or a motorcycle license were found to be over- represented in accidents when compared to controls

Riders' Profile

- Riders with only a MC license equally spread through PTW style (Age 16-17)
- Riders using the equivalence are more prone to ride a scooter (Age 25-55)
- Both rider categories mainly use their 125 in urban environment
- Accident riders using equivalence occurred during the week
- Riders with only MC license also occur during the weekend.

Compared Skills

- MC licensed riders more perception failures
- Riders using the equivalence more comprehension failures
- Major primary contributing factor is still a failure by OV driver
- Riders using the equivalence are more likely to have a skill deficiency (22.2% vs. 12.1%)
- Riders with MC license have more loss of control (42.4% vs. 37%)
- Both riders categories performed evasive manoeuvre. However 44.4% of riders using the equivalence failed, compared to the 15.2% of riders with MC license.

Suggested Conclusion

- Data suggests different level of practical skills between riders using the equivalence and MC licenced riders
- Minimum of practical training would contribute to a safer equivalence
- Caution: low numbers

Multivariate Analysis on fatal Accidents

Purpose

Perform a multivariate analysis of the MAIDS database (**fatal accidents only**) to identify the presence of any relationships between certain accident factors and PTW legal category.

i. Human factors

ii. Vehicle factors

iii. Environmental factors

iv. Crash factors

Methodology

- Selection of a fatal accident as the outcome of analysis
- Use logistic regression & develop probabilistic models to identify those factors which have a statistically significant contribution to a fatal outcome
- Using odds ratios, quantify how certain characteristics will increase or decrease the odds of being involved in a fatal accident

What is logistic regression?

$$logit(\pi) = \alpha + \beta_1 x_1 + \beta_2 x_2 + ... + \beta_k x_k$$

By looking at several variables at once, you can better understand the relationship between variables and the effect that one variable has upon the outcome event (i.e. a fatal accident)

Results

	MAIDS Database (All PTWs)	L1 Database	L3 Database
Fatal	100	25	75
Not fatal	821	373	448
Total	921	398	523

Number of factors by category

Variable	Number of factors
Human	6
Vehicle	9
Collision	7

Quantitative elements

TIME OF DAY

The majority of accidents occurred during daytime

The proportion of the number of the fatal accidents to number of accidents is higher during the night time

TYPE OF AREA

For L1 vehicles, more fatalities occurred in an urban area

For L3 vehicles a larger number of fatalities occurred in a rural area

Quantitative elements

TYPE OF ROADWAY

The majority of PTW fatalities occurred on straight roadways

16.5% of all L3 vehicle crashes that took place on a curved roadway resulted in a PTW rider fatality

TYPE OF ROADWAY

PTW fatalities occur on major arterials (40%)

Major arterial accidents account for 44% of L1 rider fatalities, 39% of L3 rider fatalities and 40% of all PTW rider fatalities

Quantitative elements

PRESENCE OF INTERSECTION

The majority of the accidents took place at an intersection (60% of cases)

The majority of PTW rider fatalities took place at a non-intersection location (62% of all PTW rider fatalities)

PTW STYLE

Scooter style vehicles was found to have the highest frequency of L1 rider fatalities

Sport replica style motorcycles was found to have the highest reported frequency of L3 rider fatalities

Quantitative elements

AGE OF THE RIDERS

The majority of L1 riders were between the ages of 16 and 21
The L1 rider fatalities were distributed across all L1 rider age groups.

The highest frequency of L3 rider fatalities were between 26 and 40

SPEEDING

15% of L1 and 32% of L3 riders were speeding at the time of the crash

Out of those, 12% (or 7 cases) resulted in a L1 rider fatality

24% of the L3 riders (or 40 cases) resulted in a L3 rider fatality

Quantitative elements

PTW RIDER ERROR

40% of all L1 vehicle crashes involved a L1 rider error
64% of L1 fatal crashes involved rider error

These data indicate a larger percentage of rider error occurs in fatal crashes in comparison to all crashes

OV DRIVER ERROR

51% of all PTW crashes involve OV driver error, whereas only 33% of fatal crashes involve OV driver error (for both L1 and L3 vehicles)

These data indicate a smaller percentage of OV driver error occurs in fatal crashes, in comparison to all crashes

Summary Multivariate analysis
All PTWs

- PTW riders over 41 years of age appear to be at greater risk
- PTW riders between 18 to 21 years appear to have lesser risk of being involved in a fatality when compared to 26 to 41 year old PTW riders

Summary Multivariate analysis
All PTWs

- There is a significant increase in the risk of a PTW rider fatality when the accident takes place on a major arterial roadway
- Accidents that take place at a site other than an intersection appear to have a greater risk of PTW rider fatality
- When other factors are taken into consideration, no vehicle factors were found to be statistically significant predictors of a PTW rider fatality
- For every 10 km/h increase in crash speed, the odds of a PTW rider fatality increase by 1.31

Summary – L1

- Urban accidents have a reduced risk of fatality when compared to rural accidents
- Nighttime accidents have a greater risk of fatality when compared to daytime accidents (odds ratio = 1.06)
- Accidents involving a collision with a fixed object have an 8.1 times greater risk of involving a L1 rider fatality when compared to a collision with a light passenger vehicle

Summary – L1

- For every 10 km/h increase in crash speed, the odds of a L1 rider fatality increase by 1.24
- Other vehicle driver impairment significantly increased the odds of a L1 rider fatality (odds ratio = 5.74)
- L1 rider errors significantly increased the odds of a L1 rider fatality (odds ratio = 3.37)
- The risk of a L1 rider fatality increases with age. L1 riders over 41 years of age have an 8.5 times greater risk of being involved in a fatality when compared to L1 riders that are 26-40 years of age.

Summary – L3

- Travelling speed was found to be a significant factor in predicting an L3 rider fatality. For every 10 km/h increase in traveling speed, the odds of a L3 rider fatality increase by 1.38
- Environmental factors (i.e., intersections and major arterial roadways) were also found to be significant in predicting an L3 rider fatality
- L3 vehicle engine displacement and L3 vehicle maximum velocity are not significant predictors of an L3 rider fatality.

Summary – L3

- L3 rider age was not a good predictor of an L3 rider fatality
- However, when considering L3 rider speeding, L3 riders aged 22-25 were found to have a significant increase in risk of L3 rider fatality when compared to L3 riders aged 26 to 40 years
- OV driver errors were not found to be a significant predictor of an L3 rider fatality

EXTERNAL COOPERATION

FURTHER RESEARCH

- **eSUM project – analysis on urban accidents**

- **PPE – fact sheet for dealers, few findings on PPE effect in preventing or mitigating injuries:**

Upper Torso and Upper extremities

<u>L1 riders</u>

- **Light and medium garment –73% (in three accidents out of four)**
- **Heavy garment – 93% (almost in all cases)**

<u>L3 riders</u>

- **Light and medium garment – in 69% (in two accidents out of three)**
- **Heavy garment – in 92% (almost in all cases)**

PPE – a few findings on PPE effect in preventing or mitigating injuries

Lower Torso and Lower extremities

L1 and L3 riders

- Light and medium garment –one accident out of two (in 54% of the cases)

L3 riders

- Heavy garments – all most all accident cases (96% of all the cases)

Footwear

L1 rider

- Light: 50% (in one accident out of two)
- Heavy: 89% (in almost all cases)

L3 rider

- Light: 46% (one accident out of two)
- Heavy: 93% (almost all accidents)

Thank you!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In-Depth investigation of motorcycle accidents