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More Life Lived



Do motorcyclist injuries depend on motorcycle and crash types? An analysis based on the German In-Depth Accident Study

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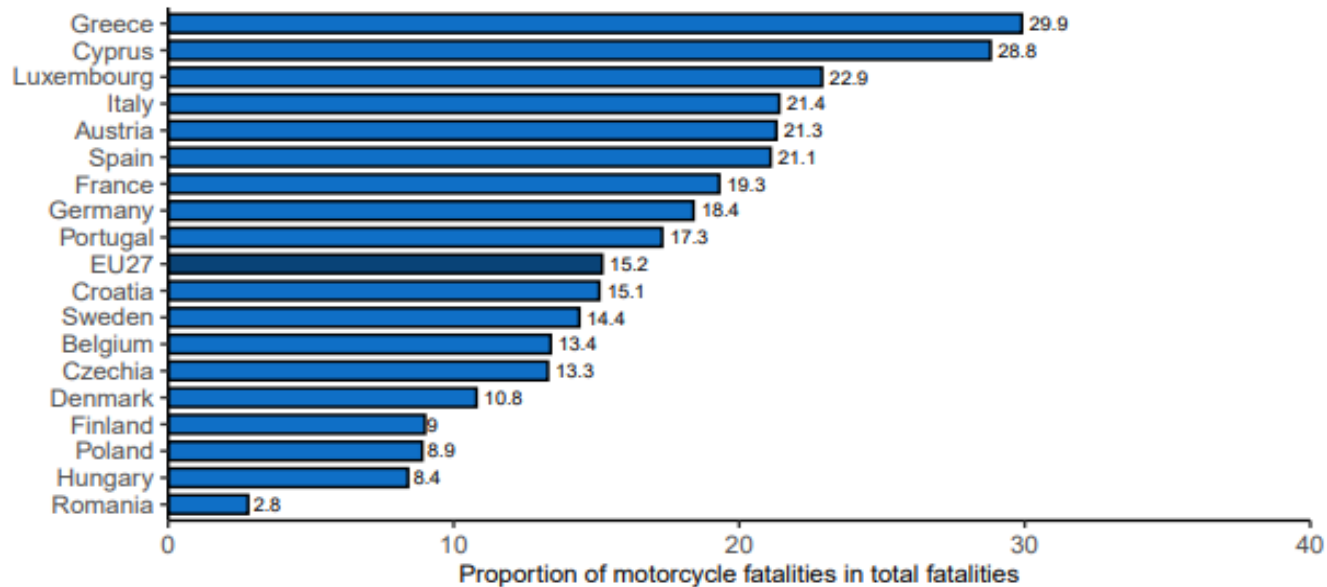
European Road Safety Observatory

Facts and Figures - Motorcyclists riders - 2021

Introduction

- High-level statistics provided by CARE, EUROSTAT
- European Commission report identifies the main trends in the EU

Figure 3. Number of motorcycle fatalities in the total number of fatalities, per country in the EU27 (2019). Source: CARE



Introduction

- EU data differentiate between moped and motorcycle riders

GIDAS AIS3+ injuries sustained by motorcyclists

| Full Sample, n=1347 | | Σ |
|---------------------|-------|-------|
| Thorax (T) | 31.3% | 31.3% |
| Lower Extr. (L) | 29.9% | 61.2% |
| Head (H) | 18.3% | 79.5% |
| Upper Extr. (U) | 6.3% | 85.8% |

| | | | |
|----|---------------------|-------|-------|
| T | Internal Org. (io) | 50.0% | 50.0% |
| | Skeletal (sk) | 41.5% | 91.5% |
| io | Lung | 56.9% | 56.9% |
| | Thorac. cavity inj. | 31.3% | 88.2% |
| sk | Rib cage | 100% | 100% |

| | | | |
|----|---------------|-------|-------|
| L | Skeletal (sk) | 93.3% | 93.3% |
| sk | Femur | 61.4% | 61.4% |
| | Tibia | 25.3% | 86.7% |

| | | | |
|----|--------------------|-------|-------|
| H | Internal Org. (io) | 47.4% | 47.4% |
| | Skeletal (sk) | 40.9% | 88.3% |
| io | Cerebrum | 76.9% | 76.9% |
| | Brain stem | 16.2% | 93.1% |
| sk | Base (basilar) | 79.2% | 79.2% |
| | Vault | 20.8% | 100% |

| | | | |
|----|---------------|-------|-------|
| U | Skeletal (sk) | 91.8% | 91.8% |
| sk | Radius | 37.2% | 37.2% |
| | Ulna | 30.8% | 68.0% |
| | Humerus | 14.1% | 82.1% |

| Car Sample, n=304 | | Σ |
|-------------------|-------|-------|
| Lower Extr. (L) | 50.7% | 50.7% |
| Thorax (T) | 20.1% | 70.8% |
| Head (H) | 18.1% | 88.9% |

| | | | |
|----|---------------|-------|-------|
| L | Skeletal (sk) | 92.9% | 92.9% |
| sk | Femur | 60.1% | 60.1% |
| | Tibia | 35.7% | 95.8% |

| | | | |
|----|---------------------|-------|-------|
| T | Internal Org. (io) | 45.9% | 45.9% |
| | Skeletal (sk) | 44.3% | 90.2% |
| io | Lung | 46.4% | 46.4% |
| | Thorac. cavity inj. | 46.4% | 92.8% |
| sk | Rib cage | 100% | 100% |

| | | | |
|----|--------------------|-------|-------|
| H | Internal Org. (io) | 52.7% | 52.7% |
| | Skeletal (sk) | 40.0% | 92.7% |
| io | Cerebrum | 93.1% | 93.1% |
| sk | Base (basilar) | 72.7% | 72.7% |
| | Vault | 27.3% | 100% |

| Object sample, n=170 | | Σ |
|----------------------|-------|-------|
| Lower Extr. (L) | 27.1% | 27.1% |
| Thorax (T) | 22.4% | 49.5% |
| Head (H) | 21.2% | 70.6% |
| Spine (S) | 10.0% | 80.6% |

| | | | |
|----|---------------|-------|-------|
| L | Skeletal (sk) | 89.1% | 89.1% |
| sk | Femur | 58.3% | 58.3% |
| | Tibia | 26.8% | 85.1% |

| | | | |
|----|---------------------|-------|-------|
| T | Internal Org. (io) | 52.6% | 52.6% |
| | Skeletal (sk) | 42.1% | 94.7% |
| io | Lung | 65.0% | 65.0% |
| | Thorac. cavity inj. | 35.0% | 100% |
| sk | Rib cage | 100% | 100% |

| | | | |
|----|--------------------|-------|-------|
| H | Internal Org. (io) | 47.2% | 47.2% |
| | Skeletal (sk) | 38.9% | 86.1% |
| io | Cerebrum | 76.5% | 76.5% |
| | Brain stem | 17.6% | 94.1% |
| sk | Base (basilar) | 78.6% | 78.6% |
| | Vault | 21.4% | 100% |

| | | | |
|-----|----------------------|-------|-------|
| S | Thoracic spine (tho) | 41.2% | 41.2% |
| | Cervical spine (cer) | 35.3% | 76.5% |
| tho | Lumbar spine (lu) | 17.6% | 94.1% |
| | Thoracic cord | 71.4% | 71.4% |
| cer | Vertebra | 28.6% | 100% |
| | Cervical cord | 66.7% | 66.7% |
| lu | Vertebra | 16.7% | 83.4% |
| | Nerves | 66.7% | 66.7% |
| cer | Vertebra | 33.3% | 100% |
| | Nerves | 33.3% | 100% |

| Road sample, n=91 | | Σ |
|-------------------|-------|-------|
| Thorax (T) | 36.3% | 36.3% |
| Head (H) | 26.4% | 62.7% |
| Lower Extr. (L) | 16.5% | 79.2% |
| Upper Extr. (U) | 15.4% | 94.6% |

| | | | |
|----|---------------------|-------|-------|
| T | Skeletal (sk) | 72.7% | 72.7% |
| | Internal Org. (io) | 27.3% | 100% |
| sk | Rib cage | 100% | 100% |
| | Lung | 66.7% | 66.7% |
| io | Thorac. cavity inj. | 33.3% | 100% |

| | | | |
|----|--------------------|-------|-------|
| H | Internal Org. (io) | 54.2% | 54.2% |
| | Skeletal (sk) | 41.7% | 95.9% |
| io | Cerebrum | 84.6% | 84.6% |
| sk | Base (basilar) | 90.0% | 90.0% |

| | | | |
|----|---------------|-------|-------|
| L | Skeletal (sk) | 100% | 100% |
| sk | Femur | 73.3% | 73.3% |
| | Tibia | 13.3% | 86.6% |
| U | Skeletal (sk) | 100% | 100% |
| sk | Radius | 50.0% | 50.0% |
| | Humerus | 28.6% | 78.6% |
| | Ulna | 21.4% | 100% |

Fatalities 2019

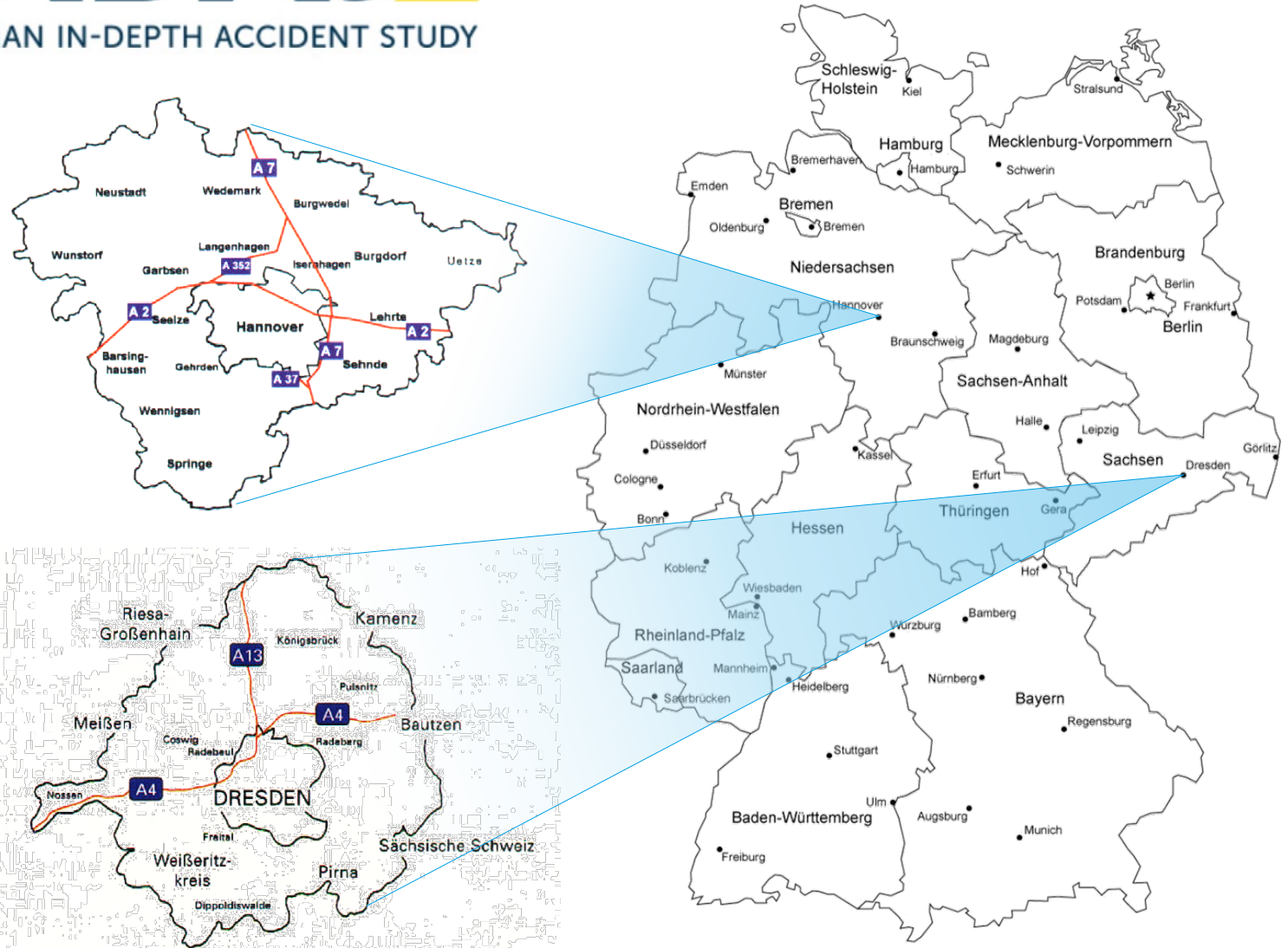


- but, so far, our injury priorities do not

Gidion et al. (2021). Motorcyclist injuries: Analysis of German in-depth crash data to identify priorities for injury assessment and prevention. Accident Analysis and Prevention.

Method

- GIDAS (release, January 2022)
- Fully reconstructed cases
- Motorcycles of type L1e and L3e
- Main rider (driver), no pillion rider
- Rider was wearing a helmet or had 'unknown' helmet wearing



Method

- AIS injury codes (2015 Revision)
- AIS2+ or AIS3+ injuries of PTW riders
- Femur fracture

Femur shaft fracture

complex; comminuted; segmental; Winquist IV

open

THE ABBREVIATED INJURY SCALE © 2015 Revision

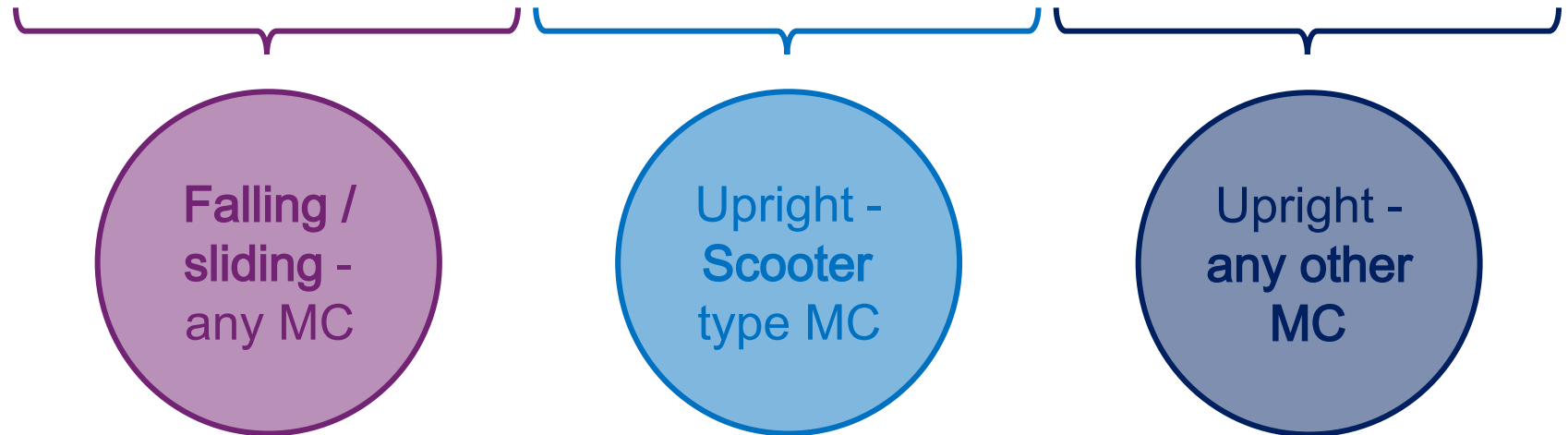


Association for the Advancement of Automotive Medicine

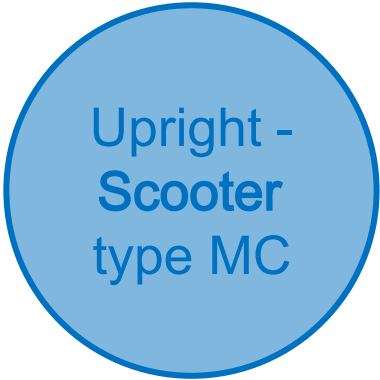
| AIS Code | Description |
|----------|-------------|
| 1 | Minor |
| 2 | Moderate |
| 3 | Serious |
| 4 | Severe |
| 5 | Critical |
| 6 | Maximal |
| 9 | Unknown |

Method – Groups

| | | | |
|-----------------------------------|--|---|---|
| Pre-/in-crash kinematics of rider | Fall before contact with another participant (1) | Free flight (2); scooping (3); collision without scooping (4) | Free flight (2); scooping (3); collision without scooping (4) |
| Type of Powered Two-Wheeler | Any MC - PTW, nfs (40); Scooter (42); chopper (43); tourer (44); sport motorbike (45); enduro (46) | Scooter (42) | PTW, nfs (40); chopper (43); tourer (44); sport motorbike (45); enduro (46) |

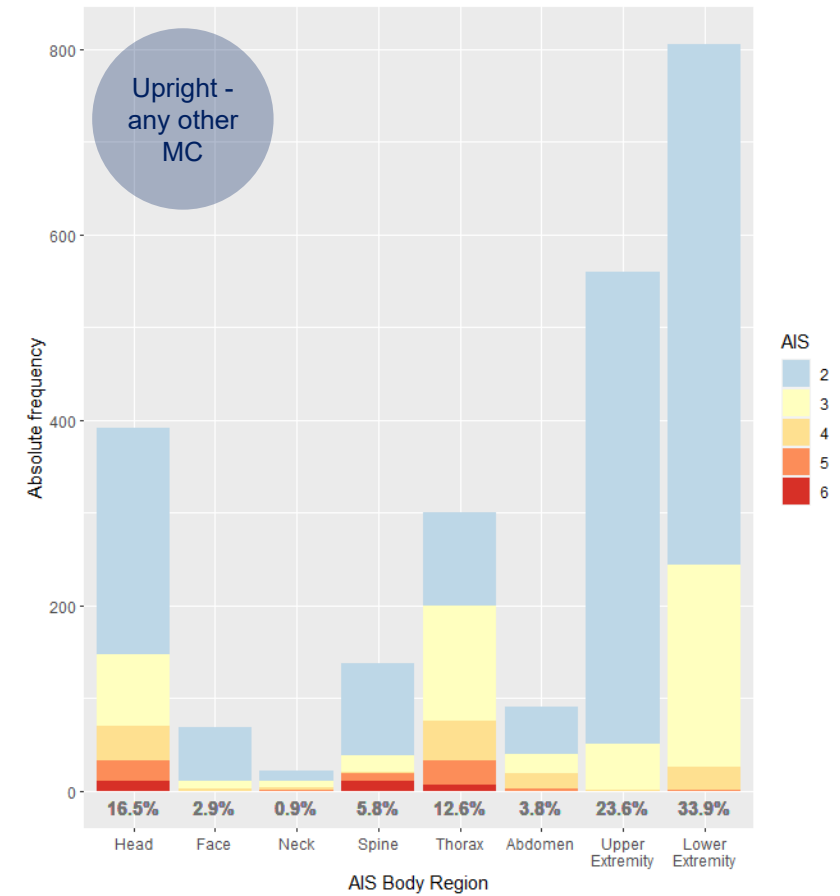
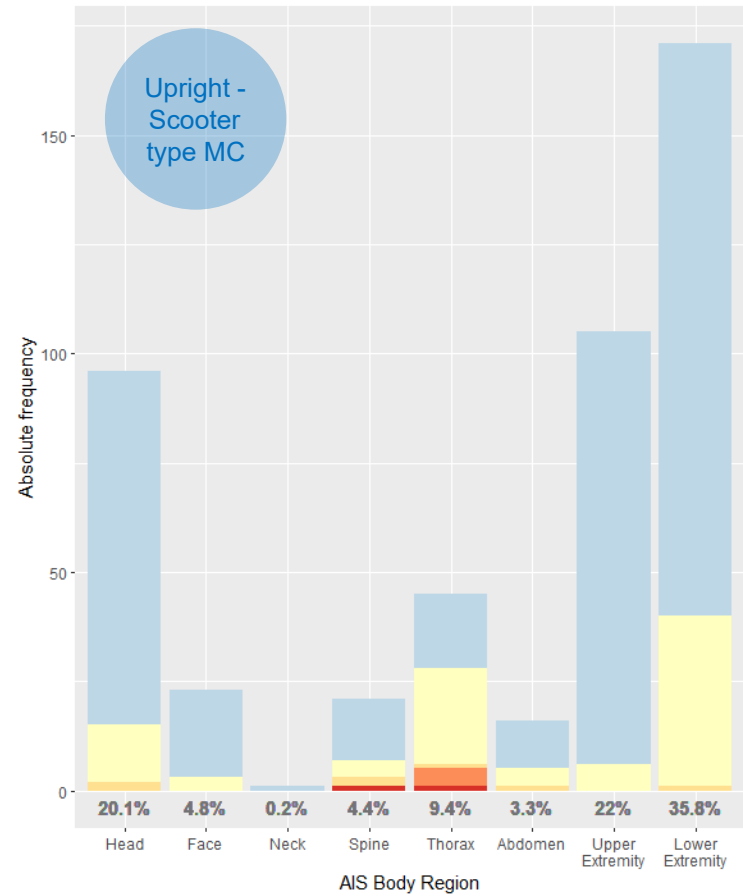
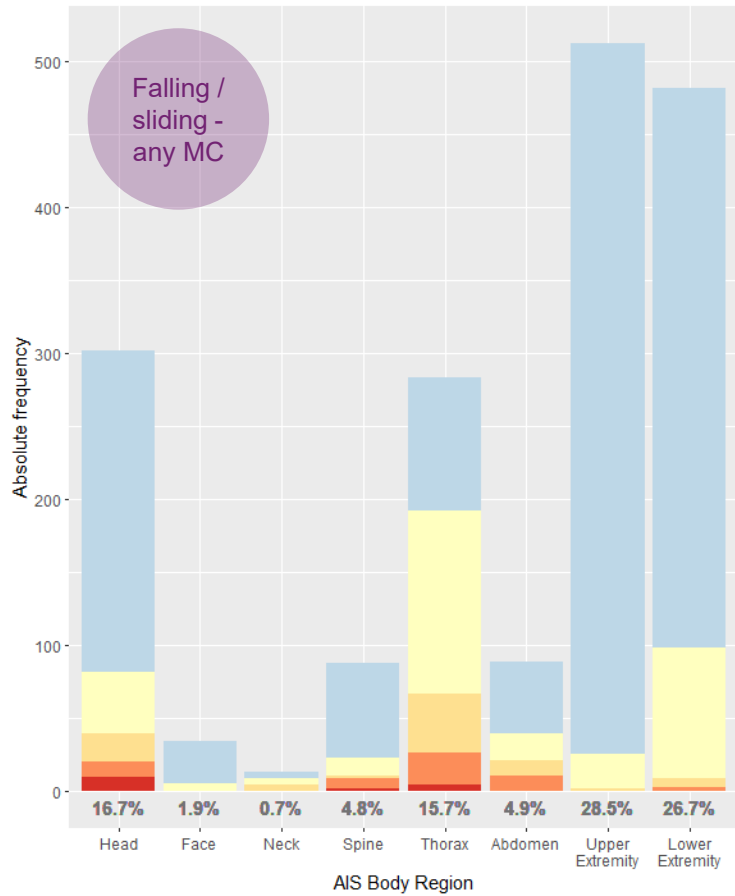


Results – Groups



| | Falling/sliding – any MC | Upright – Scooter | Upright - any other MC |
|------------------|--------------------------|-------------------|------------------------|
| Number of cases | 838 | 237 | 770 |
| Number of riders | 839 | 237 | 775 |

AIS2+ Injuries by Body Region



Top 5 AIS2+ Injuries by group

Falling / sliding - any MC

1. Cerebral concussion 10.0%
2. Clavicle fracture 8.3%
3. [Fracture to the] rib cage 6.1%
4. Radius fracture 5.5%
5. Tibia fracture 5.0%

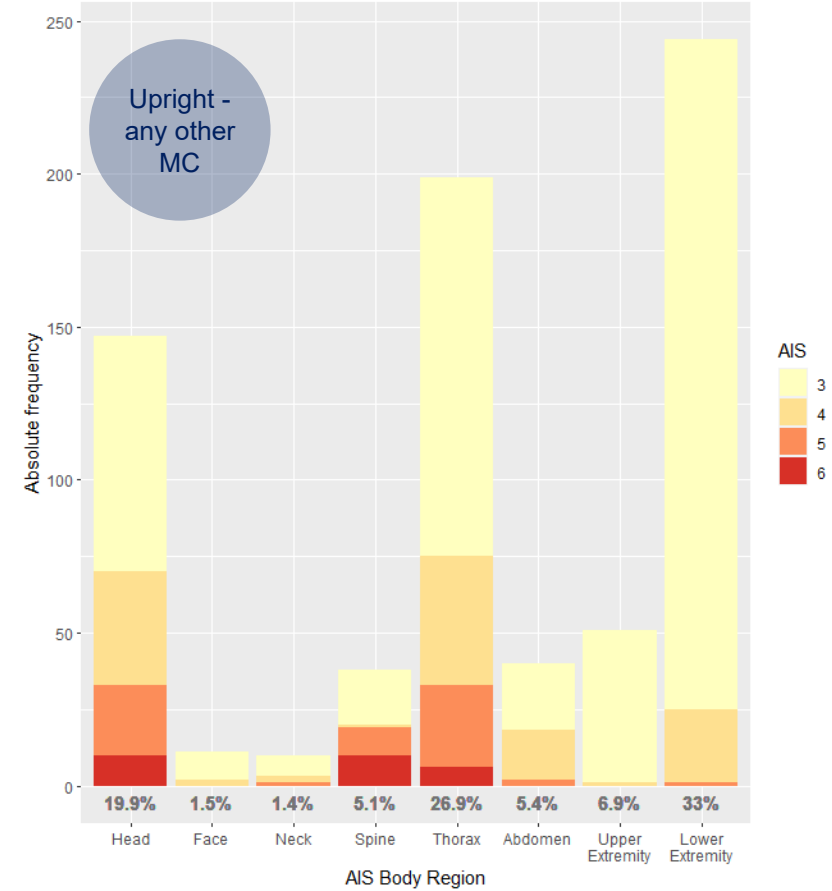
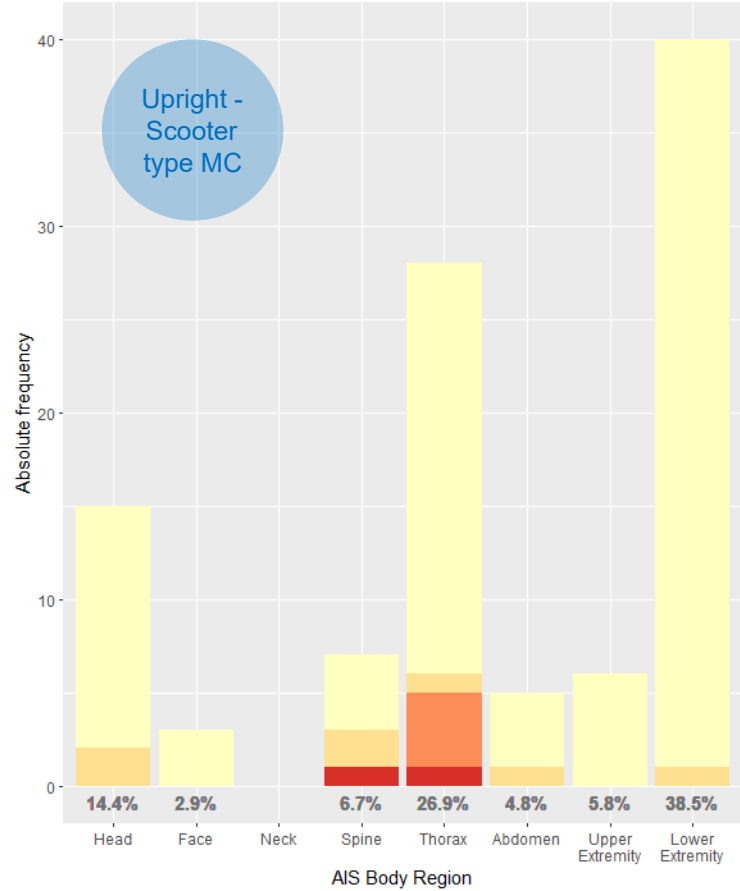
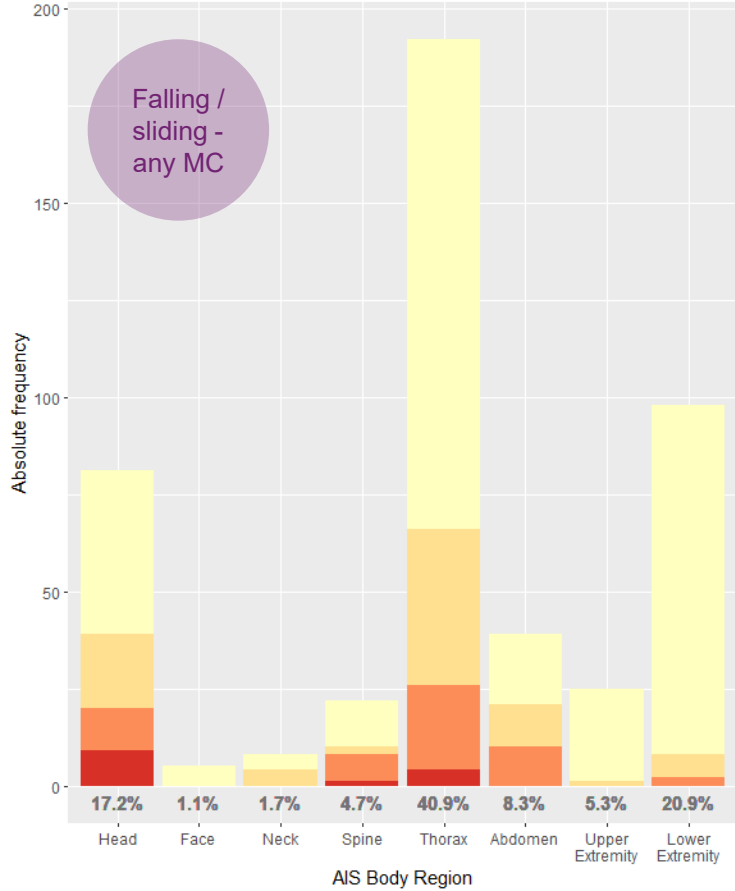
Upright - Scooter type MC

1. Cerebral concussion 15.3%
2. Tibia fracture 6.3%
- Femur fracture 6.3%
4. Clavicle fracture 5.9%
5. Radius fracture 4.2%

Upright - any other MC

1. Cerebral concussion 7.8%
2. Tibia fracture 7.4%
3. Radius fracture 6.4%
4. Femur fracture 5.1%
5. Vertebra 4.6%

AIS3+ Injuries by Body Region



Top 5 AIS3+ Injuries by group

Falling / sliding - any MC

1. [Fracture to the] rib cage 17.2%
2. Femur fracture 13.0%
3. [Injury to] lungs 11.3%
4. Cerebrum 7.2%
5. Thoracic cavity injury 5.7%

Upright - Scooter type MC

1. Femur fracture 28.9%
2. [Fracture to the] rib cage 12.5%
3. Tibia fracture 7.7%
4. [Injury to] lungs 6.7%
- Base (basilar) fracture 6.7%

Upright - any other MC

1. Femur fracture 16.5%
2. [Fracture to the] rib cage 11.1%
3. Tibia fracture 9.3%
4. [Injury to] lungs 8.0%
5. Cerebrum 7.2%

Conclusions (1/2)

- Injuries are broadly similar...
 - Whether you fall before any other collision or crash upright
- The **head, lower extremity and upper extremity** are the most frequently AIS2+ injured body regions
- Precisely:
 - Cerebral concussion, tibia fracture, femur fracture, clavicle fracture, radius fracture and fractures of the rib cage
- The **head, lower extremity, and thorax** are most frequently injured at the AIS3+ level
- Precisely:
 - Fractures to the base of the skull, cerebrum injuries, femur fracture, tibia fracture, rib cage fractures, and injuries to ~~the~~ hands or thoracic cavity

Conclusions (2/2)

- Some differences exist...
- Femur injuries were more frequent for upright scooter riders than for other types of motorcyclists or those falling before a collision
 - The majority of femur fractures originate from contact with a car
- Despite wearing helmets, powered two-wheeler riders still sustain head injuries
 - Riders of other types of motorcycles sustain **more head injuries** and **more severe head injuries** than scooter riders
- Particular focus on:
 - Femur protection for upright scooter riders in frontal impacts
 - Head protection for (other types of) motorcycle riders



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