Understanding the Factors Influencing Heavy Vehicle Related Fatal and Serious Injuries in Victoria, Australia

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Abstract

Limited number of studies were identified to investigate factors contributing to injury severity of heavy vehicle crashes in Victoria. This gap indicates a key need to further analyse the factors influencing injury severity of heavy vehicle crashes. In this study, an analysis of crash data was conducted using crash data provided by the TAC. The analysis was conducted using descriptive analysis, chi-square test and the binary probit model. Results showed that time of day, crash type, road pavement condition, crash location, speed limit, age, license type, restraint usage and vehicle type were the factors significantly affted the serious injury outcomes.

Background

With the growing importance of heavy vehicle transport in Australia, there has been sustained growth in the vehicle fleet, composition and vehicle technologies. These have led to associated increases in heavy vehicle crashes as reflected in the Victorian statistics which indicate a doubling in the number of fatalities in heavy vehicles crashes from 28 in 2013 to 56 in 2014 before falling to 41 in 2015 (VicRoads 2016).

According to the Bureau of Infrastructure, Transport and Regional Economics (BITRE 2016), there were 23 fatalities from crashes involving articulated trucks in Victoria in 2011, followed by 30 in 2012 and a reduction to 14 in 2013 before increasing to 20 in 2015. Over the same period, the number of fatalities from crashes involving heavy rigid trucks was 14 in both 2011 and 2012, increasing to 23 in 2014 before falling to 18 in 2015.

Literature review of factors influencing heavy vehicle crashes revealed that limited number of studies were identified to investigate factors contributing to injury severity of heavy vehicle crashes in Victoria. This gap indicates a key need to further analyse the factors influencing injury severity of heavy vehicle crashes.

Method

To gain a better understanding of factors contributing to heavy vehicle crashes in Victoria, a brief literature review was conducted. The review identified key characteristics, methodologies, data and assessment periods used in analysing heavy vehicle crashes in Victoria between 2000 and 2016.

Following the literature review, an extensive analysis of crash data was conducted using crash data provided by Transport Accident Commission (TAC). This is an injury based data linking insurance, hospital and VicRoads RCIS (i.e. police data) data bases. In this data, 16.7% and 83.3% of fatal and serious injuries were sustained by heavy vehicles and other vehicles occupants respectively. This statistics is 26.4% and 73.6% for total injuries respectively. The analyses involved:

- identifying key factors associated with fatal and serious injuries (FSIs) resulted from heavy vehicle crashes. This analysis includes all user types involved in heavy vehicle crashes.
- identifying key risks in casualties sustained from heavy vehicle crashes.

The analysis was conducted using descriptive analysis, chi-square test and the binary probit model.

1. A Pearson's Chi-square test of independence was performed to identify significant variables affecting the dependent variable (injury severity)
2. A binary probit model was developed to determine the strength and importance of significant variables (identified using Chi-square test) in the crash serious injury outcome.

All the statistical analyses were conducted using IBM's Statistical Package for the Social Sciences (SPSS) version 22.

To establish the relationship between contributing factors and injury severity of heavy vehicle related crashes, a binary probit model was developed. The dependent variable in this analysis is the injury outcome which is a binary variable, with the response of interest referring to fatality and serious injury (FSI) and the response of contrast to slight injury or no injury (non-FSI). The model is a form of Generalised Linear Regression model which uses the maximum likelihood method to calibrate the model parameters. The model estimates the probability of being killed or seriously injured (FSI) in a heavy vehicle crash against sustaining a slight injury (non-FSI).

Results and Conclusions

The key findings indicated that:

1. Time of injury has a statistically significant impact on the probability of an FSI injury. Specifically, an FSI injury is less likely to occur from 6:00 am up to midnight relative to between midnight and 6:00 am as indicated by the negative coefficients.
2. The probability of an FSI injury decreases in a pedestrian crash relative to vehicle-to-vehicle crashes as indicated by the statistically significant estimate for pedestrian crash type.
3. The probability of an FSI injury increases for crashes at non-intersection locations compared to intersection.
4. While the results indicated a reduction in the probability of an FSI injury on unknown pavement conditions relative to dry pavement conditions, this result is difficult to interpret due to the uncertainties surrounding the true nature of the pavement conditions.
5. The analysis showed statistically significant results for all the vehicle types included in the analysis. The results indicated increases in the likelihood of an FSI injury for all vehicle types (except buses) relative to heavy vehicles. The probability of an FSI injury decreases where buses are involved compared to heavy vehicles.
6. There is a higher probability of an FSI injury from a crash involving a vehicle 'leaving a driveway' versus changing lanes while crashes involving slow or stopping vehicles or parking vehicles are less likely to result in an FSI injury compared to vehicles changing lanes.
7. The analysis of traffic control showed that the probability of an FSI injury is lower at roundabout and stop controlled locations compared to locations without traffic controls. Similar to pavement conditions, there was a statistically significant result for unknown traffic control; this will be treated as a non-result as it does not inform the overall analyses.
8. The results indicated a reduction in the likelihood of an FSI injury outcome for road users who wear restraints compared to those who do not.

9. The probability of an FSI injury increases for probationary licence holders compared to standard licence holders.
10. The results for licence status showed an increase in the probability of an FSI injury for holders of invalid licences compared to valid licences.
11. A rollover on or off a carriageway increases the likelihood of an FSI injury compared to a collision. Additionally, the probability of sustaining an FSI injury decreases for road users struck by stone projectile or those that fall from a vehicle.
12. An analysis of the DCA groups indicated that the probability of sustaining an FSI injury increases in head on collisions relative to adjacent approach at intersection crashes. Conversely, the likelihood of an FSI injury decreases in same direction and manoeuvre/overtaking crashes compared to adjacent approach at intersection crashes.
13. The probability of suffering an FSI injury increases for road users aged 60 years and older compared to those younger than 18 years of age.
14. Traffic volumes (proxied by average annual daily traffic – AADT) are associated with reductions in the probability of FSI injuries.

References

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