Characteristics of Crashes between Motorised Two Wheelers and Passenger Cars in India

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I. INTRODUCTION

According to the report published by the Ministry of Road Transport and Highways [1], roughly 150,000 people die in road crashes in India every year. Among the different road user types, Motorised Two Wheelers (M2Ws) accounted for the highest share in total number of road crashes (33.8%) followed by cars, jeeps and taxis (23.6%). M2Ws were also the most vulnerable road users accounting for all 34.8% of all road fatalities. An analysis of data collected under the Road Accident Sampling System – India (RASSI) [3] showed that, passenger cars (26%) constitute the most frequent collision partners for M2Ws among all road user types. Hence this study aims to understand the characteristics of crashes involving M2Ws and passenger cars. In-depth crash investigation data collected in both urban and rural areas all across India, were used in the study.

II. METHODS

The Road Accident Sampling System India (RASSI) database was developed to provide in-depth crash and injury data on real world crashes in India. Jeya Padmanaban *et al.* [2] detailed the selection criteria for cases in RASSI, its representativeness and the crash investigation methodology. A total of 206 RASSI cases involving collisions between passenger cars and M2Ws from 2011 to 2017 [3] were used in this study.

The selection criteria for the query were:

1. Passenger cars include hatchbacks, sedans, sports utility vehicles (SUVs), multi utility vehicles (MUVs) and vans.
2. Only single event crashes involving M2Ws and passenger cars were studied.
3. Parameters containing unknown values were ignored in the study.

Injury severity rating was done based on the Abbreviated Injury Scale (AIS). Crash speeds for passenger cars impacting the two-wheelers were obtained from vehicle deformations, skid marks and validated using PC Crash.

III. INITIAL FINDINGS

Pre-crash analysis was done to identify the frequent critical events experienced by the vehicle types and their subsequent avoidance maneuvers. Changing lane to the right was the most common critical event for both passenger cars and M2Ws. For passenger cars, braking is seen as an avoidance in 50% of the cases while no avoidance was seen by car drivers in 37% of the cases. For M2Ws, a lack of avoidance is seen for 87% of the cases whereas braking is seen in only 6% of the cases. In crash phase, head-on collisions (37%) were the most frequent configurations seen followed by side/angle impacts (33%), rear end collisions (car in M2W rear-19%) and sideswipe impacts (11%). Fig. 1 shows the most frequently observed crash configurations between M2Ws and passenger cars.

Analysis of passenger car crash speeds (n=143 passenger cars) showed that 58% of the passenger cars had a crash speed between the range of 31 to 60kph.

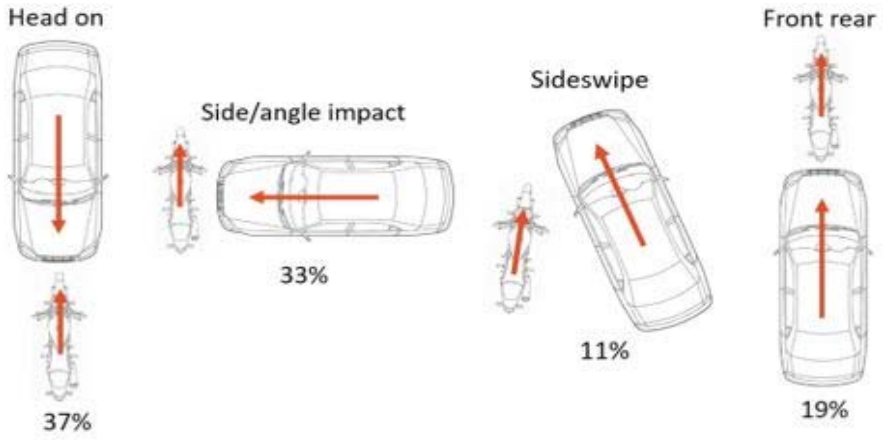

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Fig. 1. Frequent Crash configurations between Passenger cars and M2Ws

The most frequently contacted passenger car component was the windscreen (43%) followed by bonnet (25%) and front bumper (14%). Distribution of injury source by AIS injury severity revealed that around 71% of the AIS3+ injuries suffered by the M2W occupants were caused by contacts with passenger car components while the remaining 29% were due to ground contacts (n=226 injuries). Body region distribution for serious (AIS3+) injuries (n=226 injuries) revealed that the head region is the most frequently injured (58%) followed by lower extremity (24%). Distribution of all AIS3+ injuries for all body regions versus crash speed of the passenger car reveals that 73 % injuries were suffered at a speed of above 20kph. Representation of the above studies is shown in Fig. 2.

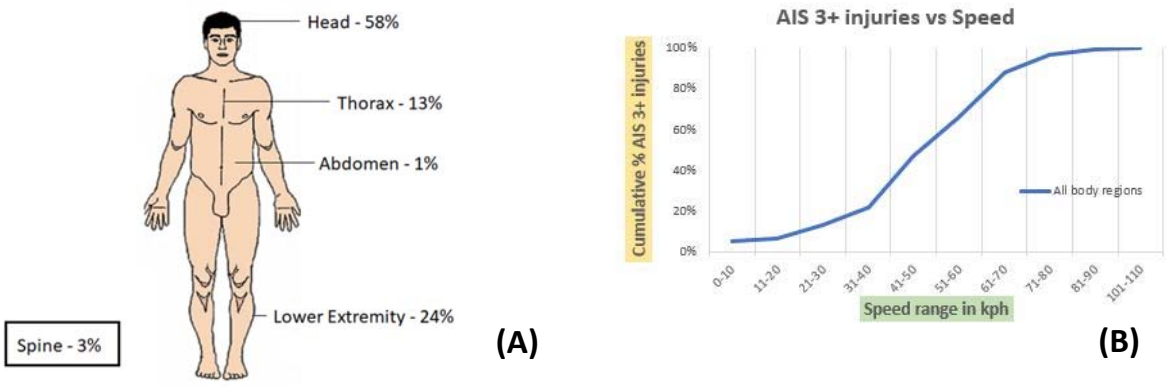

Fig.2. (A) Distribtution of AIS3+ injuries by occupant body regions (n=226 injuries); (B) Distribtution of AIS3+ injuries versus speed range in kph for all body regions

IV. DISCUSSION

The high frequency of critical events involving changing lane to the right and head on collisions indicate towards crash scenarios more commonly seen on undivided roads. The lack of avoidance manoeuvres indicate the importance of Autonomous Braking systems along with existing systems such as Anti-lock Braking Systems (ABS).

Correlation of M2W occupant injuries to their contact sources indicate that contacts with passenger car components caused a higher percentage of severe injuries as compared to contacts with ground.

The study also shows that the head is the most likely body region to suffer AIS3+ in crashes with 58%. This outcome is different to the outcome of the study made by S Piantini *etc. al* [4] which showed that the Thorax was the most likely body region with AIS3+ injuries. Passenger car component and injury correlation reveals that contact to windscreen region (which includes the glazing, A-pillars and roof rails) leads to the highest number of head injuries. The new regulations proposed for pedestrian safety for passenger cars may also be helpful in reducing severe injuries to M2W occupants impacting the bonnet and windscreen regions. In addition, use of pedestrian airbags may also reduce the injury severities for M2W occupants.

Passenger car crash speed analysis reveals that over 73% of AIS3+ injuries took place at speeds above 20kph, which is marginally lower than the 30 kph speeds obtained from the study of S Piantini *et.al*. The high injury severities for lower passenger car crash speeds may also be due to the higher travel speeds of the M2Ws.

Last of all, study of helmet usage shows that 94% of the AIS 3+ head injuries (n=132 head injuries) were caused when the occupant did not wear the helmets or improperly wore helmets.

V. REFERENCES

[1] ROAD ACCIDENTS IN INDIA – 2016 report by Ministry of Road Transport and Highways Research Wing.

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[4] S Piantini *et. al (2016)* Injury Analysis of Powered Two-Wheeler versus Other-Vehicle Urban Accidents – IRCOBI 2016