

CREATION OF AN IN-DEPTH ROAD TRAFFIC CRASH DATABASE FOR INDIA: THE COIMBATORE RURAL DISTRICT CASE STUDY

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ABSTRACT

Research Question/Objective:

To create an accident database for India based on proven in-depth accident investigation methodologies from the US and Europe.

Methods:

Researchers conducted the first ever in-depth crash investigation study in South India. Research was conducted on five accident-prone national highways in Tamil Nadu. Upon police notification, investigators examined 123 crashes on-site, followed by detailed inspections of vehicles and injury coding. The methodologies of NASS, the Pedestrian Crash Data Study (PCDS) and GIDAS were adapted to reflect the Indian experience. Injury reports obtained from hospitals were coded using the AIS and ICD-10.

Data Sources:

Data were obtained from: 1) Examination of the crash scene followed by vehicle inspection; 2) Information from police reports; and 3) Injury information from hospital records and autopsy reports.

Results:

123 crashes resulting in 43 fatalities and 89 injured road users were examined. The following observations were made:

- Head-on collisions occur more frequently on undivided highways while front-rear collisions are more frequent on divided highways.
- For heavy trucks, lack of rear reflectors, tail lamps and lack of underrun protection devices contribute to rear end collisions.
- For light vehicles, significant crash factors included departing from lane and driver loss of control. Hence, active safety systems including ABS systems and/or ESC (electronic stability

control) would be beneficial in reducing both crash frequency and severity.

- Most frequent intruding vehicle components were: A-pillars, windshield headers and instrument panels. Most common interior vehicle contacts were: seat backs, instrument panels and steering wheels.
- Pedestrian injuries can be reduced by providing infrastructure such as crossing zone markings and improving front vehicle structures.
- Lack of crumple zone in some vehicle types was associated with increased intrusion and injury.

The use of safety systems, such as helmets and seat belts, continues to be low.

Conclusions:

This study shows that detailed on-site crash investigation, with support of police and hospitals, provides significant benefits into understanding and mitigating injuries in India. This data also helps to address the effectiveness of infrastructure measures that are currently being developed in India.

Limitations of Study:

Injury data was often sparse and not detailed. In addition, these studies focused on national highways in a rural area for one state. A follow-up study on urban streets and an expansion to other states is required to address all types of crashes and injuries.

What does the paper offer that is new in the field?

This paper offers the first in-depth traffic crash research performed in India, with findings for improving vehicle, occupant and road safety.

INTRODUCTION

With over 3,300,000 kilometers (2,050,620 miles) of roads, India has the second largest road network in the world [1]. Road traffic fatalities in India have been steadily increasing, from 91,376 in 2004 to a staggering 118,239 only four years later in 2008, more than any other country in the world [2].

This alarming increase in road traffic fatalities is due in no small part to the huge increase in vehicle ownership, driven by the booming Indian economy. India's Gross Domestic Product rose by 7.2% from 2009 to 2010 [3] alone. This economic boom is bringing vehicle ownership within reach for an increasing percent of the population every year. According to the Society of Indian Automobile Manufacturers (SIAM) vehicle sales in India went from 6,810,537 during 2003-2004 to 12,292,770 from 2009-2010 [4].

Indian national highways are the most important roadways in the country and are developed and maintained by the central government. National highways account for just over 2% of India's road network but it is estimated that they carry approximately 40% of the nation's road traffic [1]. In addition, it is estimated that nearly 40% of road traffic fatalities occur on national highways in India, despite their representing such a small percentage of total roadways. In Tamil Nadu, national highways account for 2.5% of the length of all roads yet account for 33.2% of all crashes and 35.4% of all fatalities. This adds up to nearly one fatality per kilometer per year, highlighting the dangers of Indian national highways [5].

BACKGROUND

JP Research India (JPRI), an engineering and statistical consulting firm, (headquartered in the US) pioneered the accident data collection effort in India in 2008. To date, over 100 motor vehicle crashes have been investigated through 3 completed projects.

The first project involved examining crashed vehicles in service centers after receiving notification from Indian auto insurance companies [6]. This project showed the feasibility of collecting crash data in India. The second crash research project involved working in conjunction with the Tamil Nadu police in the Kanchipuram district. Upon notification from the police, JPRI researchers arrived on-scene to take photographs and collect on-scene

information relating to the crash. JPRI's third project focused on several national highways around the city of Coimbatore with police collaboration and notification. As an additional component of the Coimbatore crash research project, JPRI started soliciting cooperation from hospitals and medical examiners in order to obtain reliable crash injury information [7].

METHODOLOGY

This section details the procedures used to collect data on-scene, perform post-crash vehicle inspection and record injury data. A coding manual containing about 400 variables was developed to provide teams standardized definitions for data collection. The investigations included three stages: 1) scene inspection; 2) vehicle inspection and 3) injury data collection. Each stage is discussed in more detail below.

Scene Inspection

The crash scene inspection included taking pictures of the roadways and vehicle paths, as well as final rest positions of the vehicles if they were still on-scene. In addition, photos were taken of any scene evidence, such as skid marks, debris or gouges in the roadway.

A scene sketch, a to-scale diagram of the crash scene, was then created, which included the road, any evidence and vehicle final rests. This was accomplished by using a measuring wheel to take measurements based on an X and Y axis created by the researcher. These measurements and sketches were then taken back to the office where the researchers created an electronic to-scale scene diagram using the Microsoft Visio drawing program.

Global Positioning System (GPS) logs were also taken for every accident spot, in order to map out the locations of the crashes investigated.

Finally, infrastructure variables were collected on scene to be entered into the database. These included the configuration of the road and roadside, traffic control information, road and weather conditions and other pertinent information. Figures 1A, 1B and 1C show the types of highways investigated in the studies.



Figure 1A, 1B and 1C: Types of Indian National Highways Studied.

Vehicle Inspection

JPRI usually conducted a detailed vehicle inspection after the vehicles had been removed from the crash scene. Photographs showing vehicle damage, crush, belt marks, intrusion and contact points were taken. JPRI vehicle inspection and data collection methodology were based on National Automotive Sampling System (NASS, USA), German In-Depth Accident Study (GIDAS, Germany) and the Co-operative Crash Injury Study (CCIS, UK).

Data forms addressing different types of road users were developed. For pedestrians, data on height/ weight, as well as their knee, hip and shoulder height measurements were used to match up vehicle damage, although this data was not always available. In a methodology similar to the National Highway Traffic Safety Administration's (NHTSA) Pedestrian Crash Data Study (PCDS), an X and Y axis was created on the vehicle's hood and windshield. The X axis is the farthest forward point of the base of the windshield, and is extended left and right. The Y axis is the center of the vehicle. Then, any pedestrian contact points (dents, blood, scuffs, etc) were measured along this axis to establish the specific point on the vehicle where the contact occurred. In addition, 'wrap' measurements were taken for any vehicle that struck a pedestrian, as shown in Figure 2. Wrap measurements are measurements taken from the ground that wrap around the vehicle. For example, the wrap measurement for the base of a windshield would start on the ground and wrap up the vehicle's bumper, across the entire length of the hood and then end at the base of the windshield. These measurements were useful in establishing how the pedestrian interacted with the vehicle during a crash.

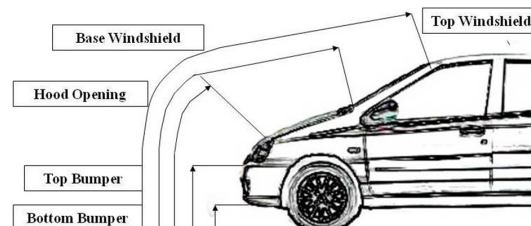


Figure 2: Vehicle Wrap Measurements Collected for Pedestrian Crashes.

Exterior Inspection There were several data elements that were collected on the exterior of every vehicle included in JPRI's study. Six crush measurements were taken for each impact in a method that is internationally accepted. These measurements could be used later to calculate an approximate delta-V associated with each crash event by inputting the results into the CRASH3 program. These vehicle crush measurements were also used to code a Collision Deformation Classification (CDC) [8] or Truck Deformation Classification (TDC) [9] for each impact. These are 7-character codes that describe the direction of force, location and specifics of each crash event. The CDC and TDC were both developed by the Society of

Automotive Engineers (SAE). In addition, post-crash measurements were taken of the vehicle's wheelbase, track width and other specifications to compare pre and post crash measurements. Information about tires was also collected, including tire pressure and tread depth. During the exterior vehicle inspection, information was collected on vehicle visibility (presence of reflectors and lights), vehicle integrity (if any doors or windows opened during the crash), and damage to vehicle's fuel system.

Interior Inspection After the completion of the vehicle exterior inspection, JPRI researchers conducted detailed interior inspections for the vehicles in the study. The interior of the vehicle was searched for places that the occupants could have contacted, and these contacts were then documented. Contacts included dents, stress marks, blood and other marks that indicate that a vehicle occupant touched a particular interior vehicle component. Measurements were also taken of all intrusions into the vehicle passenger compartment. This was achieved by taking intruded measurements and comparing these to the same measurement in an undeformed vehicle. Finally, JPRI researchers documented the performance of the vehicle's safety systems. This included information about the seat position and performance, airbag availability and performance and seat belt use. Seat belt use was determined by examining the belt and buckle for evidence of use during the crash.

Medical Information

With cooperation from local hospitals and police departments, JPRI researchers were able to examine autopsy reports and medical records for people involved in crashes. Once this medical data was collected, it was coded in two formats. First, the Abbreviated Injury Scale (AIS) [10] was used to document the injury. In addition, the International Classification of Disease- 10th edition (ICD10) [11] was also used to code the victims' injuries. Occupant and pedestrian injuries were linked to vehicle contacts to understand the injury consequences.

Database Design

While in the field, JPRI researchers used forms to document all the information they collected on-scene and at vehicle inspections. Data was inputted into a relational database, where the variables were coded using a standardized

format. A coding manual was also developed to ensure the quality and consistency of the data entry. Appendix A presents some of the approximately 400 accident, vehicular and occupant data elements collected as part of these studies.

RESULTS

To date, JPRI has investigated 123 crashes (43 fatalities, 89 injuries) during its three traffic safety studies. These studies spanned five national highway sections, one in the Kanchipuram district (NH 45) and four around the Coimbatore district (NH 47, NH 67, NH 47 Bypass and NH 209) of Tamil Nadu, India¹. Figure 3 shows the breakdown of vehicles by vehicle type. As this figure illustrates, there is a great deal of vehicle diversity on Indian national highways.

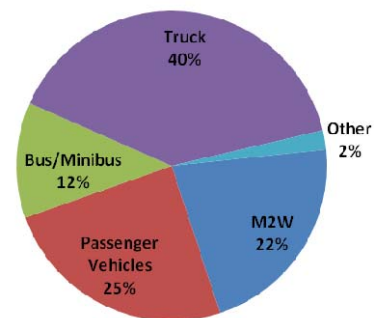


Figure 3: Distribution of Crash Vehicles by Vehicle Type (2008-2010).

About 40% of vehicles involved in crashes were heavy trucks, followed by passenger vehicles², which accounted for 25% and then motorized two wheelers (M2Ws), accounting for 22% of vehicles.

About 62% of crashes studies were multi-vehicle crashes. Figure 4 presents these crashes by crash type.

¹ The 2010 Coimbatore Study was sponsored by Robert Bosch Engineering & Business Solutions, India.

² Passenger vehicles include passenger cars, SUVs and vans.

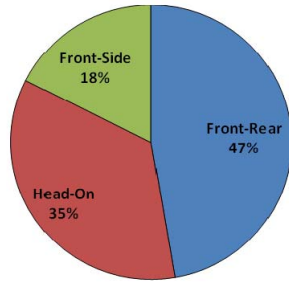


Figure 4: Multi-Vehicle Crashes, by Crash Type (2008-2010)

Front-rear crashes were the most common crash type, accounting for 47% of all crashes. This was followed by head-on crashes, which accounted for 35% of crashes

Head-on crashes were more common on undivided highways while front-rear collisions were seen more on divided national highways than on undivided highways. Many front-rear crashes are caused by vehicles breaking down and not having adequate space to pull off the road due to small shoulders, or vehicles decelerating in a traffic lane to make a U-turn or to enter a shop in a traffic lane due to there being no deceleration lane [12]. The difference in crash configurations by the two different road types illustrates the fact that different road types can produce different crash scenarios.

Given the high incidence of front-rear collisions and heavy truck involvement, underrun protection for heavy trucks is essential for road safety. Underride impacts usually results in the passenger vehicle taking the impact at the level of the hood, radiator or A-pillars and not the bumper, where the vehicle is designed to absorb an impact. The importance of underrun protection is compounded by the fact that many heavy trucks in India are not equipped with reflectors or brake lights, making them extremely difficult for drivers to see at night. This lack of visibility makes night time rear end collisions with heavy trucks more likely. Figure 5 illustrates an example of a heavy truck examined during the Coimbatore study that was not equipped with underrun protection or rear reflectors.



Figure 5: Heavy Truck Without Functioning Brake Lights, Rear Reflectors or Underride Protection During the 2010 Coimbatore Study

Discussion of Coimbatore Study (2009 and 2010)

For a total of 50 cases, in-depth investigations were performed and more detailed data elements were gathered based on the 400 variables developed were gathered. Some of the data elements included: crash type, occupant safety system use, pre-impact stability, intrusion (by magnitude and component), pre-impact movement, injury severity, crush measurements and occupant contacts.

This section presents a discussion of crash types, belt use, pre-impact stability, intruding components and occupant contact points associated with cases investigated. For each topic, examples from cases are included for a thorough understanding of accident patterns.

As seen in Figure 6, 48% of light vehicle crashes were head-on collisions. On undivided highways, there were many opportunities to encroach into oncoming traffic unintentionally or during a passing maneuver.

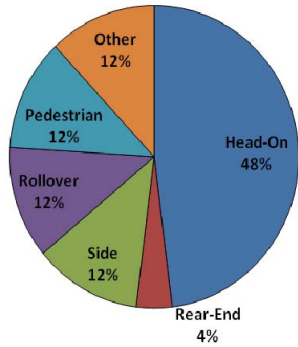


Figure 6: All Light Vehicle Crashes by Crash Type

Safety system use was low for all vehicles involved in the study regardless of the type of system available. The studied passenger vehicle population had a belt use of 27%, as seen in Figure 7.

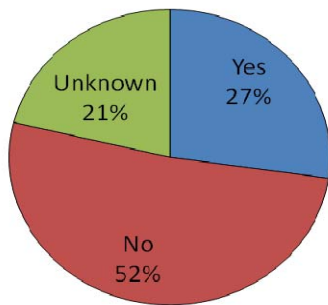


Figure 7: Seatbelt Usage for Occupants in Passenger Vehicles

Helmet use was also found to be very low among M2W drivers and passengers in the study. Despite helmet use being mandatory by law in India, the actual rate was seen to be extremely low in crashes researched, as is shown in Figure 8. Many riders were observed to have suffered serious head injuries due to lack of helmet use.

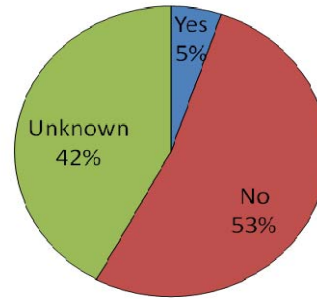


Figure 8: Helmet Usage for Riders on Motorized Two Wheelers

The pre-impact stability of vehicles was assessed by examining the accident scene, vehicle skid marks, direction of traffic, terrain and other factors prior to crash. 11% of vehicles involved driver losing control prior to impact, as shown in Figure 9. Loss of control was defined as when a vehicle was not tracking straight (following its intended path), but instead was skidding or rotating either longitudinally or laterally prior to impact. For example, if the vehicle was rotating clockwise or counterclockwise and was not following its intended path, this was considered a loss of control for the vehicle's pre-impact stability.

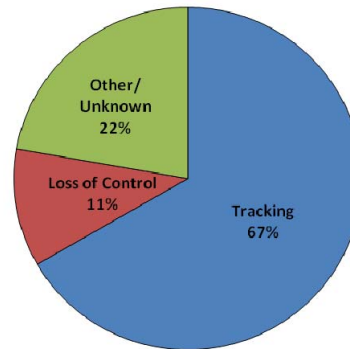


Figure 9: Distribution of Pre-Impact Stability

The installation of electronic stability control (ESC) could be a useful countermeasure to maintain vehicle control. For example, one of the cases investigated (Figure 10A) shows the skid marks left on the roadway by a vehicle that lost control and departed the roadway, and then rolled over. Figure 10B shows the scene diagram for this crash and illustrates the sequence of events leading up to the crash that were coded by the investigators. While rollovers were relatively infrequent in the studied population, unique data elements for rollover

crashes were coded. These included: pre-rollover maneuvers (whether the vehicle departed road, struck an object, returned to road, etc); rollover initiation type (a trip-over, climb-over, impact with object, etc); the number of quarter turns and the rollover distance. In this case, the vehicle passing another vehicle in the oncoming traffic lane attempted to steer back into its lane. The vehicle lost control and began to rotate and departed the roadway. The vehicle's pre-rollover maneuver was departing the roadway and the rollover event was a trip-over. The vehicle then rolled seven quarter turns, over a distance of 47 meters (154 feet), as shown in Figure 10C, which indicated that this was a severe crash.

Had this vehicle been equipped with ESC, the driver could have maintained control and remained on the roadway, avoiding this crash altogether.



Case 31	Weather : No adverse atmospheric conditions
NH 47 Bypass	Date : 16/08/2010
All dimensions are in metres	Time : 2130

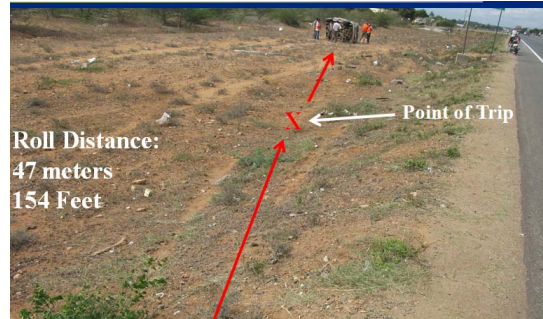
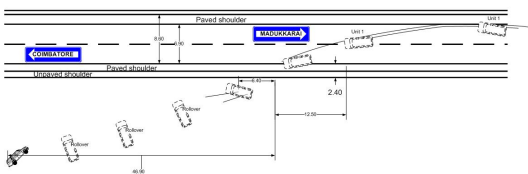


Figure 10A, 10B and 10C: Example of a Rollover Crash Caused by the Loss of Control of the Vehicle in the Roadway

In addition to accident factors, the study team looked at vehicle factors related to crashes. While one vehicle can have multiple intrusions to a single component (such as two A-pillar intrusions), each component was only counted once per vehicle to examine and identify intrusion patterns. Intrusion per vehicle by intruding component, as seen in Figure 11, shows that the most frequently intruding component was A-pillar, followed by windshield header and the instrument panel.

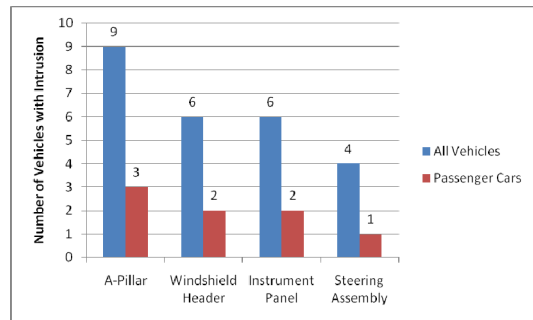


Figure 11: Passenger Compartment Intrusion by Intruding Component

The actual amount of intrusion is determined by comparing the measurement at a particular location in the damaged vehicle with that of an exemplar vehicle. An example of an A-pillar intrusion sustained during a crash is illustrated in Figure 12. This intrusion was sustained when the vehicle was involved in a frontal impact with another vehicle, resulting in induced damage and intrusion to the A-pillar.



Figure 12: Example of A-Pillar Intrusion

Vehicle intrusion is related to injury and crash severity. For many crashes, the crash severity involved mass incompatibility and travel speed (in rollovers crash severity involved the number of rolls or the drop in terrain). These factors were associated with a high degree of intrusion. There was also lack of crush space (crumple zone) in some vehicles that contributed to intrusion into occupant compartment and injury.

In addition to vehicle factors, occupant factors including contact points (interior and exterior) and restraint use were examined. Figure 13 presents occupant contact points. The high number of contacts to a vehicle's frontal components, such as the instrument panel, steering wheel/assembly and the windshield suggest that airbags or collapsible steering columns could be effective safety measures to mitigate occupant injury. Needless to say, an increase in restraint system use would significantly reduce injuries in these types of crashes.

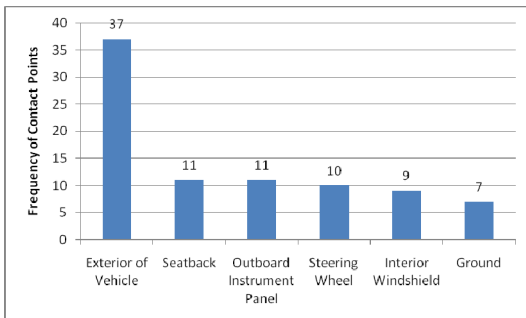


Figure 13: Frequency of Occupant/Pedestrian Contact Points

An example of occupant contact to the steering wheel is shown in Figure 14. In this frontal crash, the unrestrained driver's chest and head came into contact with the steering wheel rim

and hub. A collapsible steering column and frontal airbags along with belt use would have been highly effective in preventing or reducing the severity of injury.



Figure 14: Example of Steering Wheel Contact

Aftermarket parts are observed to be much more common and sometimes unique to the Indian market than they typically are in western countries. Add-on parts such as brush guards and Liquefied Petroleum Gas (LPG) tanks were seen on several case vehicles. These parts can have unintended consequences during a crash, causing damage to the interior of a vehicle, as illustrated in Figure 15. In this crash, the aftermarket LPG tank was not secured properly and moved forward from the trunk during a frontal impact, striking the back of the driver seat and potentially causing occupant injury.



Figure 15: Example of an Aftermarket LPG Tank Contacting Front Seat

Aftermarket parts can also increase the severity of crush and intrusion to the exterior of a vehicle. In this crash, the crush and intrusion to the front of the vehicle followed the outline of the brush guard. It was determined that the brush guard

pushed into the vehicle’s own passenger compartment, causing more damage to the vehicle than if it had not been there. As shown in Figure 16, this was determined because the vehicle struck another similar vehicle without a brush guard, and the other vehicle had much less severe intrusion and damage as a result of the impact.



Figure 16: Example of Vehicles Involved in a Head-On Crash, One with an Aftermarket Brush Guard (Left) and One Without (Right)

In addition to vehicle occupants, several cases involving pedestrians were investigated. Figure 17A illustrates a case where a pedestrian was attempting to cross a roadway immediately after exiting a bus. There was no pedestrian infrastructure at this bus stop and the pedestrian’s vision was obstructed by the back of the bus while crossing the street. Upon examination, it was found that the head of the pedestrian had contacted the hood of the vehicle during the collision, as evidenced by the dent in the hood shown in Figure 17B. The high number of pedestrian head contacts to the hood observed during the study highlights this as an important component for further review and analysis of pedestrian safety.

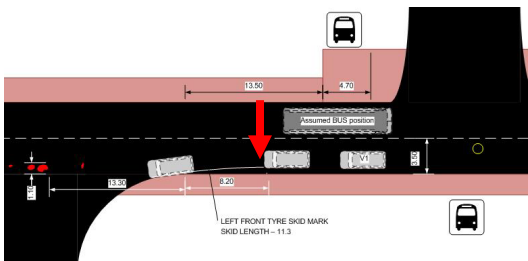


Figure 17A and 17B: Example of a Pedestrian Crash with Head Contact to the Hood

Another issue identified was the lack of crumple zones on the front of some vehicles, as illustrated in Figure 18. If this vehicle had been equipped with a larger frontal structure, there would have been more room for the vehicle to absorb the crush from the impact before intrusion into the passenger compartment began.



Figure 18: Example of the Lack of Crumple Zone

In-Depth investigations provided many significant insights not readily apparent with police reports. Issues related to road traffic controls, infrastructure, road factors, vehicle factors, driver behavior, occupant and pedestrian factors show the need for data collection at the level of detail used in this study.

LIMITATIONS

Collecting real-world crash data creates a unique set of challenges and limitations for researchers. JPRI investigators were reliant on local police for notification of crashes. This means that JPRI data is a sample of crashes that police were aware of, not all crashes. Though the team arrived at the scenes promptly, some evidence

was not clear due to traffic conditions or other factors. Vehicles were not always available for complete inspection as they were sometimes moved away from the crash scene by the vehicle owner or a third party. Varying degrees of crash information were available from police and hospital sources about the vehicle occupants. While there was often very detailed information in police reports and medical records, these data were sometimes inconsistent or not very specific, particularly for injury information. The sample areas for these studies were Indian national highways or rural lanes, and not urban streets and they represent data from one state and not all the populated states across the country. JPRI is continuing this crash research project in 2011 and the number of cases collected for the database is expected to grow significantly over the coming years.

CONCLUSIONS

This is the first successful in-depth traffic research project to be conducted in India. The results from the study show that soliciting cooperation from police and hospitals is a sustainable way to collect reliable and accurate information on traffic crashes. In addition, these studies show that by analyzing the data collected, there are many important safety issues that were highlighted concerning road infrastructure, vehicles and road users.

The vehicle population in India is very different from those in North America and Europe, with a much higher number of M2Ws on the roads. Instances of safety system use, such as seatbelt and helmet use, was observed to be very low in crashes that JPRI studied, especially when compared with rates of safety system use in North America or Europe.

Infrastructure issues were also seen as a factor in many of the crashes studied by JPRI. The lack of pedestrian safety features (road crossing signals, crossing zone markings) was seen as a potential area for improvement. In addition, the type of national highway was also seen to influence the type of crashes that were seen on a given roadway. When highways were undivided, head-on crashes were common due to vehicles passing in the oncoming traffic lane. When highways were divided, this prevented many head-on crashes but the number of front-to-rear crashes increased.

Issues involving vehicle design/equipment often depended on vehicle type. For heavy trucks, the lack of rear reflectors, tail lamps and underrun

protection were all seen as areas for improvement. For light vehicles, loss of control was seen as a factor in many crashes. ESC could potentially help prevent these crashes by helping maintain vehicle stability. The most common intruding components were seen to be A-pillars, the windshield header and the instrument panel. Intrusion was often associated with crash severity factors including vehicle mass incompatibility, travel speed and lack of crush space. For occupant contacts, the seat back, instrument panel and steering wheel were observed to be the top three components. In addition, both light vehicles and heavy trucks were observed to lack crumple zones. This was associated with higher levels of intrusion and injury.

This traffic crash research project undertaken by JPRI has provided a framework for creating an in-depth crash research program in a developing nation. Through cooperation with local police and hospitals, detailed and reliable data can be collected on real-world crashes and the resulting data can be used to identify areas of improvement for road safety.

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**Appendix A: Selected List of Variables
Collected as Part of the JPRI Coimbatore
Study**

Accident Level:

1. Crash day/month/year/time
2. Crash configuration
3. Roadway type
4. Road structure
5. Traffic flow
6. Roadway profile
7. Roadway surface conditions
8. Weather/Lighting conditions
9. Signs/Traffic control devices
10. Shoulder/Roadway widths
11. GPS coordinates
12. Accident Summary
13. Struck object information

Vehicle Level:

14. General area of damage
15. Class of vehicle
16. Damage severity ranking
17. Vehicle body type
18. Vehicle make, model, year
19. General vehicle specifications
20. Vehicle Identification Number (VIN)
21. Insurance information
22. Driver license information
23. Override/Underride
24. Driver distraction
25. Pre-event movement
26. Critical pre-crash event
27. Avoidance maneuver
28. Pre-impact stability
29. Pre-impact location
30. Primary Direction of Force (PDOF)
31. Pre-impact travel speed
32. Certified altered vehicle
33. Vehicle defect
34. Contributing factors
35. Cargo type
36. Cargo secured
37. Driver seat construction
38. Seatbelt availability
39. Pretensioner availability
40. Airbag availability
41. Antilock brake availability
42. Electronic stability control availability
43. Underride protection
44. Tire damage
45. Tire pressure
46. Tire tread depth
47. Steering type
48. Steering wheel deformation
49. Brake type

50. Doors opened during crash
51. Door damage
52. Integrity loss
53. Tail lamp availability/functionality
54. Reflector availability/functionality
55. Mirror availability/functionality
56. Windshield wiper type
57. Motorcycle change in wheelbase
58. Motorcycle leg guard damage
59. Motorcycle fork damage
60. Motorcycle handlebar damage
61. Rollover type
62. Number of quarter turns
63. Direction of rollover
64. Location of rollover
65. Interrupted roll
66. Rollover distance
67. Fire information
68. Fuel tank type/location/damage
69. Intrusion to interior compartment
70. Collision Deformation Classification
71. Crush profile information
72. Delta-V (from Crash-3)
73. Window glazing details
74. Vehicle wrap measurements (for pedestrian crashes)

Occupant Level:

75. Occupant contacts to vehicle
76. Pedestrian contacts to vehicle, including X-Y axis mapping
77. Occupant injury information (AIS and ICD-10 coding)
78. Link of occupant contacts and injuries
79. Occupant demographics
80. Seating position
81. Seat details
82. Occupant role
83. Ejection
84. Entrapment
85. Occupant mobility
86. EMS arrival/departure
87. Hospital admittance/discharge
88. Discharge status
89. Treatment
90. Belt use
91. Airbag deployment
92. Pretensioner deployment
93. Helmet usage
94. Pedestrian anthropomorphic measurements
95. Pedestrian demographics
96. Pedestrian movement
97. Pedestrian orientation
98. Pedestrian-vehicle interaction
99. Pedestrian avoidance