

Bicyclist Injuries Leading to Permanent Medical Impairment

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I. INTRODUCTION

In Sweden, cyclists account for a higher proportion of hospital-reported crashes than any other road user [1]. However, most bicycle crash injuries are non-fatal, with cyclists making up around 3% of all road fatalities. Hospital data shows that the most frequently injured body regions in bicycle crashes are the upper extremities (37%), followed by lower extremities (30%), and head injuries (26%) [2]. The injury patterns in single bicycle crashes versus bicycle-car crashes differs [3]. Few studies have had the opportunity to study if long term consequences arise from bicycle crashes [4]. The existing studies primarily focus on serious injuries that have required hospital care. Hence, aim of this study was to analyse injuries leading to permanent medical impairment (PMI) in bicycle crashes, with a general overview and a specific focus on those affecting the upper extremities.

II. METHODS

Two data sets with bicyclist sustaining injuries leading to PMI were studied, cyclists in collisions with cars and single bicycle crashes. Those injured in car crashes consisted of 504 bicyclists with 623 injury diagnoses in crashes reported 1995 to 2021. The single bicycle crashes consisted of 176 bicyclists between 2002 and 2015. The materials represent all injuries leading to PMI reported to Folksam via their car insurance (20% market share in Sweden) or non-mandatory accident insurance during the time periods respectively. The degree of PMI for each injury is decided at least three years after the accident and is assigned between 1 and 99% [5]. The degree may differ between individuals with same injury diagnose due to different circumstances.

III. INITIAL FINDINGS

Injuries to upper and lower extremities were dominating the injury outcome in both collisions with cars and in single bicycle crashes, Table 1. Note that in single bicycle crashes there was a category with multiple injuries (23/13%) that could not be divided into body regions. Most of the injuries to the upper extremities (97,5%) were AIS 1 and AIS 2. The AIS3+ injuries were dominated by skull/brain and injuries to the lower extremities. The injuries with the highest mean PMI were skull/brain injuries, Table 1. Multiplying the mean PMI with the injury proportion for each body region, injuries to skull/brain, upper and lower extremities show the highest numbers in collisions with cars, and in single bicycle crashes cervical spine and upper extremities were dominating, Table 1.

TABLE I

NUMBER AND PROPORTION OF INJURIES (AND MEAN PMI FOR CAR-TO-BICYCLE CRASHES) PER BODY REGION AND CRASH TYPE.

Body region	<i>Car-to-bicycle Crashes</i>				<i>Single Bicycle Crashes</i>			
	n	Prop	mean PMI	Prop*mPMI	n	Prop	mean PMI	Prop*mPMI
Abdomen	2	0%	2.5	0.01	3	2%	8.0	0.14
Cervical Spine	87	14%	5.0	0.70	7	4%	31.6	1.28
Face	18	3%	3.6	0.10	1	1%	1.0	0.01
Lower Extremities	202	32%	4.2	1.37	39	22%	3.2	0.72
Lumbar Spine	19	3%	3.2	0.10	2	1%	5.0	0.06
Multiple Injuries				0.00	23	13%	5.7	0.76
Skull/Brain	50	8%	12.6	1.01	8	5%	22.6	1.05
Thoracic Spine	27	4%	8.8	0.38	6	3%	7.2	0.25
Thorax	5	1%	2.4	0.02	8	5%	3.3	0.15
Upper Extremities	213	34%	3.0	1.03	79	45%	3.5	1.60
Total	623	100%	5.6		176	100%	5.9	

Focusing specifically on injuries to the upper extremities, the most frequent injuries in car-to-bicycle crashes were shoulder dislocations/distortions and wrist fractures. These two injury types also remained the most severe when considering the mean PMI, as shown in Table 2. In single bicycle crashes, shoulder injuries were also the most frequent and severe. Examining the details of injuries to the upper extremities, the majority were linked to the shoulder. Most humerus fractures occurred near the shoulder joint, although no further details were found regarding scapula fractures. Shoulder dislocation/distortion were primarily related to ligament damage. In single bicycle crashes 56 out of 79 were fractures.

TABLE 2.

NUMBER AND PROPORTION OF INJURIES, MEAN PMI AND MEAN PMI MULTIPLIED WITH THE PROPORTION OF INJURIES FOR EACH BODY REGION IN CAR-TO-BICYCLE AND SINGLE BICYCLE CRASHES.

<i>Car-to-bicycle Crashes</i>					<i>Single Bicycle Crashes</i>				
Injury Type	n	Prop.	mean PMI	Prop*mP MI	Injury Type	n	Prop.	mean PMI	Prop*mPMI
Clavicle fracture	23	11%	2.70	0.29	Clavicle	10	13%	2.4	0.30
Shoulder dislocation/distortion	35	16%	4.17	0.69	Shoulder	20	25%	5.7	1.44
Shoulder ligament	5	2%	2.40	0.06					
Scapula fracture	6	3%	2.67	0.08	Scapula	3	4%	3.3	0.13
Humerus fracture	13	6%	2.92	0.18	Humerus	3	4%	3.7	0.14
Elbow dislocation/distortion	3	1%	1.33	0.02	Elbow	13	16%	2.7	0.44
Elbow fracture	13	6%	4.31	0.26					
Radius/ulna fracture	20	9%	3.90	0.37	Radius/Ulna	3	4%	7	0.27
Wrist dislocation/distorsion	4	2%	1.50	0.03	Wrist	12	15%	3.1	0.47
Wrist fracture	30	14%	3.13	0.44					
Hand/finger fracture	23	11%	2.00	0.22	Hand	7	9%	2.7	0.24
Hand/finger ligament	3	1%	3.33	0.05					
Finger dislocation/distortion	9	4%	2.33	0.10	Finger	8	10%	1.7	0.17
Skin	26	12%	2.04	0.25					
Total	213	100%	3.01		Total	79	100%	3.5	

IV. DISCUSSION

Injuries to upper and lower extremities were dominating the injury outcome in both collisions with cars and in single bicycle crashes. Most of the arm injuries (97.5%) were AIS 1 and 2. The AIS3+ injuries were dominated by skull/brain injuries and injuries to the lower extremities and injuries with the highest mean PMI were skull/brain injuries. When considering the combined effect of the severity expressed as mean PMI, skull/brain, upper and lower extremities were dominating in car-to -bicycle crashes. And in single bicycle crashes injuries to the skull/brain, cervical spine, upper and lower extremities were dominating. The most severe injuries were to the cervical spine, which resulted in above 90% PMI. Looking at injuries to the upper extremities specifically, the most frequent and severe injuries in car-to-bicycle crashes were shoulder dislocation/distortions and wrist fractures. The majority were linked to the shoulder as many humerus fractures were close to the shoulder joint. Regarding shoulder dislocations or distortions most related to ligament injuries. The severity of these injuries, particularly shoulder injuries, underscores the need for targeted safety measures to protect cyclists' upper extremities.

V. REFERENCES

- [1] Swedish Transport Administration 2017
- [2] Juhra C. et al. Injury. 2012.
- [3] Rizzi. M et al. IRCOBI 2013
- [4] Stigson H et al. IRCOBI. 2019.
- [5] Malm et al. AAAM. 2008.