sciendo

DOI: 10.2478/rjti-2024-0012

ROMANIAN JOURNAL
OF TRANSPORT INFRASTRUCTURE

ROAD TRAFFIC CRASHES IN UP'S METROPOLITAN CITIES: A PUBLIC HEALTH SCOURGE

Sanjay Kumar Singh, Professor, Indian Institute of Management Lucknow, India, e-mail: sanjay@iiml.ac.in
Vijay Lakshmi Singh, Associate Professor, Jaipuria Institute of Management Lucknow, India.

Abstract:

Fatalities and injuries on account of road traffic crashes are a public health scourge of rising concern in the metropolitan cities of Uttar Pradesh (UP) in India. While in many Indian cities, including Delhi, the situation is generally improving, UP's cities face a deteriorating situation. Currently, road traffic accidents on UP's city roads claim 29% more lives, in comparison to the past decade. Hence, there is an urgent need to take cognizance of this increasingly alarming problem and take requisite measures to arrest this situation. Particular interventions like legislation enforcements for controlling vehicle speed, use of seatbelts, helmets, design of safer roads, construction of separate paths for two-wheelers and segregated green modes for bicycles and pedestrians, promotion of public transport, and setting up of emergency trauma care networks have immense potential to decrease the prevalence and impact of road traffic crashes in the metropolitan cities of UP.

Keywords: Road accidents; road safety; fatality risk; public health; Uttar Pradesh

1. INTRODUCTION

India faces a serious road accident problem; compared to various major causes of accidental deaths in India, road accidents are the most notorious one. As per National Crime Records Bureau (NCRB), in 2022, 41% of all accidental deaths in India are caused by road accidents, followed by drowning (8.9%), falls (5.5%), poisoning (5%), electrocution (3%), and other causes.

In spite of the low level of motorization, 237 vehicles per 1,000 people vis-à-vis more than 600 vehicles per 1,000 people in most of the developed countries, India suffers from an alarmingly high level of road accident fatality risk, 12.4 fatalities per 100,000 people, in comparison to developed countries such as Germany (3.7 fatalities per 100,000 people), the UK (2.9 fatalities per 100,000 people), and Japan (2.5 fatalities per 100,000 people). Further, while in developed countries, the fatalities are declining, India records an increasing number of fatalities due to road traffic crashes (Singh, 2017). In 2012, 1,39,100 people died in India due to road crashes; in comparison to 2012, road traffic fatalities in 2022

are higher by 32,000. Consequently, during the last ten years from 2012 to 2022, road accidental deaths have increased, on an average at 2.1% yearly rate, with country's population increase at 1.1% per year. Consequently, road accident fatality risk in India is still increasing and is amongst the highest in the world.

In general, the burden of road traffic crashes in India is relatively low in its metropolitan cities. In 2022, fatality risk in Indian cities, on an average, was almost half of that was in their mofussil counterparts. However, the burden of traffic crashes is relatively high in some of the metropolitan cities, predominantly the ones located in UP, the most populous state of the country (Figures 1 and 2). As per Demographia (2023), in 2022, there were 29 cities in India having population of more than 2 million; out of these 29 cities, 6 (Lucknow, Kanpur, Varanasi, Agra, Prayagraj, and Meerut) are in the state of UP. In 2022, fatality risk was higher than the country's average in 7 out of 29 metropolitan cities, compared to the fatality risk in 2012, being higher than the national average in 11 cities, marking a slight improvement. Nevertheless, UP accounted for the top three riskiest cities in 2022 and the top two riskiest cities in 2012.

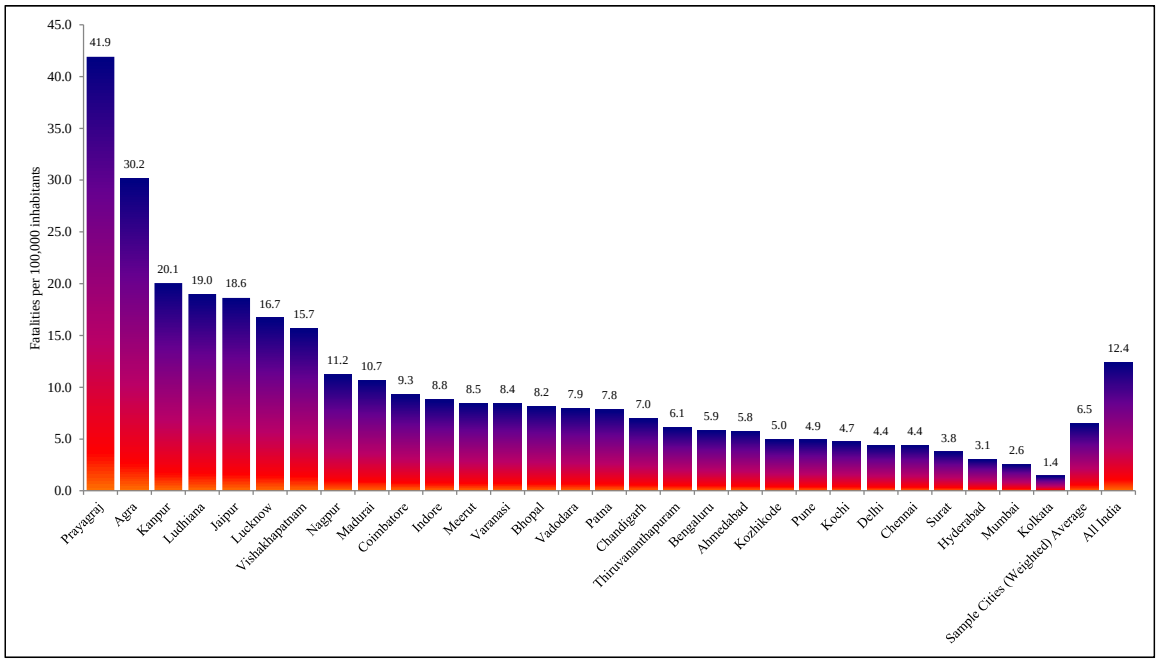

Figure 1. Road accident fatality risk in twenty-nine most populated Indian cities in 2022

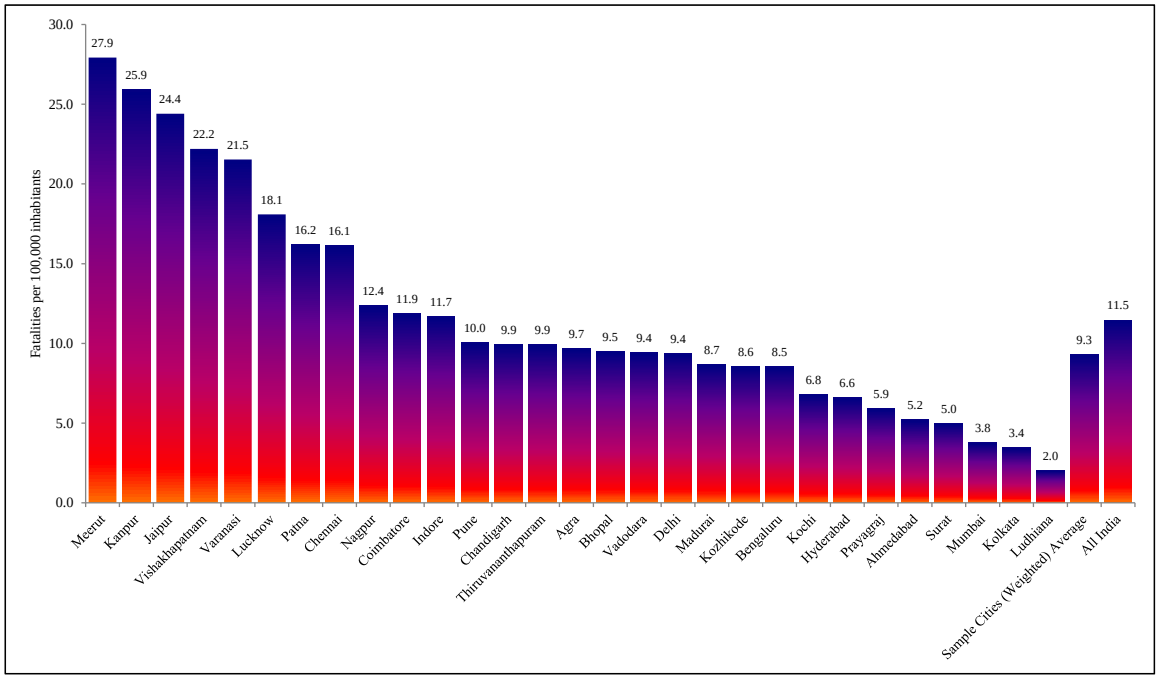

Figure 2. Road accident fatality risk in twenty-nine most populated Indian cities in 2012

2. WHAT ARE THE MOBILITY AND ROAD SAFETY PROBLEMS IN UP'S MOST POPULATED CITIES?

As expected, in Uttar Pradesh, one of India's poorest and densely populated states, the big cities are noisy, crowded, polluted, and somewhat chaotic. The situation is getting worse because of sluggish improvement in public transport system and rapid increase in human population and motorized vehicles particularly cars, two-wheelers, and three-wheelers. In most cities, the motorized vehicle population is predominated by two-wheelers and cars, accounting for over 90%, whereas the share of buses is negligible in comparison to personalized vehicles. For instance, in the cities of Prayagraj and Agra, 93% of vehicle traffic consists of two-wheelers and cars, in Kanpur and Meerut it is 92%, 91% in Lucknow, and 89% in Varanasi, against the all-India city average of 88%; whereas buses constitute less than 0.2% in Prayagraj, Agra, Kanpur, and Lucknow, 0.3% in Meerut, and 0.6% in Varanasi, against the all-India city average of 0.6%. Two-wheelers alone constitute 83% in Prayagraj, 82% in Agra, 80% in Varanasi, 79% in Meerut, 73% in Lucknow, and 72% in Kanpur, against the all-India city average of 71%.

The fatality risk due to road traffic crashes in Indian cities is closely linked with the availability of public transport and two-wheeler ownership. In general,

cities having inadequate availability of public transport and greater reliance on two-wheelers face a very high fatality risk (Figures 3 and 4). An estimated regression equation given below, equation **(1)**, reveals the same. The equation is estimated using the 2022 data from 29 most populated cities of India. Estimated equation clearly shows that the coefficient of two-wheeler ownership is positive and statistically significant at 1% level of significance whereas the coefficient of availability of public transport, measured in terms of number of buses per 1,000 people, is negative, though statistically significant only at 10% level of significance. Two-wheeler ownership and availability of public transport alone explain 40% variation in road accident fatality risk across most populated cities of India.

$$FR = 2.87 + 0.028TW - 1.70Bus;\ R^2 = 0.40 \quad \textbf{(1)}$$
$$(0.88)\quad (4.17)\quad (1.73)$$

where, FR is fatality risk (no. of fatalities per 100,000 people), TW is two-wheeler ownership rate (no. of two-wheelers per 1,000 people), Bus is availability of buses (no. of buses per 1,000 people), and t-stats are given in parentheses.

The relationship revealed by equation **(1)** is in line with expectation; when there are large number of high-risk and low-threat vulnerable road users such as two-wheeler users, pedestrians, and non-motorized road users, accident fatality risk will be high (Bhalla et al., 2007). At low level of income, there are large number of vulnerable road users; low-income cities are also associated with poor driver training infrastructure, poorly maintained vehicles, potholed roads, weak enforcement of traffic rules, and inadequate availability of emergency medical services (Sinha, Singh, and Singh, 2021). That's why cities having high level of two-wheeler ownership and inadequate availability of public transport face a very high road accident fatality risk.

Table 1 clearly reveals that the fatality risk in the cities of UP, on an average 20.2 fatalities per 100,000 people in 2022, is about four times than the comparable cities of the rest of India. This may be because of greater reliance on two-wheelers in UP's cities; there are 485 two-wheelers per 1,000 people in UP's 6 most populated cities, 60% higher than the two-wheeler ownership in the remaining 23 two million plus cities of India. Moreover, public transport availability, measured as number of buses per 1,000 people, in UP's cities is almost 30% less than that in the rest of India cities.

It seems that inadequate availability of public transport and greater reliance on two-wheelers and cars, i.e., the personalized mode of transport; auto-rickshaws and tempos, i.e., the para-transit mode; and tricycles, bicycles, and walking, i.e., the non-motorized transport mode, are one of the important reasons leading to a very high risk of road accident casualties in the metropolitan cities of UP. Though

all types of road users are at risk of being injured or killed in road traffic accidents, however the fatality risk varies across different groups of road users. The 'vulnerable' type comprising pedestrians, cyclists, and two-wheeler users are at higher risk and carry higher burden of injury as compared to other user groups. This happens because of traffic mix and the lack of separation of vulnerable users from other road users. Encroachment of footpaths by parked vehicles, hawkers, and roadside business aggravates the problem, resulting in restricted traffic flows, and higher risk of the lives of road users.

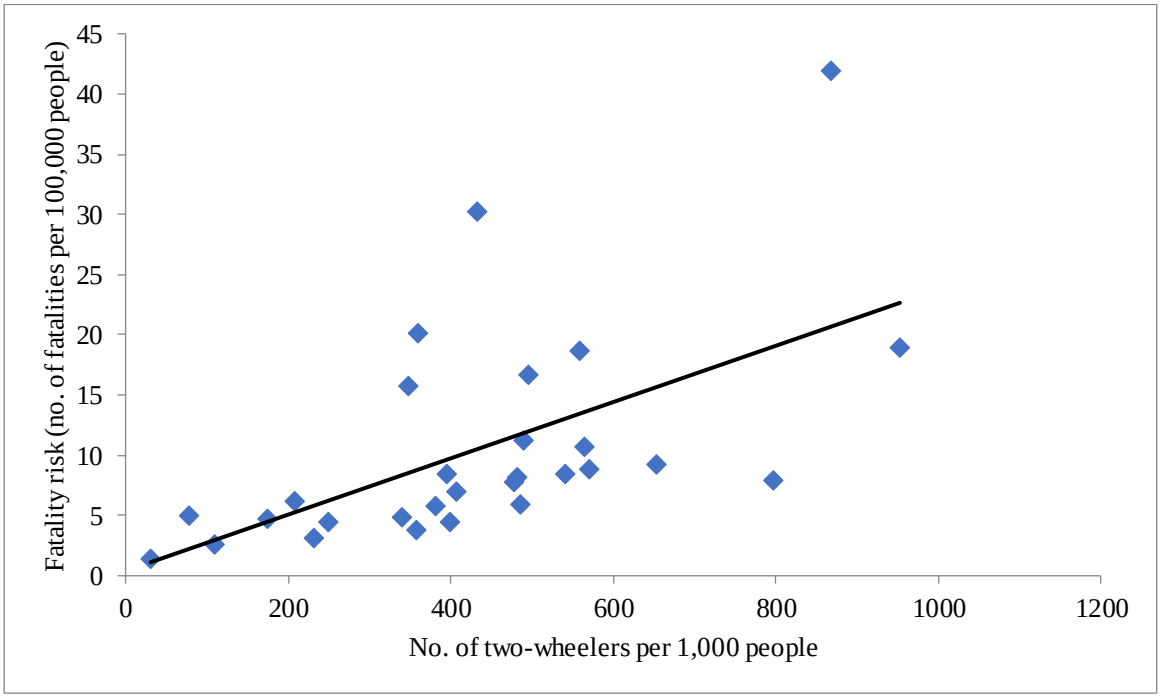

Figure 3. Relationship between fatality risk and two-wheeler ownership across twenty-nine most populated Indian cities in 2022

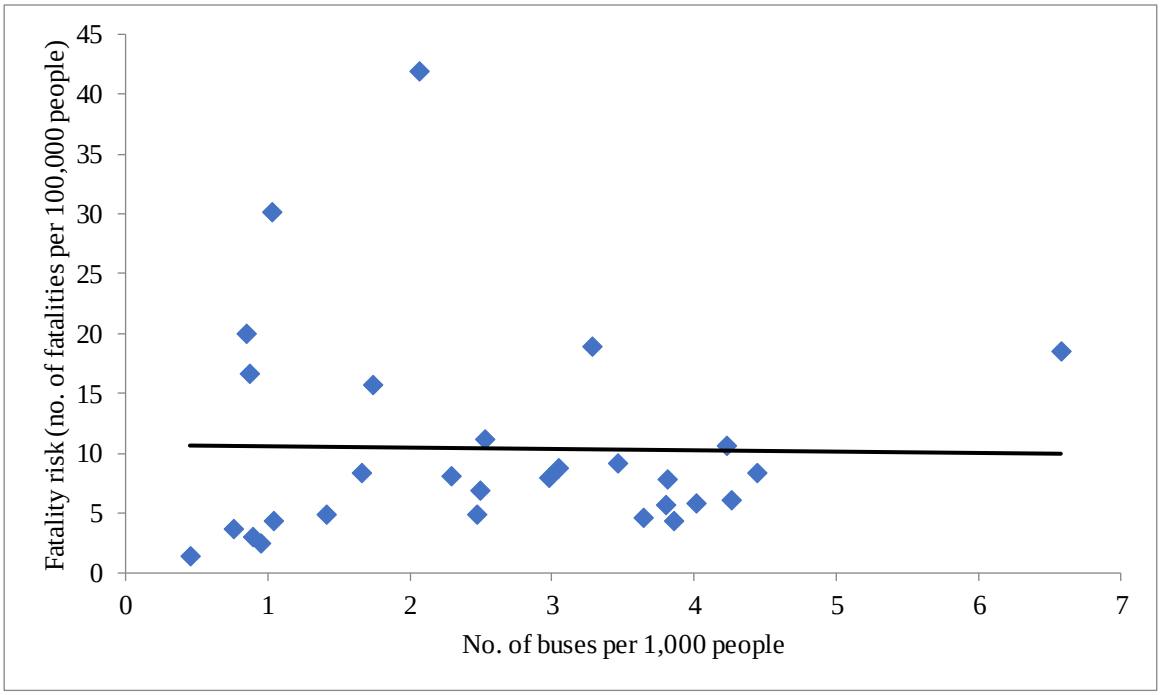

Figure 4. Relationship between fatality risk and availability of buses across twenty-nine most populated Indian cities in 2022

Table 1. Two-wheeler ownership, availability of public transport, and road accident fatality risk in UP's cities in 2022

	Number of two-wheelers per 1,000 people	Number of buses per 1,000 people	Number of fatalities per 100,000 people
Lucknow	495	0.87	16.7
Kanpur	359	0.86	20.1
Varanasi	541	4.44	8.4
Agra	433	1.03	30.2
Prayagraj	867	2.06	41.9
Meerut	395	1.66	8.5
Top 6 metropolitan cities of UP	485	1.54	20.2
Top 23 metropolitan cities of rest of India	303	2.12	5.3
Top 29 metropolitan cities of India	318	2.08	6.5
India	177	1.59	12.4

Source: Estimated by the authors using NCRB data.

3. ROAD CRASH DEATHS IN UP'S MOST POPULATED CITIES

Uttar Pradesh, with the highest level of state population in India, has six metropolitan cities having population of more than two million each. They are

Lucknow, Kanpur, Varanasi, Agra, Prayagraj, and Meerut. Road traffic crashes is the major cause of accidental fatalities across these cities. The proportion of road traffic crashes of the total accidental deaths in Lucknow (74%), Meerut (69%), Prayagraj (68%), Agra (59%), Varanasi (39%), and Kanpur (29%) was much higher than the city average at the national level (25%) in 2022. The problem of rising road traffic crashes in UP's metropolitan cities is very serious, with the incidence of at least 55 deaths per week. In UP's top populated cities, i.e., Lucknow and Kanpur alone, every week, at least 12 persons die due to fatal injuries from road accidents (Table 2).

The metropolitan cities of UP face very high risk of road accidental fatality. It is on an average about four times higher than the other metropolitan cities of India, with a record of 20.2 deaths per 100,000 people in 2022 (Table 2). Unlike cities of rest of India, road accident fatality risk scenario in UP's cities hasn't improved during the last decade; fatality risk in UP's cities increased from 19.2 in 2012 to 20.2 in 2022, while the risk has fallen from 8.4 in 2012 to 5.3 in 2022 in metropolitan cities of rest of India. In fact, unlike other Indian cities, most cities of UP face higher fatality risk, almost twice, as compared to their mofussil counterparts of the state. Moreover, the fatality risk varies highly across UP's cities. In 2022, fatality risk varied from 8.4 fatalities per 100,000 people in Varanasi to 41.9 fatalities per 100,000 people in Prayagraj; in 2012, it varied from 5.9 in Prayagraj to 27.9 in Meerut. Particularly, the UP cities of Prayagraj, Agra, and Kanpur, are presently the three cities with highest risk across India, with a fatality risk of 41.9, 30.2, and 20.1 fatalities per 100,000 people, respectively.

Table 2. Road accident fatality risk in UP's most populated cities in 2022 and 2012

	2022		2012	
	Number of fatalities	Fatality risk (no. of fatalities per 100,000 people)	Number of fatalities	Fatality risk (no. of fatalities per 100,000 people)
Lucknow	643	16.7	525	18.1
Kanpur	640	20.1	757	25.9
Varanasi	145	8.4	309	21.5
Agra	698	30.2	169	9.7
Prayagraj	603	41.9	72	5.9
Meerut	149	8.5	398	27.9
Top 6 metropolitan cities of UP	2878	20.2	2230	19.2
Top 29 metropolitan cities of India	11528	6.5	12019	9.3
Top 23 metropolitan cities of rest of India	8650	5.3	9789	8.4
Uttar Pradesh	24109	10.3	15109	7.4
India	171100	12.4	139091	11.5

Source: Estimated by the author using NCRB data.

4. THE WAY FORWARD

Fatalities due to road traffic crashes are largely preventable because prediction of accidents is possible and also effective countermeasures to prevent accidents exist. For this purpose, an integrated approach can be useful, focusing on majorly four group of factors contributing to the risk of road crash incidences - exposure, behavioral, road environment, and vehicle related aspects (Evans, 2003).

A primary reason behind the rising road traffic crashes and associated injuries in the metropolitan cities of the state of UP is the increasing number of motor vehicles, especially two-wheelers. For example, in Prayagraj, the total vehicle fleet tripled in a decade from 0.5 million in 2010 to 1.5 million in 2020, however, much of this rising numbers of vehicle fleet was on account of rapid growth in the number of two-wheelers, from 444,551 in 2010 to 1,247,995 in 2020. Presently, the two-wheelers population constitutes 83% of total vehicle fleet in Prayagraj. Similarly, in Lucknow, vehicle fleets increased by 136% from 1.1 million in 2010 to 2.6 million in 2020; two-wheelers, which constitute 73% of total fleets, increased by 114% from 890,442 in 2010 to 1,906,077 in 2020. Since the rising incidence of road traffic crashes is closely associated with an increasing use of motorized two-wheelers, the need of effective regulations to monitor the speed and engine performance of two-wheelers is important. In the developed countries, for example, the United Kingdom and Japan, they have effective restrictions through successful interventions (Chiu et al., 2000). For example, during the early 1980s, in the United Kingdom, fatalities among young motorcyclists were reduced by about 25%, through restricting the maximum engine size of learners' motorcycle from 250 cc to 125 cc (Margie et al., 2004). Further, the separation of two wheeled motorcycles from large, high-speed vehicles can also ensure motorcycle safety. For instance, in Malaysia, exclusive motorcycle lanes are separated from the main carriageway by a physical median. While, in Vietnam, joint motorcycle and small motorized vehicles lanes provide routes that pedal cyclists and other non-motorized vehicles can also use.

In general, travel by public transport, particularly by the bus or train mode, is much safer in comparison to other modes of road travel (Singh, 2005). Therefore, public transport should be promoted, particularly traveling by bus, in the metropolitan cities of UP. Usually, bus transport has been mainly seen as an option to solve the travel needs of the less affluent section of the society, however, it is high time now to transform this perception by attracting those people opting for two-wheelers, auto-rickshaws, cars, and taxis, as bus travel has potential of

contribution towards improving road safety, congestion relief, and environmental preservation (Singh, 2012).

Moreover, transport policy should also provision the development of green modes for bicycles, cycle rickshaws, and pedestrians, because motor vehicles cannot deliver time advantage for the short distance journeys, usually within 6 km, made by two-wheelers and cars within the cities (Singh, 2012). Green modes, especially walking and cycling, hold enormous potential towards pollution reduction as well as public health enhancement. Hence, there should be segregated right of way for bicycles and pedestrians. Wherever it is reasonable to do so, there should be provision of separate routes or pavements for pedestrians to keep them away from vehicles. Where possible, pedestrian traffic routes should represent the paths people would naturally follow.

The risk exposure of a population differs by demographic differences, and it varies over time as per changing demographical structures. India, having a higher youthful population, suggests that road users would be predominantly youngsters and hence also bear a higher burden of road crashes and accident fatalities. Young or beginner drivers lack both the skills and experience of driving and thus the recognition of potential dangers on the roads is low, hence the provisioning of a graduated driver licensing scheme would be helpful. Under this plan, the first stage involves passing a written test, an oral theory test, and an eyesight test, basis which supervised learner driver permit is issued to new drivers for six months. The next stage constitutes the issuance of a provisional license for eighteen months entailing temporary restrictions, for example, limits on night-time driving. Finally, a full driving license is issued after clearing a practical driving test. In fact, the graduated driver licensing schemes have been reliably effective in decreasing accident risk for new drivers in the context of many developed countries.

The speed of motor vehicles is a major determinant of road traffic crashes and its consequences. Hence, imposition of speed limits on motor vehicles by city authorities has to be coupled with more strengthened enforcement of restrictions. Particularly in mixed traffic situations, such restrictions could also help in reducing fatalities of pedestrians, cyclists, motorcyclists, and other vulnerable road users.

The metropolitan cities of UP are conspicuous of an overall lag in effective enforcement of road safety policies. Enforcement is poor even in the case of basic mandatory measures, for example, the use of seatbelts and helmets, as per the Motor Vehicle Act. Local city administration grapple to control the regular menace of over-speeding and rash driving. Additionally, the common problem of facing stray cattle on the roads while driving, is also not tackled effectively. The

situation worsens due to acute lacuna of requisite medical facilities and trauma centers, accounting for another significant reason behind high death rates in the cities of UP (Singh, 2009).

As mentioned earlier, the speed of motor vehicles is a strong determinant of road traffic crashes and associated causalities. The opted speed level by a driver obviously depends on the legal speed limits, but also on the driver's age, skill and experience, substance abuse, mental health, road design, traffic levels, road surface condition, and the speed limit enforcement levels. Drivers need to be made aware and understood that speed choices aggravate accident risk for self as well as the other road users.

The perception and behavior of road users is also influenced by the enforcement level of traffic laws and the severity of penalties for indiscipline. All efforts towards improving road safety through legislation are wasted due to poor enforcement of applicable laws. Public awareness about applicable traffic laws needs to be increased through education and publicity campaigns in order to establish shared social norms for road safety along with strict and effective enforcement of restrictions. Without the latter, efforts towards sustained decline in traffic accident deaths and injuries, through the help of education, publicity, and information is not met with much success. Hence, government needs to adopt the systems approach towards effective road injury prevention, by utilizing the legislation and stricter law enforcement along with the enhanced support of education, information, and publicity campaigns, in order to improve the perception and behavior of road users for subsequent sustained reduction in the rates of road traffic crashes and associated deaths and injuries.

It is noteworthy that human errors are the main cause of traffic crashes. In fact, 85% of the road traffic deaths are caused by drivers' fault as per NCRB, 2022. Hence traditionally, measures towards accident prevention focus on 'fixing' the driver. The typical road-safety education and enforcement approaches such as always wear *helmet* while riding a bike, please wear your *seat belt*, say no to *drunken driving*, and general adherence to *traffic rules* are undoubtedly useful in curbing road crashes, but nevertheless it should be accepted that people will make mistakes. Thus, safer vehicle designs and safer road conditions and environment can potentially contribute to curtailing road traffic injuries and fatalities. This would aid in protecting the road user by ensuring that crash energies do not overwhelm the human, rather quality vehicle designs and safer roads work together in synergy. Especially, road infrastructure should be adequate and safer in the context of more vulnerable road users such as pedestrians, bicyclists, motorcyclists, and users of informal public transport, by not exposing such groups to high-speed traffic.

Another concern is that road accidents are not distributed evenly across the road network. They either cluster at single sites, or along particular sections of road, or are scattered throughout whole residential neighborhoods. The road infrastructure, through various signs and traffic controls communicates important instructions for road users, influencing their perceptions, decisions, and behavior, and hence have significant effect on accident risk. Rather, misleading road environment might confuse road users and raise the risk of errors, while faulty road design can directly trigger an accident.

The risk of accident is lower on self-explaining roads and injuries are less severe on forgiving roads. Roads are self-explaining when they align with the expectations of road users and easily signal where they should be and how to use the road safely. Forgiving roads protect road users in the event of an accident. Injuries and fatalities can be reduced by protecting road users from hazards through ensuring quality design of roads. For instance, a simple feature of a safety barrier separates fast moving vehicles from vulnerable road users. Likewise, crash cushions could be used to minimize the adverse outcomes of a road crash (Singh, 2009).

Though only about 2% of road traffic crashes occur due to vehicle defects, the risk is directly impacted by vehicle design through its braking systems, lighting, and tyre quality. In India, the regulation of vehicle safety standards is less systematic in comparison to developed countries, signaling the requirement for adoption of standard safety practices. As a specific issue, overloaded trucks are a threat on Indian roads, causing road infrastructural damage, as well as serious accidents. The primary reason being the lax enforcement of laws. Hence, the entry of overloaded trucks on city roads can be prohibited by stricter legal enforcement.

5. CONCLUDING REMARKS

Road traffic accidents are becoming a significantly important public health concern in the metropolitan cities of Uttar Pradesh. It is the main cause of accidental deaths in almost every metro city of UP. The gravity of the issue can be understood from the fact that road accident fatality risk in these cities is almost quadruple than that in the rest of Indian metropolitan cities. The menace of rising number of fatalities and injuries in the cities of UP due to road accidents warrants the attention of respective administrative authorities. A simultaneous and integrated approach of action is required to target the factors of behavior, road, and vehicle, that impact road traffic crashes. Specific interventions such as stricter legal enforcements to control vehicle speed, use of seatbelts and helmets,

promotion of public transport, designing self-explaining and forgiving roads, and creation of a segregated right of way for two-wheelers and green modes like bicycles and pedestrians have immense scope to arrest the occurrence and impact of road traffic crashes. Further, in order to shorten the critical time in the event of an accident, existence of good pre-hospital care and emergency system is significant, hence UP's cities also require setting up an emergency trauma care network to help accident victims get timely treatment (Singh, 2017). It is high time for the state and municipal governments to act now; acting now will save hundreds of lives in UP's metropolitan cities.

REFERENCES

[1] Bhalla et al. (2007), "A risk-based method for modelling traffic fatalities", *Risk Analysis*, 27(1): 125-136.

[2] Chiu W. et al. (2000), "The effect of the Taiwan motorcycle helmet use law on head injuries", *American Journal of Public Health*, 90(5): 793-796.

[3] Demographia (2023), World Urban Areas 13th Annual Edition (Report). Demographia. August 2023.

[4] Evans L. (2003), "The new traffic safety vision for the United States", *American Journal of Public Health*, 93(9): 1384-1386.

[5] Margie P. *et al.* (2004), "World report on road traffic injury prevention", World Health Organization, Geneva (available at http://www. w ho.int/ violence_injury prevention/publications/ road_ traffic/ world_report/summary en_rev. pdf).

[6] National Crime Records Bureau. Accidental Deaths and Suicides in India. New Delhi: Government of India, 2012-2022.

[7] Sinha A., Singh S. K., and Singh V. (2021), "Linkage between road safety and economic development: a case study of India", *Metamorphosis, 20*(1): 7-15.

[8] Singh S. K. (2017), "Road traffic accidents in India: issues and challenges", *Transportation research procedia, 25*: 4708-4719.

[9] Singh S. K. (2012), "The neglected epidemic: road traffic crashes in India", *Metamorphosis, 11*(2): 27-49.

[10] Singh S. K. (2009), "Road traffic crashes: The scourge of UP's cities", *Economic and Political Weekly*, 44(48): 22-24.

[11] Singh S. K. (2005) "Review of Urban Transportation in India", *Journal of Public Transportation,* 8(1): 79-97.