Vulnerable Road User Accidents in India

Junaid Shaikh, Rikard Fredriksson

I. INTRODUCTION

The World Health Organization (WHO) report [1] states 90% of global road traffic fatalities occur in low and middle income countries, where the category of Vulnerable Road User (VRU) accounts for half of those fatalities. The WHO report also shows fatalities as per road users for India, where VRU accounts for 47% of fatalities. (VRU includes motorised two-wheeler (M2W), Pedestrian, and Bicyclist and, in the India figure also includes motorised-three-wheeler (M3W).) Road Accident Sampling System India (RASSI) [2] is an in-depth accident database that collates accident data on Indian roads to aid national traffic planning and to allow engineers to analyse vehicle accidents and injury patterns. This study was initiated to understand the accident details and severity sustained by VRU in an accident, which will hopefully provide further aid to the development of VRU safety.

II. METHODS

RASSI data from April 2014 to March 2015 were examined, which data accounts for a total of 407 accidents of all road-user types. From these 407 cases we extrapolated VRU-involved accidents, which is defined as any accident involving at least one M2W, Pedestrian, or Bicyclist. We considered various parameters, such as accident severity (defined as highest injury severity among the victims involved in an accident), pre-crash event and movements, collision partners, AIS level (AIS98), injured body region, and injury sources. The injury severity was defined as follows: Fatal – a death occurs within 30 days of the accident and as a result of the accident; Serious Injury – victim is hospitalised for more than 24 hours or dies after 30 or more days from the date of the accident; Minor Injury – victim is treated on-site or provided first aid or hospitalised for less than 24 hours from the date of the accident; No Injury – victim is not reported to have any injuries.

III. INITIAL FINDINGS

In 407 accidents examined, a total of 1,328 persons were involved (1,290 occupants and 38 pedestrians). Of these, 15% were fatal (199), 29% serious injury (380), 21% minor injury (275), and 36% no injury (474). Of these 407 accidents, 37% (151) recorded VRU involvement. Of all fatalities (N=199), 40% were accounted by VRU. These VRU accidents were studied in more detail.

Of 151 VRU-involved accidents (117 M2W, 24 Pedestrian, three Bicyclist, five Pedestrian-M2W, one Pedestrian-Bicyclist, one M2W-Bicyclist), 46% were fatal, 40% sustained serious injury, and 15% were noted to have sustained minor injury. The major collision partner for M2W was Truck, for Pedestrian was Car, and for Bicyclist was Bus/Truck, as shown in Fig. 1. We decided to treat each body type individually for in-depth analysis, i.e. for the 123 M2W accidents, 30 Pedestrian and five Bicyclist accidents (seven cases have more than one VRU). Furthermore, we excluded Bicyclist accidents in this study due to the small sample size.

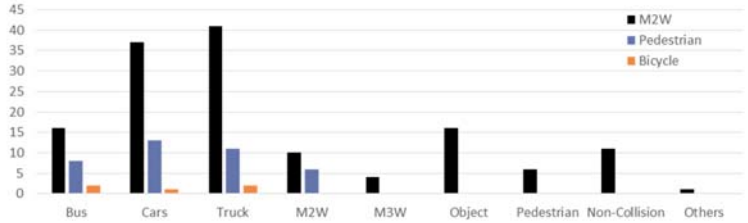
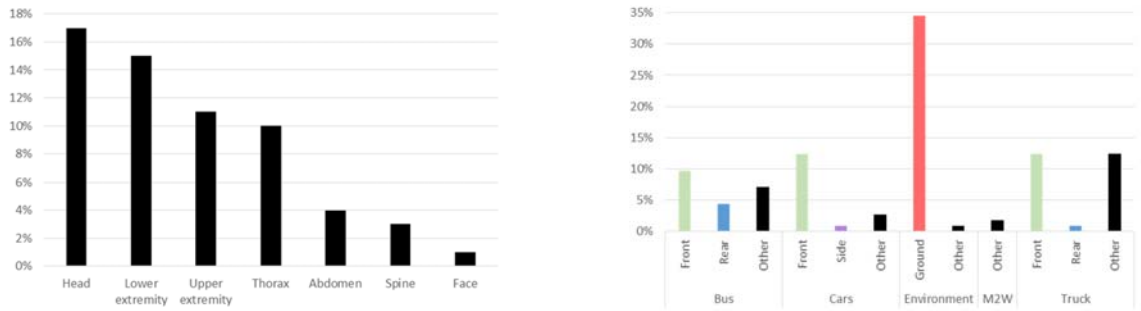


Fig. 1. Collision partners for VRU.

J. Shaikh is a Senior Accident Research Engineer with Autoliv India Pvt. Ltd, Bangalore. R. Fredriksson, PhD, is a Senior Specialist at Autoliv Research in Sweden.

Of 123 M2W accidents, 40% were fatal, 43% reported serious injury and 17% reported minor injury. In total, 241 vehicles were involved, of which 135 were M2W. There were 192 persons involved (134 riders; 58 pillion riders). The helmet-wearing rates for riders were: 86% not used (115); 10% used (14); 4% unknown (5). The helmet-wearing rates for pillion riders were: 97% not used (56); and 3% unknown (2). Only 69 occupants fit our criteria for inclusion, with 123 occupants excluded due to unavailability of injury details. We proceeded by only counting each injured body region once per occupant. Distribution of AIS2+ injured body regions and its injury sources are shown in Fig. 2(a) and 2(b), respectively.



(a) (b)

Fig. 2. Distribution of 119 AIS2+ injured body region and 113 injury sources for M2W occupants: (a) AIS2+ one injured body region once per occupant; (b) injury sources for AIS2+ injuries.

It is also of great interest to understand the pre-crash event scenario that precedes an accident. The most common pre-crash event was M2W impacting oncoming vehicle (head-on), followed by M2W losing control. In addition, oncoming vehicle turns/overtakes were also common, as were M2W from side drives/crosses out in front of vehicle. Of 30 Pedestrian accidents, 67% were fatal, 30% serious, and in 3% minor injury was sustained. There was a total of 38 Pedestrians, but we focused on 19 Pedestrians, excluding the other 19 due to unavailability of injury details. Head and lower extremity was the main AIS2+ injured body region reported, while hood and tires/wheels were the main source for AIS2+ injuries.

IV. DISCUSSION

VRUs are most likely to suffer head and lower extremity injuries in road accidents. When looking to injury source, ground and front of the vehicles contribute to nearly 69% and 50% of all AIS2+ injury sources for M2W and Pedestrians, respectively. It is obvious that there should be stricter law enforcement with regard to the wearing of helmets for M2W/Bicyclists, and that proper pedestrian paths/crossings would result in less head injuries. The major collision partner for VRUs is cars and trucks (Fig. 1), but if the front, energy-absorbing outer structure is redesigned, it could address 34% and 44% of injury sources for M2W and Pedestrians, respectively. Injuries from car impacts could be reduced using either increased energy-absorbing structures or more advanced devices, like pedestrian protection hood lifters and airbags. Given all the current developments and innovations, it could also be possible to reduce frontal impacts to VRU by using active systems in cars, e.g. radar or vision detection and mitigation. This would be beneficial not only for pedestrian impact but also for the common scenarios in this study where the car did not see the M2W, therefore overtook or crossed in front of the approaching M2W. In a German study, Fredriksson *et al.* [3] showed that 31% of fatal M2W accidents are due to M2W losing control, and this occurred frequently in the current study, too. An anti-lock braking (ABS) system and possibly also stability control on the M2W could prove an efficient countermeasure. Due to lack of injury records, it is impossible to consider all occupants when carrying out a detailed study. Further steps are necessary to consider pre-crash scenarios and analyse the data on an accident and a person level with regard to severity, in order to identify the optimum active and passive safety products for the Indian road environment.

V. REFERENCES

[1] World Health Organization, *Global Status Report On Road Safety*, 2015.
[2] Rameshkrishnan, N. *et al*., IRCOBI, 2013.
[3] Fredriksson *et al.*, IRCOBI, 2015.