

Characteristics of Motorized Two-Wheeler (MTW) Mobility and its Safety for Indian Cities



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Content

- Background and Motivation
- Research Gap and Objectives
- Data and Methodology
- City Characteristics
- Preliminary Analysis
- Identified influencing parameters for MTW crash
- Recommendation
- Future Scope

Background and Motivation

- Rapid growth of MTWs in India is driven by **affordability**, **flexibility**, and **ease of movement** in congestion.
- **Safety concern:** MTWs account for a substantial share of road crashes (reported at **44.8%** among road users in 2023) as per MoRTH, and riders face elevated injury and fatality risk.



Source: VAHAN database

Research Gap & Objectives

The research gap identified as limited city based evidence linking **MTW mobility** patterns to **crashes**.

Objective

1. To characterize MTW mobility in terms of **Vehicle Kilometers travelled (VKT)** across Indian cities.
2. To examine associations among MTW VKT, urban density, and crash outcomes.
3. Identify key parameters that can guide targeted interventions across cities.

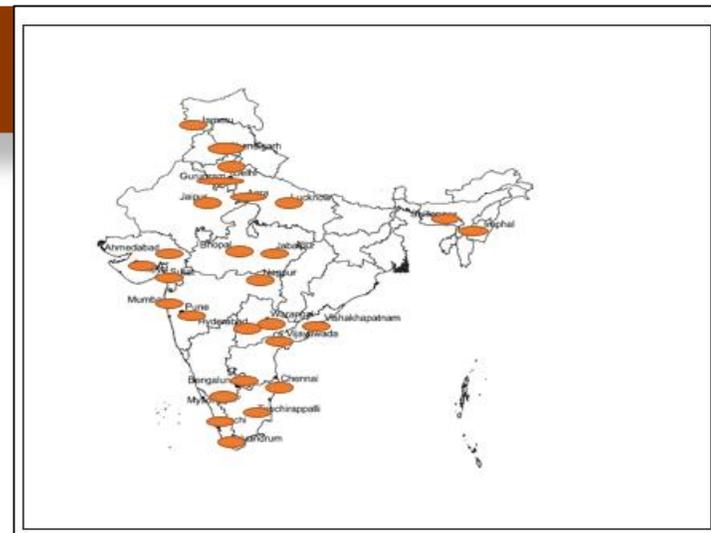
Data & Methodology

- Passenger travel information for the 27 cities were collected through in-person **household interview** conducted between **2021** to **2023**.
- VKT for MTW was estimated using the equation (Source Guha et al.,2025)

$$VKT_{MTW} =$$

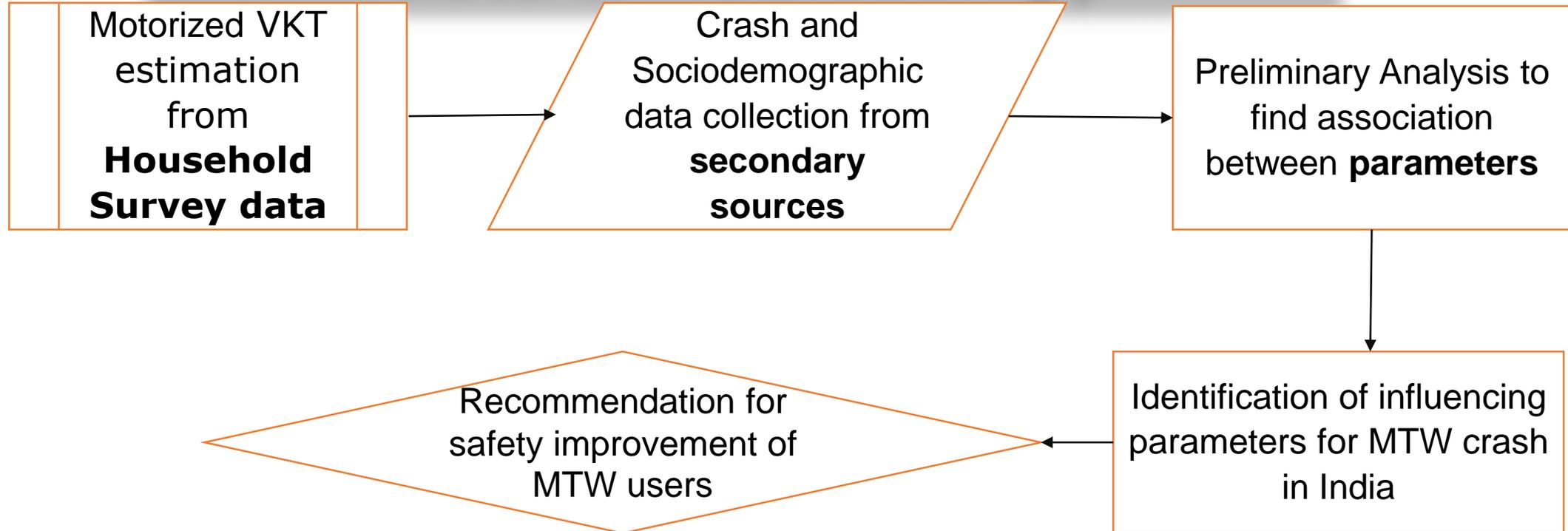
$$Population * average\ trip\ length_{MTW} * per\ capita\ trip\ rate_{MTW}$$

- Population of each city was estimated to 2023 from Census 2001 and 2011 data.

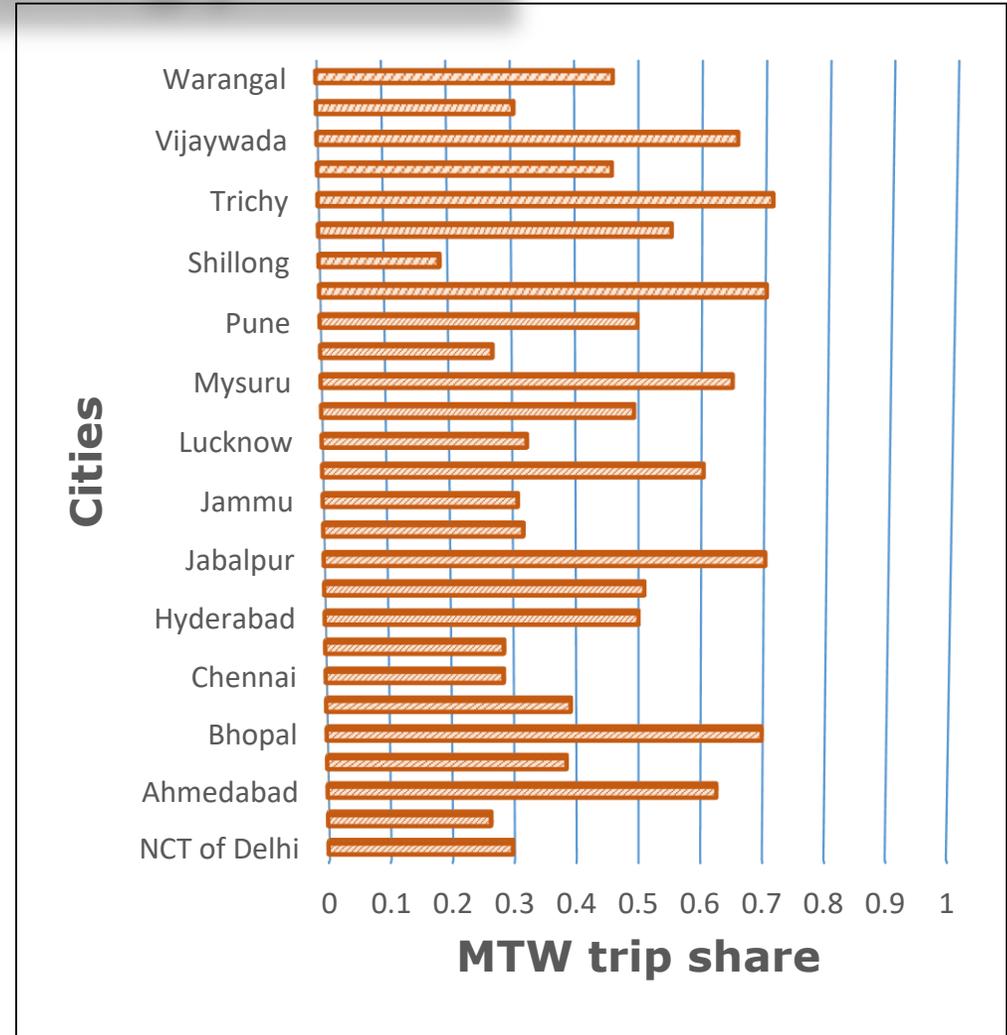
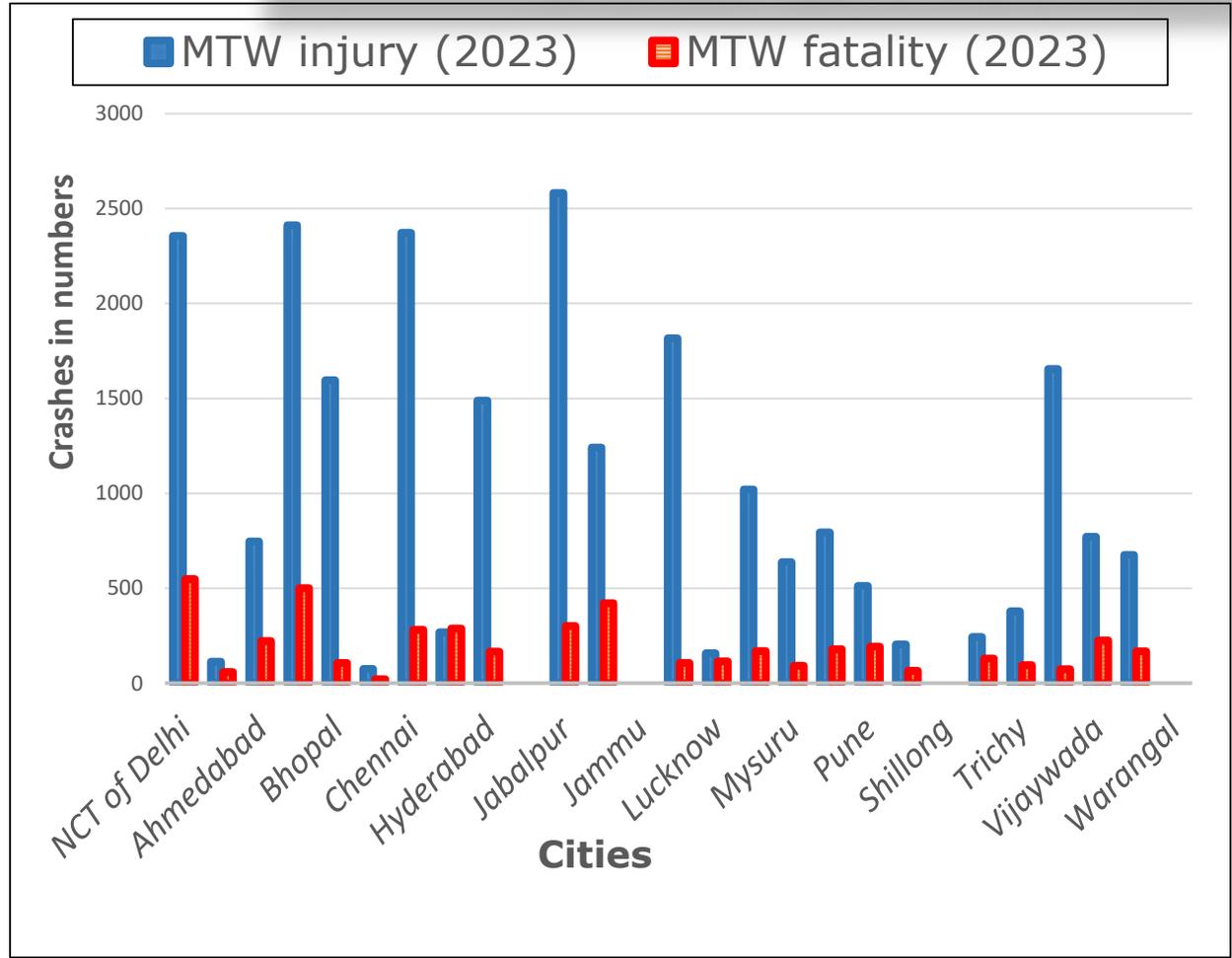


Studied Cities in India are Agra, Bhopal, Chandigarh, Gurugram, Imphal, Jabalpur, Jaipur, Jammu, Kochi, Lucknow, Mysore, Nagpur, Pune, Shillong, Trichy, Trivandrum, Vijayawada, Visakhapatnam, Warangal, Ahmedabad, Chennai, Rajkot and Surat, Bengaluru, Delhi, Hyderabad and Mumbai.

Data & Methodology



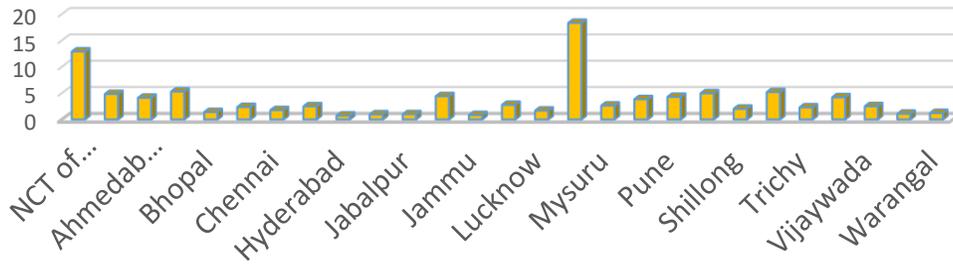
Data & Methodology



City Characteristics

POPULATION DENSITY ACROSS CITIES

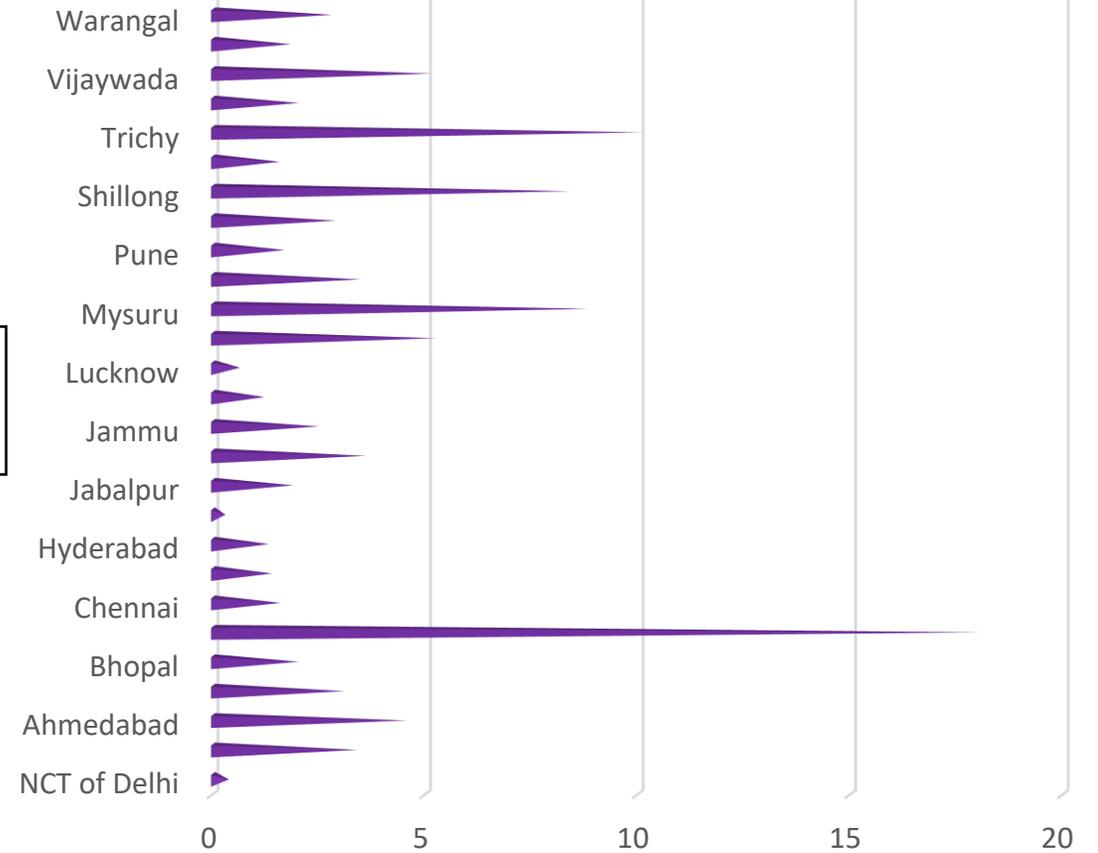
Population density share (%)



Cities

ROAD DENSITY ACROSS CITIES

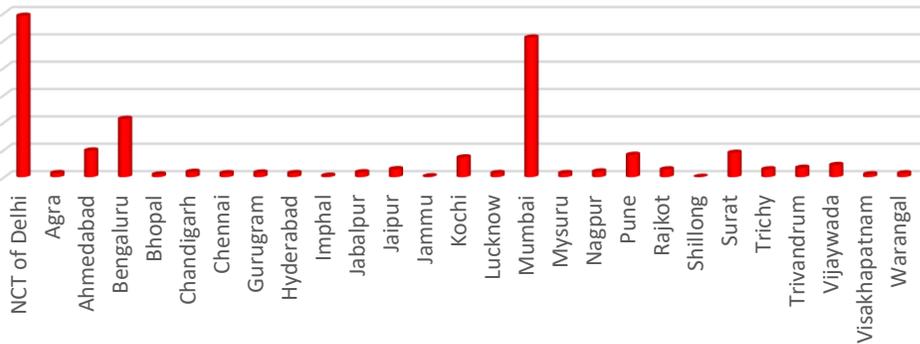
Cities



Road density share (%)

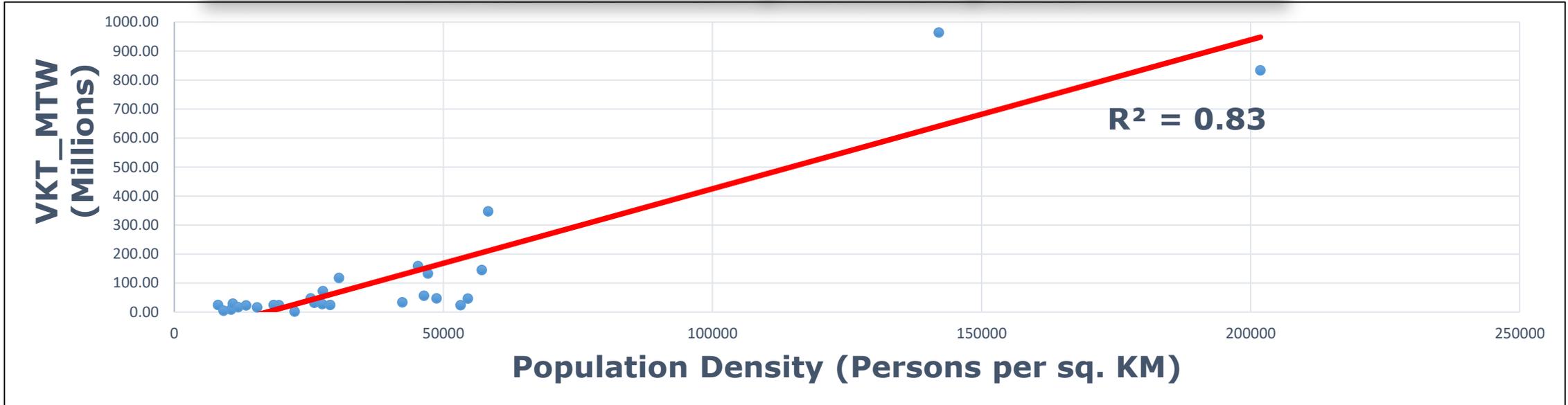
VKT_MTW ACROSS CITIES

VKT_MTW share (%)



Cities

Preliminary Analysis



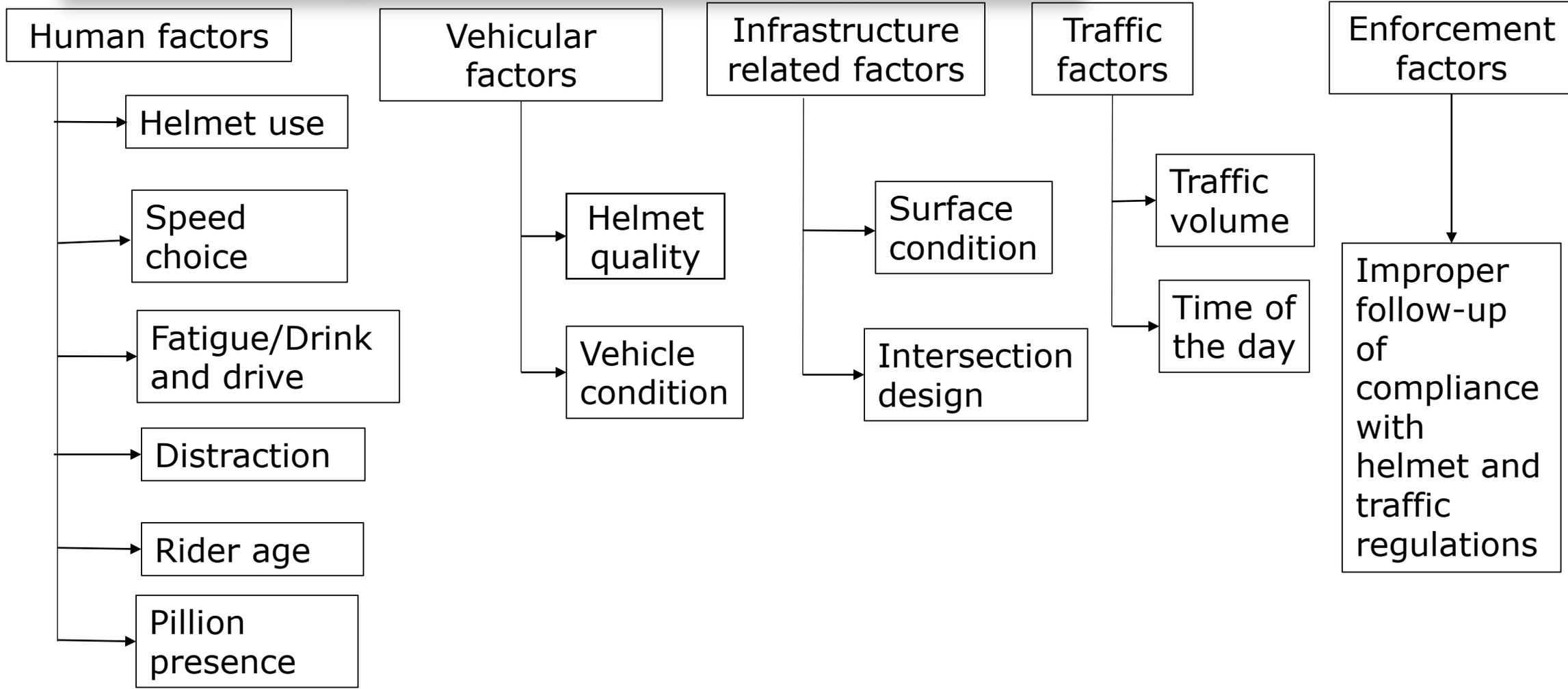
- Attempt was made to find the relationship between MTW mobility and population density in these 27 cities.
- There is a clear positive trend between these two parameters where **MTW demand** is strongly endogenous to **urban form**; denser regions generate/attract significantly more MTW trips.

Preliminary Analysis

Parameter	VKT_Motorized Two wheeler	MTW injury (2023)	MTW fatality (2023)	Population Density	Road Density (Km/Km ²)	MTW_share
VKT_Motorized Two wheeler	1.00					
MTW injury (2023)	0.33	1.00				
MTW fatality (2023)	0.51	0.62	1.00			
Population Density	0.91	0.10	0.29	1.00		
Road Density (Km/Km ²)	-0.10	-0.39	-0.36	-0.02	1.00	
MTW_share	-0.08	0.01	-0.33	-0.07	0.08	1.00

- Spearman rank correlation study shows that VKT_MTW has a strong positive correlation (**0.91**) with population density.
- VKT_MTW also exhibits a moderate positive correlation with MTW Fatalities (**0.51**), suggesting that increasing demand is accompanied by higher **fatal incident occurrence**.
- Road density is inversely associated with all the observed variables except MTW share.

Influencing Parameters for MTW crash



Recommendation (Safety improvement Strategy)

City Name	MTW fatality	Risk factor (MTW fatality/VKT_MTW in million)
NCT of Delhi	549	0.57
Agra	58	2.49
Ahmedabad	222	1.4
Bengaluru	500	1.44
Bhopal	106	6.9
Chandigarh	21	0.67
Chennai	281	12.12
Gurugram	288	10.71
Hyderabad	166	7
Imphal	0	0
Jabalpur	301	10.54
Jaipur	422	8.97
Jammu	0	0
Kochi	106	0.91
Lucknow	114	4.77
Mumbai	170	0.2
Mysuru	92	3.9
Nagpur	179	5.37
Pune	192	1.45
Rajkot	66	1.44
Shillong	0	0
Surat	130	0.9
Trichy	95	2.05
Trivandrum	74	1.33
Vijaywada	225	3.12
Visakhapatnam	167	10.13
Warangal	0	0

- Risk factor is estimated by **dividing** the **MTW fatality numbers** with **million VKT**.
- To capture the variability in travel demand across cities this was necessary.
- **Prioritized interventions** are needed in cities where risk factor is above **10**.
- To improve safety, measures like **vehicle speed regulation, increase correct helmet wearing, safer junction design, and safer vehicle standards** need to be incorporated in these cities on urgent basis.

Future Scope

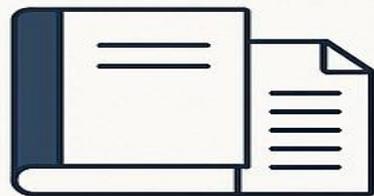
- VKT is important for understanding travel demand, but it is **insufficient as a standalone predictor** for MTW crash outcomes.
- Researchers/practitioners should combine mobility metrics with contextual determinants (travel behavior, infrastructure condition etc.).
- Future work should integrate features such as **speed, helmet quality, and road typology** to better explain crash severity and risk factors.

Key Reference

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Thank You!

Appreciate your attention and interest



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