Road traffic fatalities in India: Evaluation of injury severity, fatality risk and quality of autopsy reports

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I. INTRODUCTION

For decades, Road Traffic Injuries (RTI) have been one of the leading causes of death in the younger populations of industrialised countries. In India, 150,785 people died in Road Traffic Accidents (RTA) in the year 2016 [1]. In order to assign rational priorities to countermeasures to combat this problem, it is first necessary to measure the level of injury severity of road traffic casualties and the fatality risk involved. This paper aims to assess the fatality risks of road traffic casualties in India, based on Abbreviated Injury Scale (AIS) 2008, and to compare the findings with those of previous studies. It will also compare the differences in results between the studies and examine the reasons behind them.

II. METHODS

The government of India does not have a national representative sample of in-depth RTA data to give a comprehensive overview and to evaluate the epidemiology of RTI and the related injury burden. To address the deficit of in-depth RTA data in India, a consortium of automotive original equipment manufacturers came together in 2011 to support the development of an in-depth road accident database, christened the Road Accident Sampling System – India (RASSI) [2]. RASSI data between April 2011 and March 2017 (six years) of 2,336 crashes from five different cities in India were considered for this study, and the analysis was done in two parts. Part 1 analysed the fatality risk of road traffic casualties in the RASSI database based on Maximum Known AIS (MKAIS). Part 2 analysed a total of 1,016 fatal accidents from the RASSI data between April 2011 and March 2017, which resulted in the deaths of 1,298 people. Autopsy reports were available for 955 victims. Injury severities of these fatal victims were analysed using AIS 2008. To assess the fatality risk of MAIS 2 and 3 injuries, 447 (47%) fatalities who had died of injuries with MKAIS-2-3 were considered for this study.

III. INITIAL FINDINGS

A total of 7,657 people (vehicle occupants and pedestrians) were involved in 2,336 accidents, out of which there were 4,784 (62%) casualties. Medical records of injuries, such as autopsy reports, discharge summary, wound certificates, etc. were available for 1,952 casualties (41%). Injuries were scaled using AIS 2008.

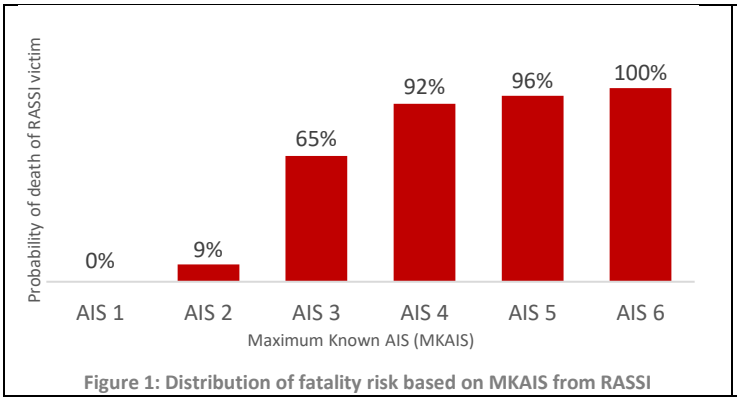

Figure 1: Distribution of fatality risk based on MKAIS from RASSI

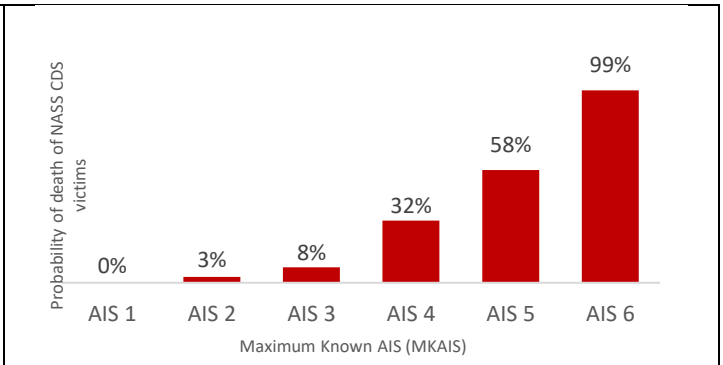

Figure 2: Percentage probability of fatality based on MKAIS from NASS CDS

The formula used for developing the fatality risk chart (Figure 1) based on MKAIS from RASSI database is,

$$\text{Probability of death} = \frac{MKAIS_{if}}{MKAIS_{ia}} \times 100$$

Where,
i = Specific AIS severity
f = Count of total fatalities at $MKAIS_i$
a = Count of total casualties at $MKAIS_i$

The fatality risk of road traffic casualties in the RASSI database was evaluated using MKAIS and is presented in Fig. 1. For the purpose of this study, Fig. 1 does not consider the victims age, sex, MKAIS body region, EMS response time, EMS ability to perform triage and quality of trauma care provided in the hospital. The fatality risk calculated as per the RASSI database was 9% for MKAIS-2 injuries and 65% for MKAIS-3 injuries. Caution is advised, however, as this analysis is based on a small sample of casualties from the RASSI database, therefore the fatality risks estimated here may be high and may not be an accurate representative value. The probability of fatality as per MKAIS based on National Accident Sampling System (NASS) data between 1988 and 2007 developed by Goertz *et al.* [3] is presented in Fig. 2. As per Fig. 2, the probability of death for AIS-2 injuries was 2% and for AIS-3 injuries was 8%. A similar study by Ulman et al. [4] also used NASS data to evaluate the correlation between the three most severe injuries in a crash victim and the probability of death. The overall mortality rate evaluated for victims with injuries of MAIS-2 was 3% and of MAIS-3 was 4%. It can be seen from Fig. 1 and Fig. 2 that the fatality risk estimated from RASSI differs a lot from the fatality risk estimated from NASS except for MAIS-1 and MAIS-6.

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IV. Discussion

AIS has been proven to be a convenient scale for individual injuries, but as most victims sustain multiple injuries, it is difficult to relate AIS directly to a probability of death. The discrepancies in the fatality risk estimated from the RASSI database are not entirely a result of problems with the scale itself, but may also result from the quality of medical records. The limited information available in the injury records may lead to inaccurate and incomplete coding of injuries.

In order to understand the problems related to the quality of the medical records for the RTIs, we analysed 447 road traffic casualties from the RASSI database who had died of MKAIS-2-3 injuries. All road traffic fatalities in India are subjected to a medico-legal autopsy, and the documentation of injuries in these autopsy reports is similar all across India – unlike the hospital reports, which vary greatly across numerous parameters. The age of the victims ranged from <1 year to 86 years, with the greatest number of victims of occurring in the 21-40 yo (year old) age group (44%), followed by 41-60 yo (27%), 0-20 yo (15%), 61-80 yo (10%) and 80-100 yo (1%). In 3% of the victims the age was not available. The distribution of MKAIS body regions is shown in Fig. 3. The 447 fatal victims sustained MKAIS-2-3 injuries in 690 body regions. (It is important to understand that a victim may sustain MKAIS injuries in more than one body region, hence the sum of percentages will exceed 100%). Figure 3 shows that in 70% of the fatal victims the MKAIS body region was head, in 40% it was thorax and in 23% it was lower extremity. Other body regions had far less significance (≤4%) with respect to MKAIS. The distribution of number of injured MKAIS body regions is presented in Fig. 4. It shows that 56% of victims suffered MKAIS injuries in only one body region, 36% in two body regions and 7% in three body regions. There were victims who had sustained MKAIS injuries in more than three body regions, but such on occurrence was very low (<1%).

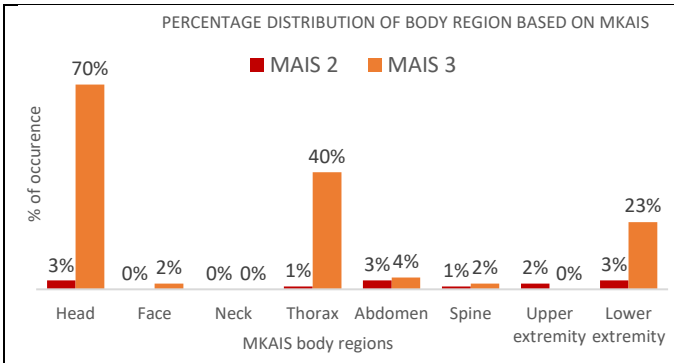

Figure 3: Percentage distribution of body region based on MKAIS

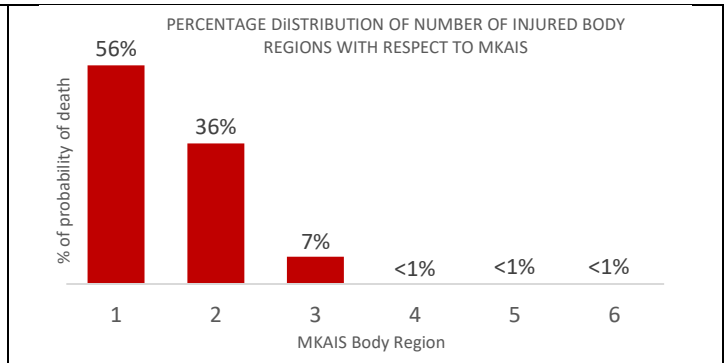

Figure 4: Percentage distribution of number of injured MKAIS body

The quality of autopsy reports of 447 fatal victims was reviewed. For the purpose of this study, only the top three most frequently injured MKAIS-2-3 body regions were considered, i.e. head, thorax and lower extremity. A review of head injuries reveals that while incidence of haemorrhage in head is recorded, detailed information, such as volume, thickness, specific anatomical region and coma information, is not provided (Example: Subdural hemorrhage present). In cases of laceration to the brain, the dimensions of laceration are not provided (Example: Brain found lacerated at frontal region). As far as fracture injuries are concerned, incidence of fracture in skull base is recorded, but type and complexity of fracture are not recorded (Example: Skull base found fractured). In cases of depressed fracture to skull vault, the magnitude of depression is not recorded.

A review of thoracic injuries suggests that, in cases of skeletal injuries, the number of ribs fractured is documented, but complexity and type of fracture, such as flail information, are not provided (Example: Right side ribs 2 to 7 found fractured). In cases of lung injury, incidence of contusions and lacerations are recorded, but the specific information with respect to lobe is not recorded (Example: Right lung found lacerated). Injuries to extremities are very common, but are generally not life-threatening. The mortality rate of extremity injuries, as per Ulman *et al.* [4], is just 3%. A review of injuries to lower extremity suggests that incidence of fracture, with details regarding type and location of fracture, is recorded in most cases. But in the case of pelvic fractures, detailed information as to stability of the structure is not provided in most cases (Example: Bilateral pelvis found fractured).

In conclusion, the review of the 447 autopsy reports of road accident victims from the RASSI database suggests that, while the incidence of injuries is recorded, in-depth information, as outlined above, is missing, and this information is crucial in determining the severity of the injury. The review of injuries documented in the autopsy reports of all 955 fatal victims from the RASSI database clearly shows that neurovascular lesions are not recorded in the autopsy reports. Of the 12,957 injuries documented in the autopsy reports, a mere 0.2% (29) injuries were to a neurovascular structure, which points to a paucity in the information recorded in the autopsy report. This research study suggests that the contrast in the fatality risk estimated, based on the RASSI database, may possibly be due to the lack of in-depth information in the autopsy reports, and the actual mortality rate estimated for MAIS-2-4 injuries may reduce substantially. Accordingly, our recommendation is that the quality of documentation of injuries in the autopsy reports in India be improved/monitored.

V. References

[1]Transport Research Wing (Ministry of Road Transport and Highways, Government of India), *Road Accidents in India* – 2016.
[2] Rameshkrishnan, N., *et al*., IRCOBI, 2013.
[3] Alan Goertz and Jennifer Yaek, SAE International, 2010.
[4] M. S. Ulman and R. L. Stalnaker, IRCOBI, 1986.