# Light Motor Vehicle (LMV) Crashes in India: Impact of Crash Dynamics on Mortality and Injury Outcomes

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## Objective

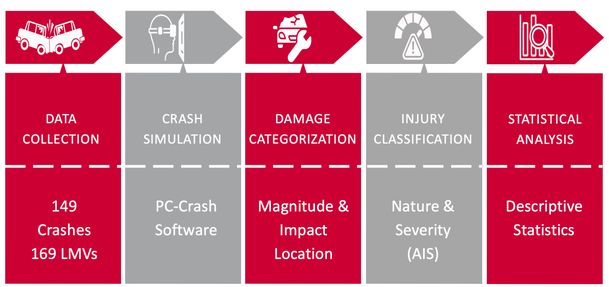
To analyze vehicle collision mechanics to map injury patterns, revealing insights that drive policy changes and engineering innovations.

## Introduction

- Road Traffic Crashes (RTCs): leading cause of mortality and morbidity.
- India has a higher rate of RTCs relative to the rest of the world, especially true with light motor vehicles (LMV) including cars, motorcycles, cycles, and rickshaws.
- Although there have been many studies that look at the effects of human behavior on RTCs, it is important to also study the effects of vehicle mechanics and crash dynamics on mortality and morbidity.

## Methods

- Retrospective cohort study in conjunction with the SaveLIFE Foundation
- Collected data of 149 crashes in 169 LMVs between the years 2019-2023.
- PC-Crash Software to simulate crashes and understand each mechanism (crash configuration, intrusion direction speed)
- Vehicular damage categorized by impact direction (longitudinal, lateral, vertical direction, catastrophic damage), magnitude.
- Car safety systems: use of seatbelt or automatic braking system (ABS)
- Injury classification via region according to Abbreviated Injury Scale (AIS)
- Descriptive statistics used




## Results

| Intrusion Direction | All Crashes (n=149) | Fatal Crashes (n=95) |
|---|---|---|
| Longitudinal | **86 (57.4%)** | **51 (53.6%)** |
| Lateral | 28 (18.6%) | 18 (19.2%) |
| Vertical | 23 (15.7%) | 16 (17.2%) |
| Catastrophic Damage | 12 (8.3%) | 9 (9.9%) |

**Fig. 1**: Majority of crashes in longitudinal direction

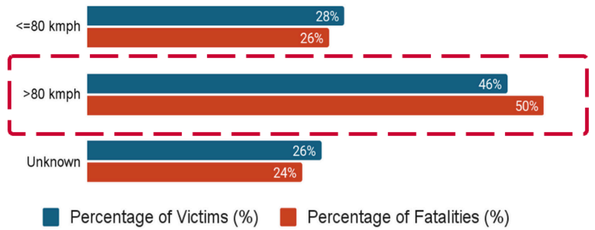



**Fig. 2**: Majority of vehicles were traveling greater than 80 kmph

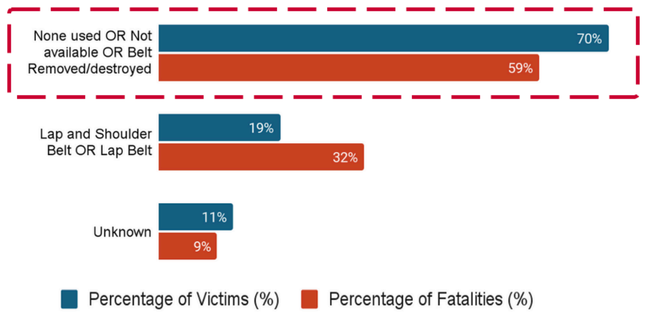



**Fig. 3**: Majority of vehicles either had no seatbelt or missing/stolen seatbelt

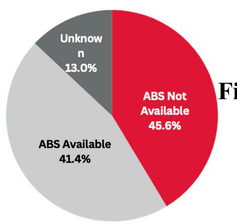



**Fig. 4**: Majority of vehicles did not have available automatic braking system (ABS)

## Results

A

| MAIS - Body Region | All Crash Victims (n = 149) | Fatal Victims (n = 95) |
|---|---|---|
| Face | 4 (3%) | 0 (0%) |
| **Head** | **92 (62%)** | **65 (68%)** |
| Lower Extremity | 7 (5%) | 3 (3%) |
| Spine | 4 (3%) | 3 (3%) |
| **Thorax** | **31 (21%)** | **20 (21%)** |
| Unknown | 7 (5%) | 6 (6%) |
| Upper Extremity | 4 (3%) | 0 (0%) |

B

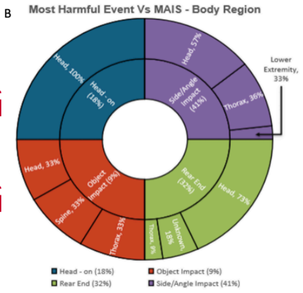



**Fig. 5: A:** Most commonly affected body regions: head and thorax. **B:** Majority of injuries in the most common harmful event (Side/Angle impact) were in the head and thorax

## Conclusions

- Strong correlation between crash configurations and injury type and severity.
- Current recommendations for vehicle safety improvements include enhancing structural integrity to reduce compartment intrusion, promoting widespread adoption of safety features such as ABS and seatbelts, and implementing effective speed management strategies.

## Acknowledgements

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