Exploratory Assessment of Road Traffic Crashes on the Intercity Expressway in India

Presented By

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Outline

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- Aim
- Study Area and Models specifications
- Methodology
- Results and discussion
- Conclusions

Overview

- A road traffic crash (RTC) is a rare and random event (AASHTO, 2010).
- RTCs and road traffic injuries (RTIs), are one of the leading causes of death and disabilities across the globe (Abbafati et al., 2020).
- As per the WHO's Global Status Report on Road Safety 2018, approximately 1.35 million people die in RTCs in a year.
- It is the 8th leading cause of death for all age groups.
- In addition, RTIs are the leading cause of death for the age group 5 to 29 years.
- The burden of road traffic deaths is excessively high in LMICs, share 93% of death.

Key messages

- The number of road traffic deaths on the world's roads remains unacceptably high.
- Road traffic injuries are the leading killer of children and young adults.
- More than half of global road traffic deaths are amongst pedestrians, cyclists and motorcyclists who are still too often neglected in road traffic system design in many countries.
- There is progress being made, however, it is far from uniform across countries.
- SDG 3.6 target to halve road deaths and injuries by 2020 will not be met without drastic action.

1.35 million deaths each year

8th leading cause of death for people of all ages

1st leading cause of death for children and young adults 5–29 years of age

3 times higher death rates in low-income countries than in high-income countries

Table 1: Leading causes of death, all ages, 2016

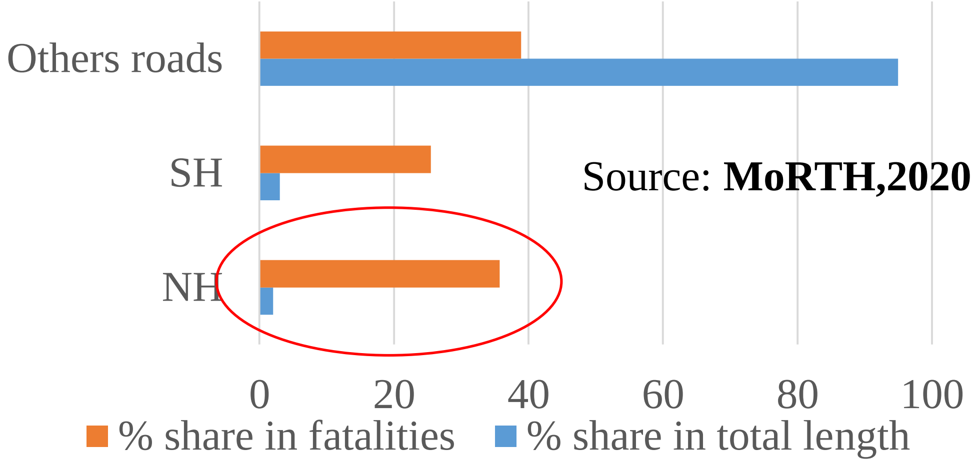
Rank	Cause	% of total deaths
	All Causes	
1	Ischaemic heart disease	16.6
2	Stroke	10.2
3	Chronic obstructive pulmonary disease	5.4
4	Lower respiratory infections	5.2
5	Alzheimer's disease and other dementias	3.5
6	Trachea, bronchus, lung cancers	3.0
7	Diabetes mellitus	2.8
8	Road traffic injuries	2.5
9	Diarrhoeal diseases	2.4
10	Tuberculosis	2.3

2016 WHO Global Health Estimates

Source: WHO,2018.

Safety Status on Indian Highways

- India has the second-largest road network worldwide, amounting to 6.3 million kms (MoRTH, 2021b).
- NHs accounted for a share of 36% of the total number of persons killed, whereas it constitutes only 2.03% of the entire road network in India in 2019 MoRTH (2020) .
- In India, the number of persons killed were more in rural areas, i.e., 61.6%, compared to urban areas i.e., 38.4% in 2016 (MoRTH, 2017).
- In 2019, rear-end crashes caused 18.4% of the fatalities; increased by 7.6% as compared to 2018. (MoRTH,2020)
- Vulnerable road users (VRUs) consist of the majority who get killed on NHs (Mohan et al.,2017)



Source: **MoRTH,2020**

Fig 4. Proportions of Length and Fatalities of Indian Roads.

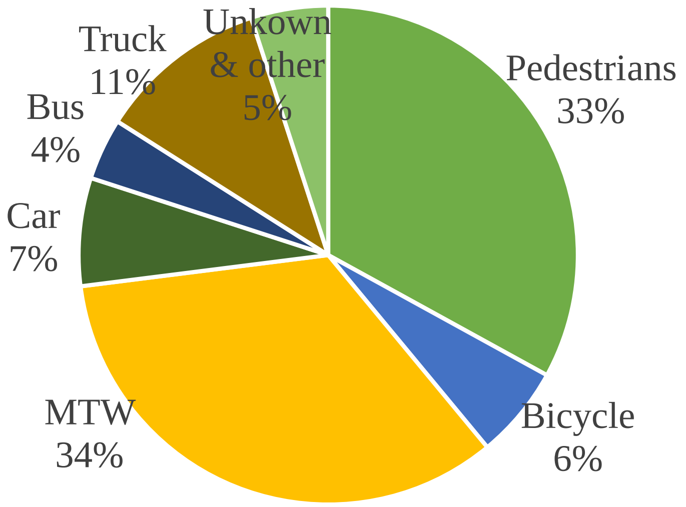


Fig 5. Share of road users' fatalities on highways in India.

Source: Mohan et al.,2017

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Aim

The study aims to evaluate the risk of RTC on the selected intercity expressway in India.

Study Area and Models specifications

- Study stretch: Six-lane access-controlled intercity highway (YE).
- Constant paved shoulder width (3.75 m)

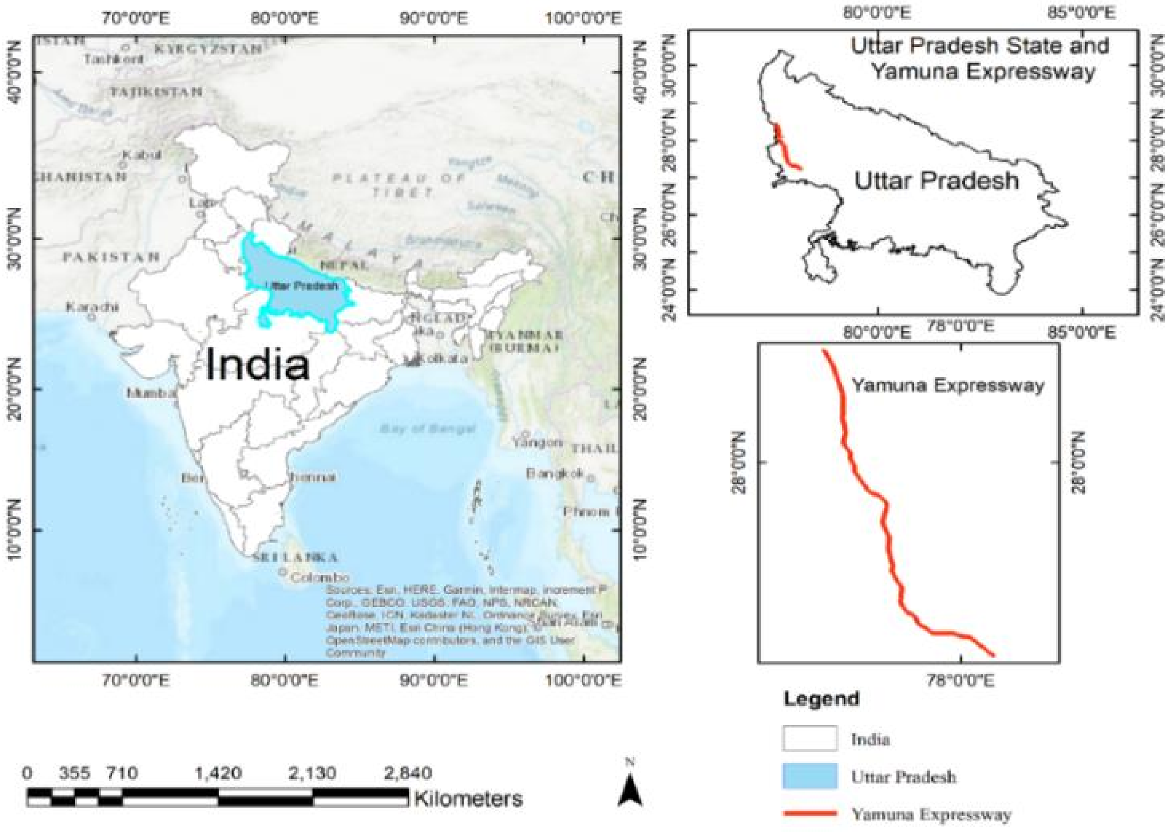

Fig.1. Map depicting the selected study stretch of the six-lane intercity highway (YE).

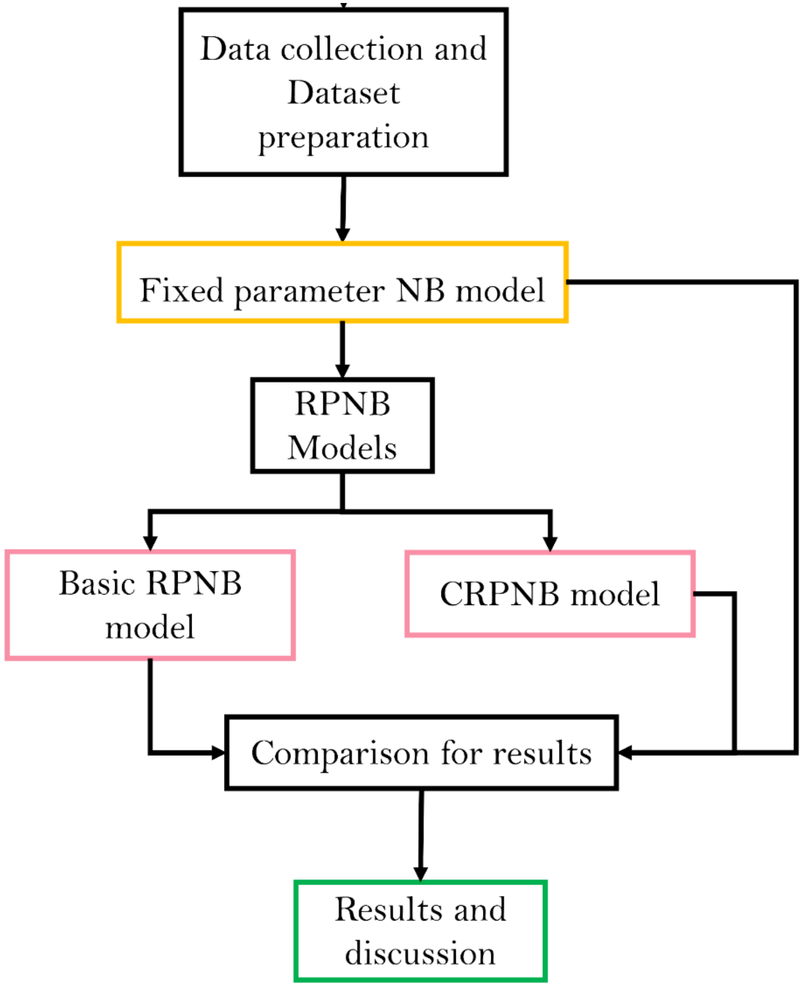

Fig.2. Methodology

Methodology

Methodology

- The study incorporates exploratory data analysis techniques to assess the crash characteristics of the selected expressway.
- The study starts with an exploratory data analysis (EDA) technique to determine the crash characteristics. And crash contributory risk factors were ascertained with the help of explanatory models.
- Developed explanatory models : Random parameter NB models
- The unobserved heterogeneity is addressed using a random parameters specification that relaxes any distributional assumptions of parameters.
- The model extracts the expressway segments with fatal crash counts that are equally sensitive to the road attributes on an average.

Results

1. Crash Characteristics

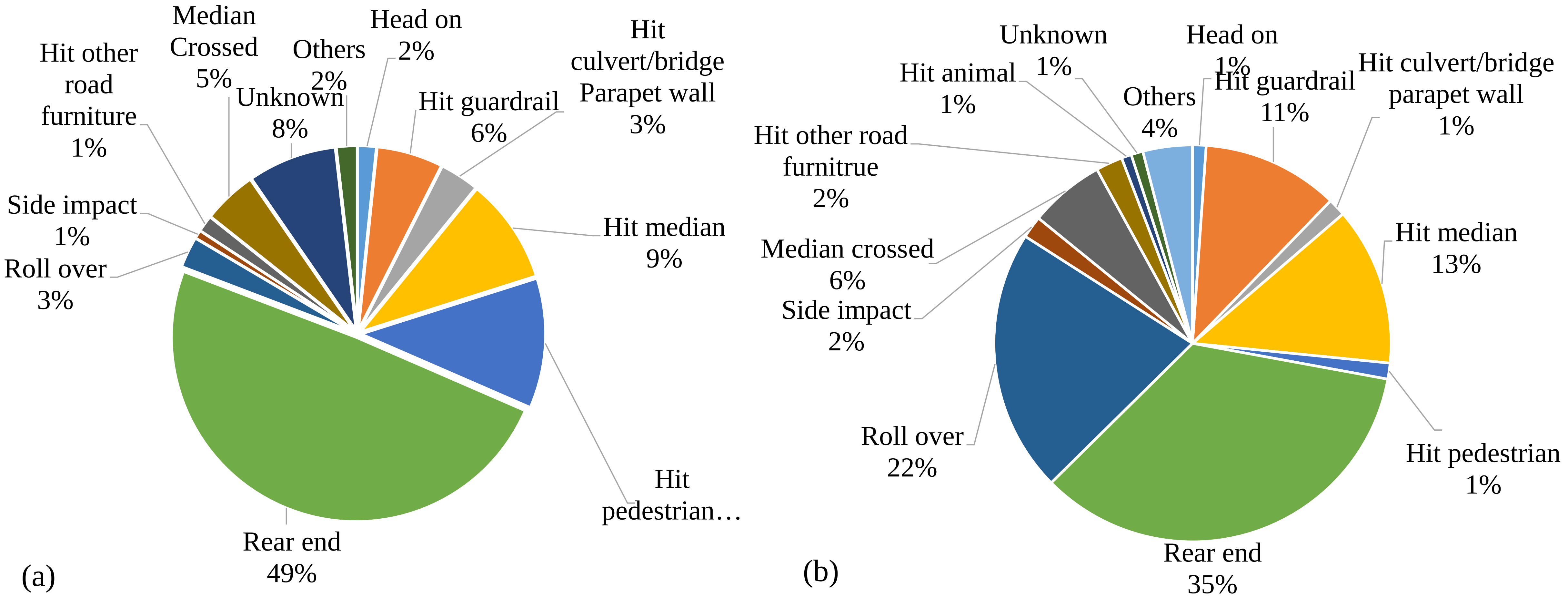

Figure 3:Distribution crashes based on collision types (a) Fatal crashes distribution (b) Non-fatal crashes distribution.

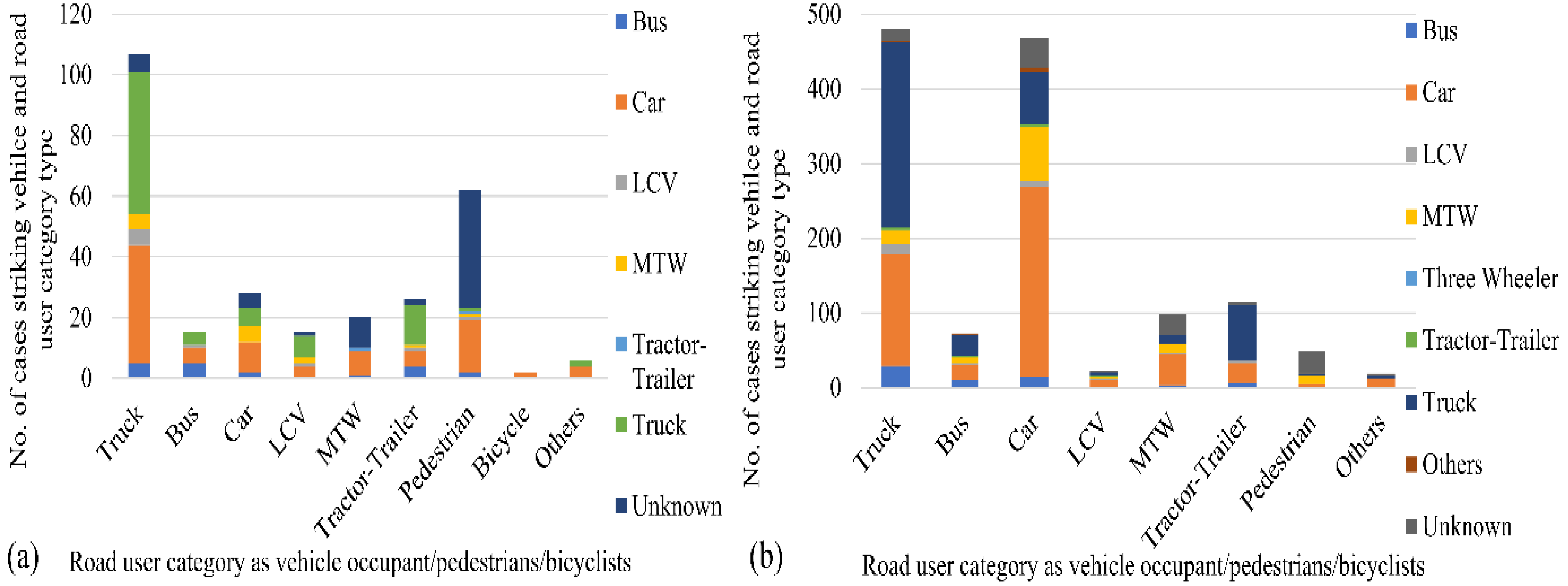

Figure 4: Distribution of the road users types at risk due to striking vehicle types (a) Distribution in fatal crashes (b) Distribution of non-fatal crashes.

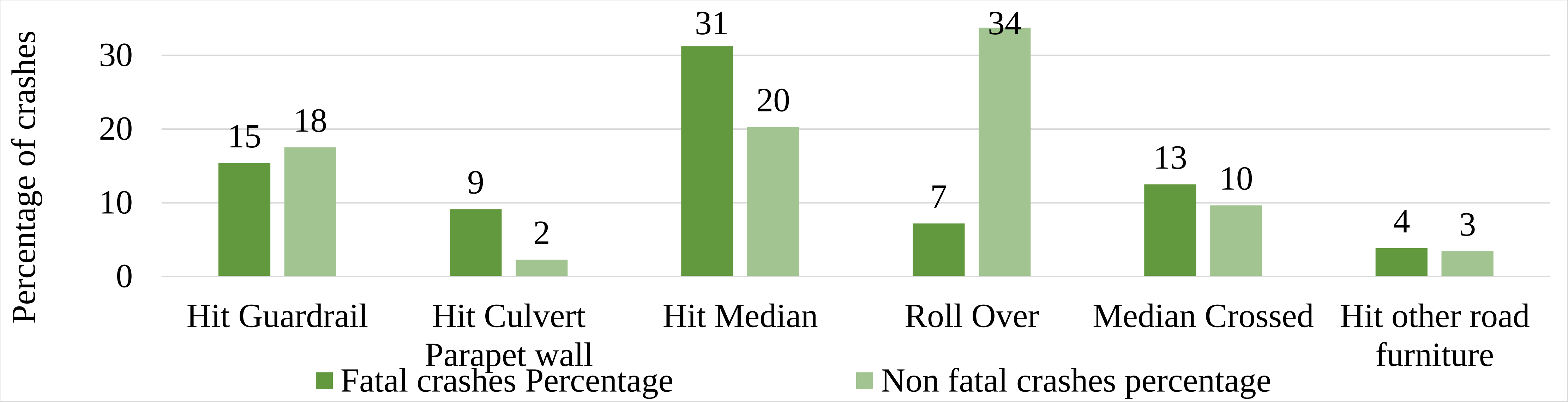

Figure 5: Comparison of the distribution of SVC (PDO) by collision types.

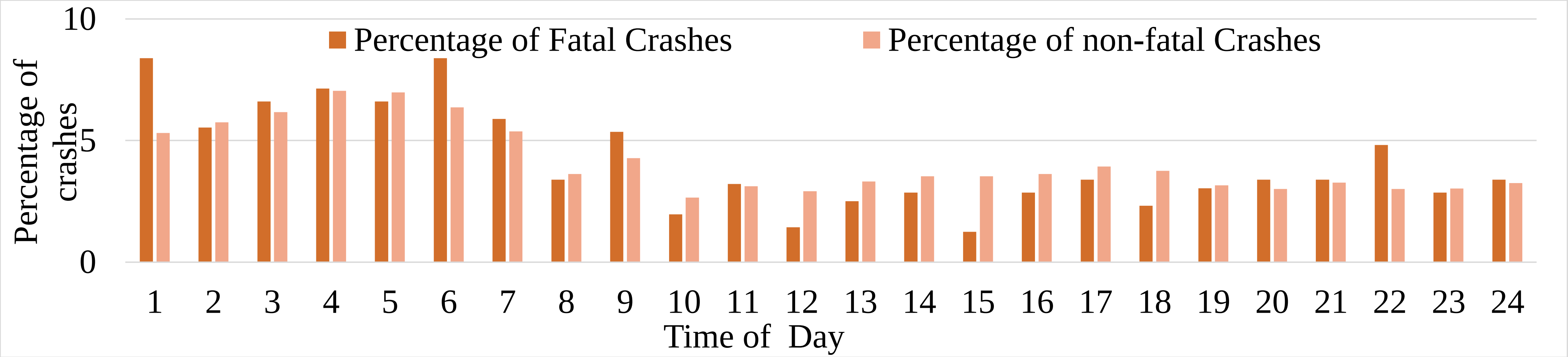

Figure 6: Distribution of crashes based on the time of the day.

Results

2. Estimates of risk factors of fatal crash

Explanatory model results

Variables	FPNB		RPNB		CRPNB	
	Coefficient	Prob. z|>Z*	Coefficient	Prob. z|>Z*	Coefficient	Prob. z|>Z*
			Nonrandom parameters			
Constant	-1.06043	0.3688	-1.05192	0.3589	-0.7495	0.513
Presence of village/settlement	-0.24376***	0.0074	-0.24127***	0.0081	-0.23072***	0.0092
Presence of hazards	0.11879	0.4835	0.11669	0.4892	0.13777	0.3958
Presence of access location and underpass	0.60648***	0.000	0.62760***	0.000	0.61151***	0.000
			Random parameters			
Vertical alignment gradient	-0.06487	0.4108	-0.06719	0.4032	-0.06565	0.3454
Standard deviation of parameter distribution			0.00042	0.9958	0.0874	0.148
Vertical alignment length	0.03371	0.9257	0.05379	0.8829	0.20269	0.5819
Standard deviation of parameter distribution			0.25419	0.2447	0.52606	0.1033
Vertical curve length	-0.42858	0.1214	-0.44692	0.1089	-0.37342	0.2073
Standard deviation of parameter distribution			0.23055	0.1748	0.56459**	0.0126
Horizontal alignment radius	0.05053**	0.0345	0.04982**	0.0383	0.06729***	0.0054
Standard deviation of parameter distribution			0.00246	0.9145	0.00877	0.6945

Variables	FPNB		RPNB		CRPNB	
	Coefficient	Prob. z|>Z*	Coefficient	Prob. z|>Z*	Coefficient	Prob. z|>Z*
Horizontal curve length	0.12257**	0.0476	0.11409*	0.0694	0.14712**	0.0205
Standard deviation of parameter distribution			0.00288	0.9536	0.08105	0.1754
Speed	-0.00548	0.6157	-0.00581	0.5825	-0.01084	0.3095
Standard deviation of parameter distribution			0.00289***	0.000	0.00311***	0.0018
AADT	0.13596***	0.0002	0.12266***	0.0009	0.13387***	0.0004
Standard deviation of parameter distribution			0.06203***	0.000	0.00305	0.7824
Scale parameter/Alpha	0.12988***	0.0097	5.37077	0.111	77494.9	0.9999
K	13		20		41	
Log likelihood function	-1211.23		-1209.63		-1205.48	
Restricted log likelihhod	-1216.56		-1309.68		-1309.68	
Chi squared	10.67		200.1		208.42	
McFadden Pseudo R-sqaured	0.004		0.076		0.08	
note: ***, **, * ==> Significance at 1%,5%,10% level						

Conclusions

- Rear-end crashes are the highest type of fatal crashes.
- On six-lane access control highway (YE), the proportion of single-vehicle crashes was also substantial.
- Temporal characteristics:
  - Nighttime crashes proportion is slightly higher than daytime crashes.
  - No significant pattern was revealed based on the weekday and month.
- Impacting vehicle types:
  - Cars
  - Large-sized vehicles such as trucks and bus;
  - MTW
- Road users characteristics:
  - VRUs are at high risk on the multi-lane highway (24 to 40% on multi-lane highways; 11% on six-lane access control).
  - MTW users
  - Car users
  - Truck users (on YE)
- SV crashes: cars users have the highest fatalities.
- VRUs fatalities: The risk of fatal crashes is high due to cars, MTW and buses.

Conclusions

- Random parameter models (RPNB and CRPNB) have shown better predictability power than the fixed parameter model (FPNB). (smaller log-likelihood)
- Between the random parameter models, the CRPNB model was best (smaller log-likelihood estimate).
- **Significant risk factors of rear-end crashes:** AADT, speed, horizontal alignment radius, vertical curve length were significant risk factors.
- **Significant random parameters** : speed, AADT, horizontal alignment radius, vertical curve length.
- Statistically significant random parameter variables indicate that their effect on the number of rear-end crashes varies across the expressway segments
- **Risk Segments Identification:** Presence of the entry and exit ramps, with an underpass, and with hazards have a relatively higher risk of rear-end crashes.

- **Speed management measures** need to be implemented in segment of high risk rear-end crashes.
- The expressway designer needs to **calibrate the design of pedestrian underpasses** as per the requirement of the villagers in the vicinity of the expressway.

Thanks!

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