RELATIONSHIP BETWEEN MOBILITY AND PEDESTRIAN SAFETY: A REGION-WIDE LEVEL STUDY

Presented by

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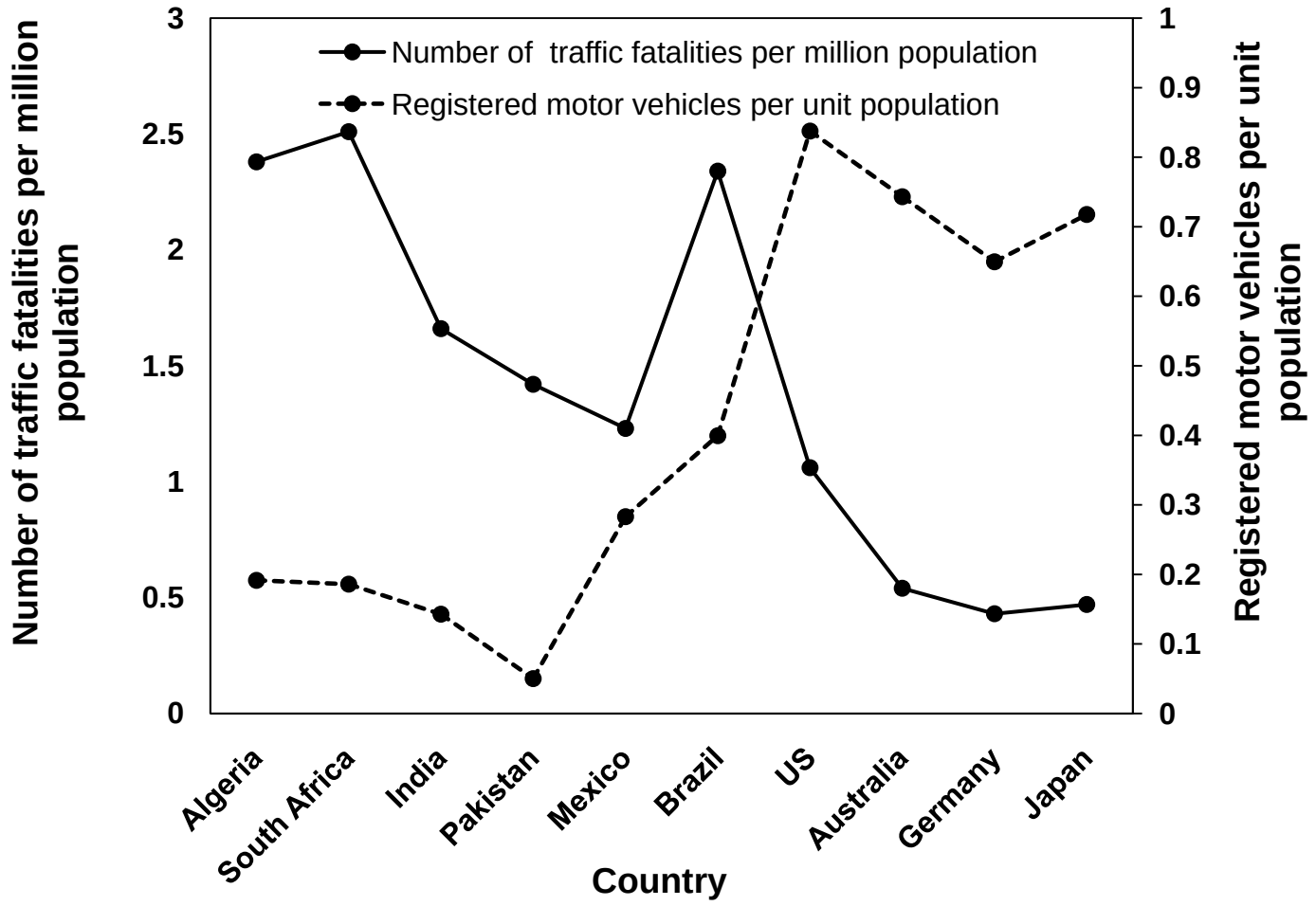
Outline

- Introduction
- Problem definition
- Objective of the study
- Need for this study
- Adopted methodology
- Results & Discussion
- Conclusion

Traffic safety-Global scenario

- Road traffic death is a global epidemic
- Total road traffic deaths of 1.25 million per year
- Children, pedestrians, and older people are most vulnerable road users
- Highest fatalities occurs in low and middle income countries
- Costs approximately 5 percent of Gross Domestic Product (GDP)

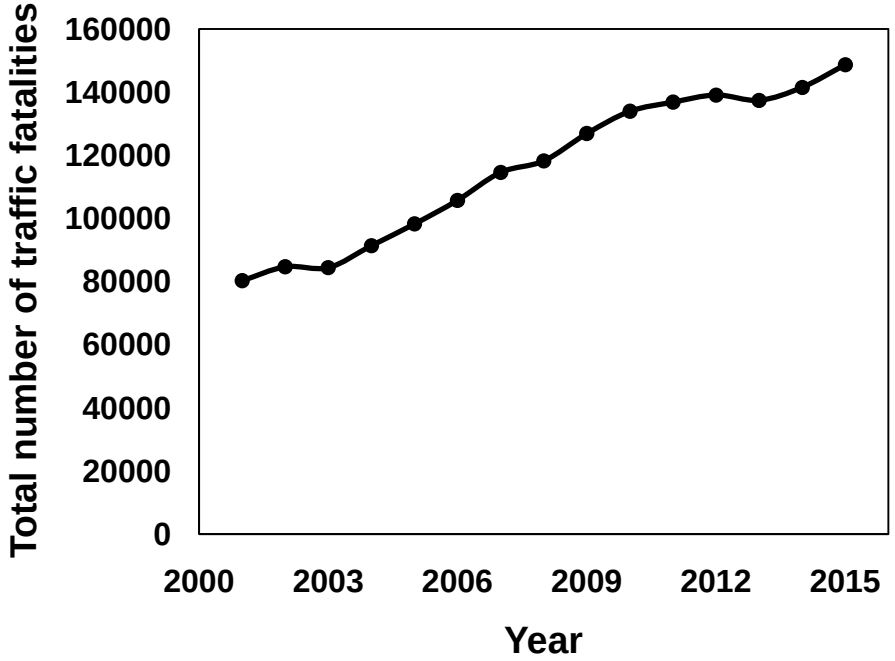
Traffic safety-Global scenario (Year 2013)



Source: World Health Organization (WHO). *Global status report on road safety 2015*

Traffic safety-Indian scenario

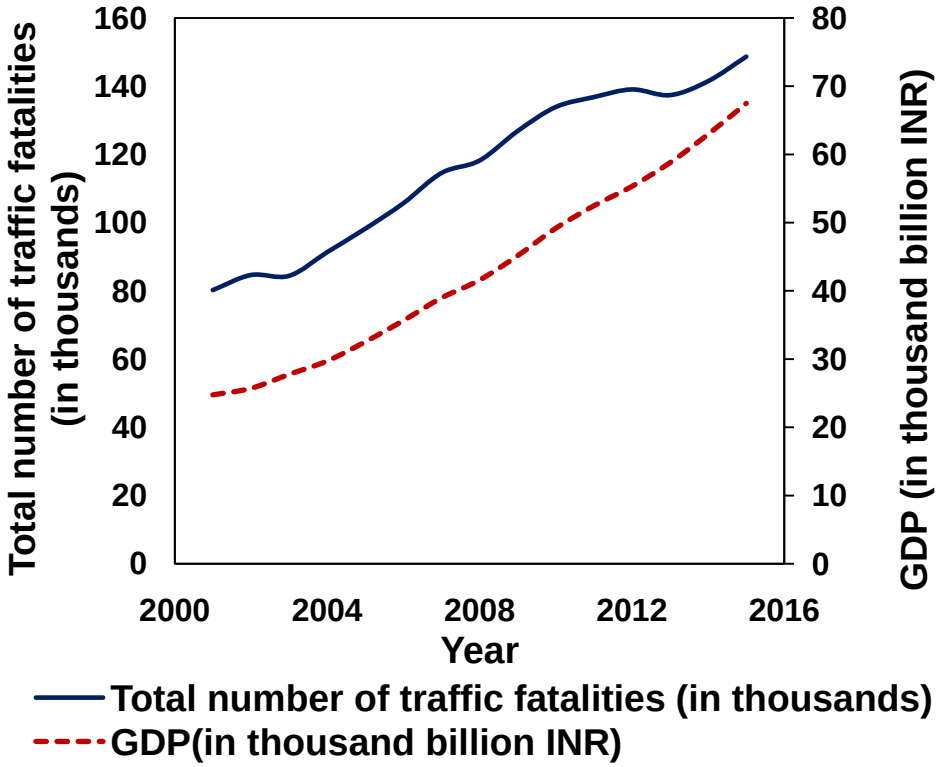
148,707 fatalities and 482,389 injuries in road traffic crashes in 2015 (NCRB, 2015)

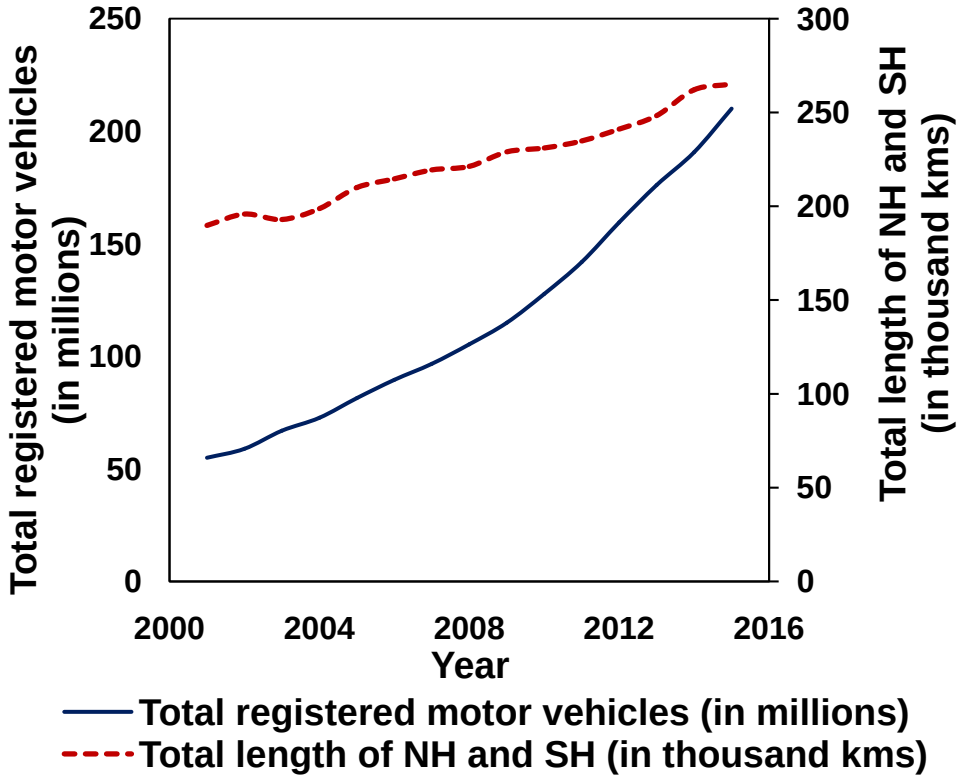


Fatal crash statistics of India for the period 2001-2015

(Source : NCRB)

Traffic safety-Indian scenario





Indian statistics for the period 2001-2015.

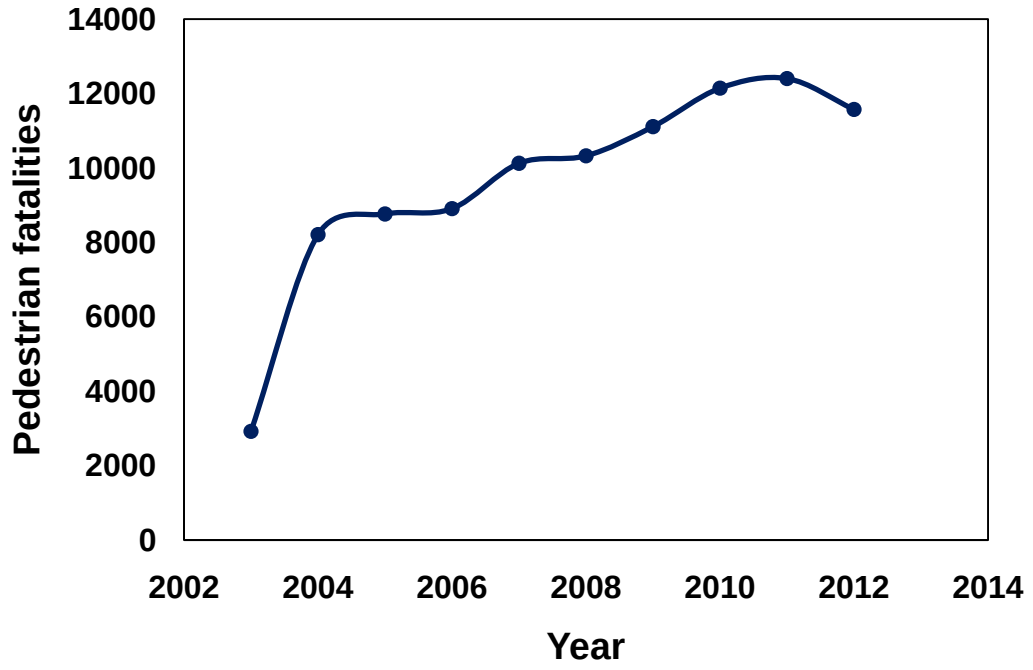
(a)Traffic fatalities and GDP at constant price (2004-2005 base year) of India during 2001-2015.

(b) Total registered motor vehicles and total length of NH and SH in India during 2001-2015.

Source : Ministry of Road Transport & Highways (MORTH). *Road Transport Year Book*, 2001-2015
Ministry of Road Transport & Highways (MORTH). Basic Road Statistics of India, 2001-2015.

Pedestrian traffic safety

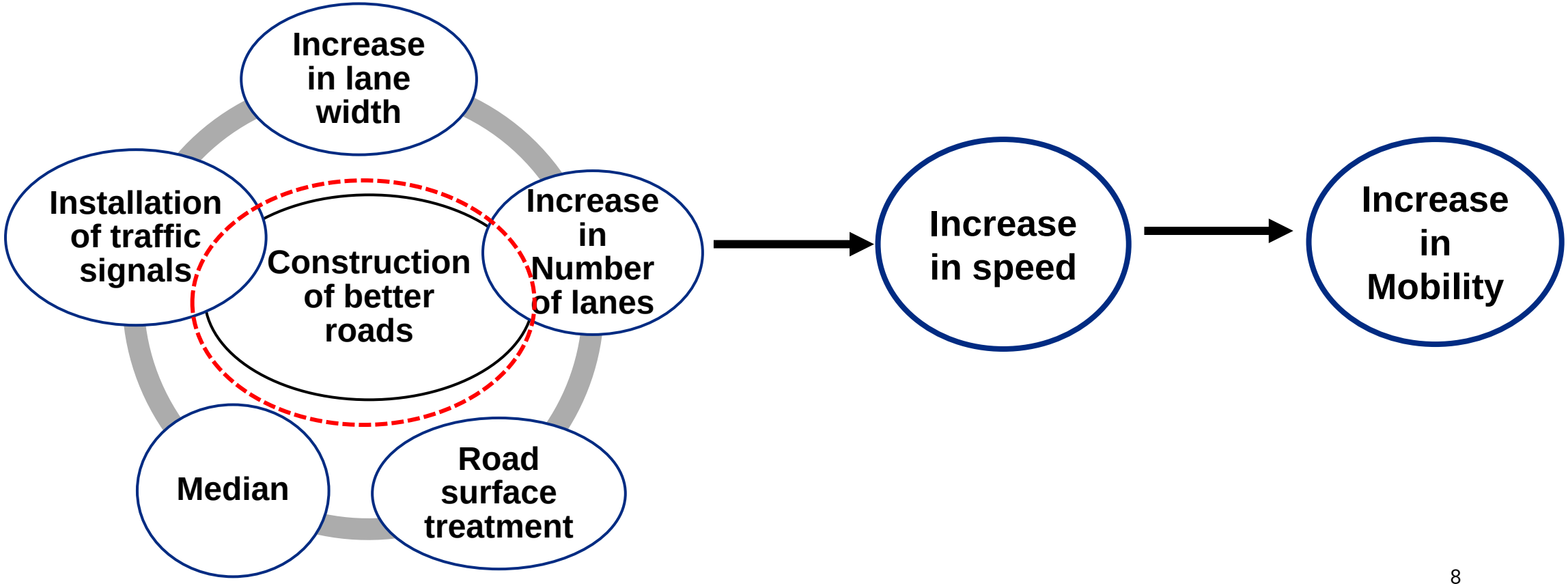
- Pedestrian fatalities comprise of 22% of global road traffic fatalities
- Pedestrians, cyclists and motorcyclists comprises half of total fatalities
- Rapid economic growth in developing countries enhances mobility



(Source: NCRB)

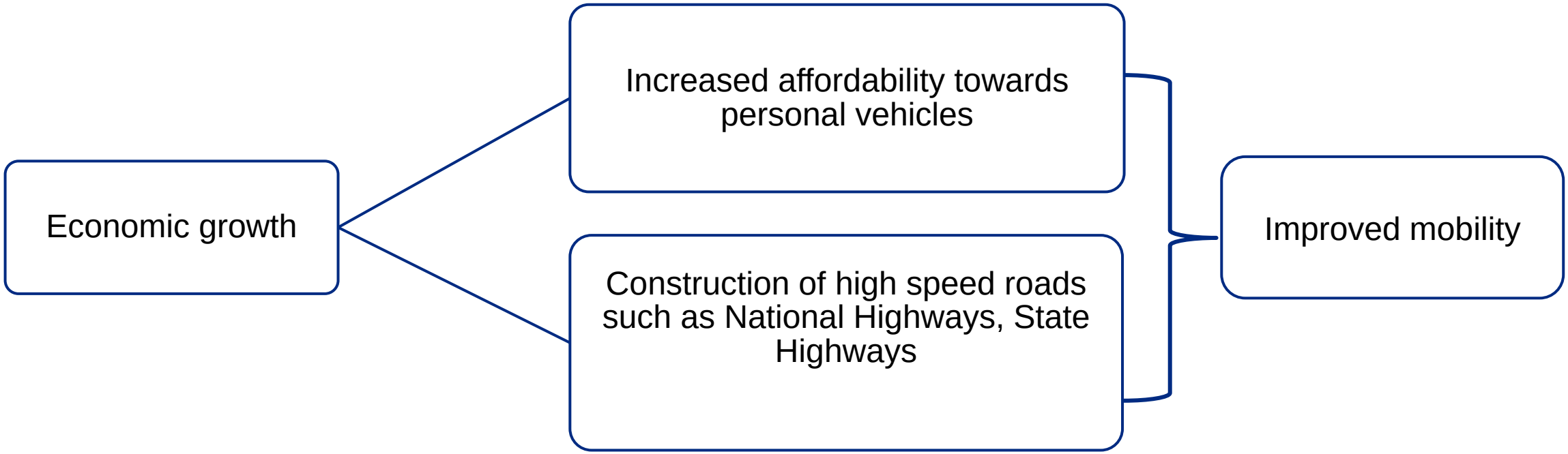
Problem definition

At a micro level



Problem definition

At a region-wide level



Objective of the study

To study the relationship between mobility and pedestrian fatality at a region-wide level.

Need for this study

- Pedestrians constitute a major portion of the total traffic
- No studies are available relating mobility improvements with pedestrian safety
- Speed related studies are location specific*
- Region-wide level studies would provide with a general inference

Issues with data

- Availability of reliable data is a serious concern
- Due to issues related to data collection and reporting, only number of fatal data related information are close to accurate
- Even for traffic related fatalities, details are missing
- Available information include:
  - Number of fatalities by year by state and by selected cities
  - Distribution of fatalities by road categories
  - Distribution of fatalities by road user type
  - Distribution of fatalities by time of the day
- No details available for individual crashes

Mobility indices and safety index

Index	M1	M2	M3	M4	M5	M6	SI
Definition	$\frac{NH}{TR}$	$\frac{SH}{TR}$	$\frac{TSR}{TR}$	$\frac{OSR}{TR}$	$\frac{MV}{P}$	$\frac{MV}{L}$	$\frac{1}{\left(\frac{F}{P}\right)}$

Abbreviation

M1, M2, M3, M4, M5, M6 - Mobility indices
SI- Safety Index
NH- length of National Highways, SH- length of State Highways
TSR- length of Total Surfaced Roads
OSR- length of Other Surfaced Roads,
MV- total registered Motor Vehicles (passenger transport related)
TR- Total length of Roads
P- Population (in hundred thousand)
F- Traffic fatalities

Mobility indices and safety index

- Data for 30 states and union territories considered
- Data from 2003-2012 considered
- Seasonal autoregressive moving average (S-ARMA) time series models were used
- Type I (5-20 million), Type II (20-60 million), Type III (>60 million)

Definition of Region Types

Type 1: Pop 5 to 20 M	Type II: Pop 20 to 60 M	Type III: > 60 M
Arunachal Pradesh	Assam	Andhra Pradesh
Goa	Chhattisgarh	Bihar
Mizoram	Haryana	Gujarat
Sikkim	Jharkhand	Karnataka
Chandigarh	Jammu & Kashmir	Madhya Pradesh
Himachal Pradesh	Kerala	Maharashtra
Manipur	Orissa	Rajasthan
Meghalaya	Pondicherry	Tamil Nadu
Nagaland		Uttar Pradesh
Tripura		West Bengal
Uttarakhand		
Delhi		

Adopted methodology

Ascertain the degree of linear correlation of the dependent variable and each of the independent variable using Pearson correlation

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Logarithmic transformation to improve the degree of linear correlation and reduce the skewness

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Fitting of linear regression model referred to as base model

↓

Plotting of ACF and PACF of the residuals of base model

↓

Statistical check of autocorrelation using Ljung Box test

↓

Check for seasonality and differencing of the data

↓

Selection of suitable S-ARMA model based on AIC, AICc and BIC value

↓

Plotting of ACF and PACF and calculation of Ljung Box test to check for any possible autocorrelation in the S-ARMA models

Model statistics

Relation	Type	Coefficient	Base model			S-ARMA model			
			Estimate	t test	p value	Estimate	t test	p value	Model
MI1-PFI	I	β_1	-0.33	-1.15	0.25	-0.75	-0.79	0.43	(0,1)
	II	β_1	-0.15	-1	0.32	0.34	1.49	0.14	(0,1)
	III	β_1	1.07	3.23	0.00**	0.25	1.96	0.02**	(0,1)10
MI2-PFI	I	β_1	0.58	2.84	0.00**	0.64	3.01	0.00**	(0,1)
	II	β_1	0.21	2.93	0.00**	0.23	2.35	0.02**	(0,1)
	III	β_1	0.84	6.57	0.00**	0.29	2.19	0.03**	(0,1)10
MI3-PFI	I	β_1	1.97	5.13	0.00**	1.70	3.66	0.00**	(0,1)
	II	β_1	0.64	4.31	0.00**	0.65	3.44	0.00**	(1,0)
	III	β_1	0.13	0.294	0.764	0.08	0.18	0.85	(0,1)
MI4-PFI	I	β_1	2.05	4.24	0.00**	2.26	2.21	0.03**	(1,0)
	II	β_1	0.63	4.59	0.00**	0.62	3.65	0.00**	(0,1)
	III	β_1	2.89	10.91	0.00**	1.37	4.86	0.00**	(1,1)10
MI5-PFI	I	β_1	0.28	1.11	0.27	0.76	2.19	0.03**	(0,1)
	II	β_1	0.47	4.27	0.00**	0.45	3.59	0.00**	(0,1)
	III	β_1	0.88	10.54	0.00**	0.54	2.79	0.00**	(0,1)10
MI6-PFI	I	β_1	0.21	1.17	0.24	0.46	2.00	0.05**	(0,1)
	II	β_1	0.25	2.43	0.02**	*0.36	1.71	0.09*	(0,1)8
	III	β_1	1.09	10.45	0.00**	0.37	2.05	0.04**	(0,1)10

**- Significant at 95%, *- Significant at 90%, Red coloured_not significant

Ljung-box statistics

Relation	Type	S-ARMA model		
		X-squared	lag	p value
MI1-PFI	I	20.73	20	0.410
	II	15.55	20	0.740
	III	30.19	20	0.066
MI2-PFI	I	20.66	20	0.417
	II	17.92	20	0.593
	III	26.52	20	0.149
MI3-PFI	I	19.44	20	0.492
	II	16.64	20	0.675
	III	0.56	2	0.750
MI4-PFI	I	21.52	20	0.367
	II	16.70	20	0.627
	III	10.00	20	0.522
MI5-PFI	I	1.91	1	0.168
	II	17.82	20	0.599
	III	30.86	20	0.057
MI6-PFI	I	2.21	1	0.136
	II	20.80	15	0.143
	III	30.16	20	0.067

Discussion

MI1 with pedestrian fatality

- MI1 shows an increase in pedestrian fatality for group III
- No significant model for Group I and Group II - less pedestrians on highways

MI2 with pedestrian fatality

- MI2 shows an increase in pedestrian fatality for all the groups

MI1-Proportion of NH to total roads ✓

MI2-Proportion of SH to total roads ✓

Discussion

MI3 with pedestrian fatality

- MI3 shows an increase in pedestrian fatality for group I and group III
- Surfaced roads provide better riding quality and high speed

MI4 with pedestrian fatality

- MI4 shows an increase in pedestrian fatality for all the groups
- OSR offer better riding surface and thus higher speed
- Pedestrian sidewalks and crossing facilities are almost non-existent

MI3-Proportion of TSR to total roads ✓

MI4-Proportion of OSR to total roads ✓

Discussion

MI5 and MI6 with pedestrian fatality

- MI5 and MI6 shows an increase in pedestrian fatality for all groups
- With increase in vehicular population, pedestrian fatality increases

MI5-Proportion of MV to total population ✓

MI6-Proportion of MV to total roads ✓

Conclusion

- Mobility improvements without safety improvements are detrimental to pedestrians
- Points to the significance of stricter enforcement to include pedestrian safety enhancements in all road categories
- Explored the use of available data from government sources

Thank you!

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