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Governance and Public Health Synergies: Lessons from systematic review of road safety research in India

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ABSTRACT

The rising number of road accidents is one of the most pressing public health and development concern of the present time. Despite various efforts, India reports the world's highest number of road accident fatalities. This paper employed the Systematic Literature Review technique to analyze existing road safety research in India to draw lessons for effective road safety governance. Three databases—Science Direct, PubMed, and JSTOR were searched and 6,293 articles were screened. A total of 86 articles were included.

Findings revealed that in line with global trends, the majority of the victims of accidents are males, belonging to the economically active age group (18-45 years) and vulnerable road users are the worst affected in India. Driver error, poor road engineering and poor enforcement of laws are the main reasons for accidents. As road safety involves multiple actors and stakeholders, establishment of cohesive multi-sectoral agency is required to strengthen institutional mechanism for road safety efforts. A lead agency with the capacity to develop and coordinate road safety measures supported by accurate and quality data for evidence-based policies and strategies is the most pressing requirement for effective road safety governance.

Key Words: Evidence Based Policy, Governance, Public Health, Road Traffic Injuries, Road Safety.

1. INTRODUCTION

In the recent decades, the issue of road safety has gained wider attention among the countries world over. The mortality and disability linked with road traffic accidents has made road safety one of the world's most important public health problems. As per the Global Status Report on Road Safety (2018), road accidents are the eighth leading cause of death for all age groups globally having significant health and socio-economic costs. It is estimated that due to road accidents, over 1.35 million people die and around 50 million people get injured or disabled every year and suffer life altering and long lasting injuries, costing around US$518 billion annually (World Health Organization, 2004, 2015a, 2018). The importance of road safety also gets reflected in the global developmental discourse.

Targets 3.6 and 11.2 emphasize halving global road accident fatalities by 2030 and ensuring universal access to safe and sustainable transport systems, respectively. However, despite significant efforts, achieving these targets remains a challenge, necessitating innovative approaches to address the complexity of road safety.

In India, road traffic injuries have become a major health and developmental concern. The statistics are alarming: in 2021 alone, there were 4,12,432 road crashes, resulting in 159,972 fatalities and 3,84,448 injuries (GOI Ministry of Road Transport & Highways, 2023a). On average, 1,130 accidents occur daily, leading to the loss of 438 lives. Rapid motorization and the expansion of high-speed road infrastructure, often lacking adequate safety provisions for pedestrians, exacerbate these challenges (The World Bank, 2020). Vulnerable road users—such as pedestrians, cyclists, motorcyclists, children, and public transport passengers—bear a disproportionate burden, highlighting the intersection of road safety with social justice. Most victims belong to lower socioeconomic backgrounds, making road safety a critical equity issue in India (GOI Ministry of Road Transport & Highways, 2002, 2022b; Mohan et al., 2016).

Existing research on road safety has predominantly focused on aspects such as accident data analysis, infrastructure improvements, user behavior, injury patterns, and awareness campaigns (Mohan et al., 2020; The World Bank, 2020). While these studies provide valuable insights, the governance dimension—which involves inter-sectoral coordination, policy mechanisms, and institutional capacity—has received relatively less attention, particularly in the Indian context. Governance encompasses the processes, mechanisms, and capacities through which governments operate, deliver services and interact with citizens (Kooiman, 2003; Osborne, 2010). The governance of road safety intersects significantly with public health, as effective policies and multi-sectoral coordination are crucial to reducing injury-related healthcare burdens and improving societal well-being.

Road safety is a collective responsibility and road traffic injuries are preventable. It requires valuable contribution and coordination of many sectors of society; governments (Central, State and Local levels) have a very important role to play in creating an enabling environment. However, it remains a major governance challenge. World over the governance of road safety hints at a holistic intervention which tries to converge multiple sectors (transport, health, police, etc.) focusing on pre-crash, crash and post-crash scenarios (Bax, Leroy, & Hagenzieker, 2014; Schopper, Lormand, & Wazweiler, 2006). The complexity of the road safety challenge requires effective governance response. It is in this context, this study analyzed the existing road safety research in India to draw lessons for effective road safety governance. In doing so, this study holistically conceptualized road safety by focusing on key areas in road safety governance, i.e. road safety management, safer roads and mobility, safer vehicles, safer road users, and post-crash response.

2. THEORETICAL AND CONCEPTUAL FRAMEWORK

Road accidents have evolved from being considered as an issue of individual responsibility or chance to a significant public health and governance issue. In the early twentieth century, road accidents were linked to bad luck or the ‘accident-prone’ nature of some drivers. therefore, the interventions were focused on driver education, enforcement and training (Hagenzieker et al., 2014). However, with rising number of road accident proved the driver-centric approach to be ineffective.

By mid-twentieth century, the role of multiple factors like road design, vehicle design, road user behavior and environment was recognized and problem of road accidents was considered as multi-causal phenomena (World Health Organization, 2004, 2015). This led to the development of systematic approaches focusing on multiple factors. In the 1970s, while addressing human, vehicle and environment factors, **the Haddon Matrix** categorized road safety measures into pre-crash, in-crash and post-crash phases (Haddon, 1972).

In the late twentieth century, emergence of **safe systems approach** led to a paradigm shift and road safety was reframed as a public health issue. This approach acknowledged human fallibility and emphasized on designing forgiving systems to mitigate the consequences of human errors. This was complete reversal of the initial approach of blaming the driver to accommodating the human errors. This approach focused on safer infrastructure, vehicle technologies and enforcement measures (Elvik et al., 2009; Hughes et al., 2015). During this time, the public health perspective of road safety gained prominence. Data driven and evidence based interventions used in managing infectious diseases were promoted for road safety as well. The focus shifted to establish robust data systems to design systemic intervention and equitable solutions to reduce the global burden of road accidents injuries (World Health Organization, 2004).

Building on these advancements, United Nations conceptualized road safety under **five-pillar framework** and introduced the Decade of Action for Road Safety (2011-2020) (United Nations, 2010). This framework provided a comprehensive set of activities to guide national strategies (Table 1).

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Table 1 Five Pillar of Road Safety and Activities to be undertaken under each Pillar	
Pillar	**Activities to be undertaken**
Pillar 1 Road Safety Management	• Establish lead agency • Develop National Strategy • Realistic long term targets based on crash data • Ensure adequate funding • Establish data system
Pillar 2 Safer roads and mobility	• Road safety ownership and accountability among road authorities, road engineers and urban planners • Promoting the needs of all road users as part of sustainable urban planning, transport demand management and land-use management • Safe operation, maintenance and improvement of existing and new road infrastructure • Encourage research and development, capacity building and knowledge transfer in safe roads
Pillar 3 Safer vehicles	• Apply global vehicle safety regulations • Implementation of new car assessment of programmes • Incorporate safety features in vehicles like seat-belts, Electronic Stability Control, Anti-Lock Braking systems for motorcycles etc. • Incentivize the motor vehicles providing high levels of protection • Application of pedestrian protection and promote research into safety technologies
Pillar 4 Safer road users	• Increase awareness about risk factors and prevention measures • Enforcement of safety laws like speed limits, drink driving, helmet use, seat-belt use and child restraints etc. • Establishment of Graduated Driver Licensing system for novice drivers • Research, develop and promote comprehensive policies and practices to reduce work-related road traffic injuries
Pillar 5 Post crash response	• Develop prehospital care systems • Develop hospital trauma care systems • Provide early rehabilitation and support to injured patients • Establish road user insurance schemes to finance rehabilitation • Effective legal response • Research and development into improving post crash response
Source: (Global Plan for the Decade of Action for Road Safety 2011-2020 United Nations, 2010)	

The five-pillars emphasized on the need for governance at each aspect from developing institutional mechanisms and enforcement of traffic rules and regulations to foster collaborations among various stakeholders.

Governance, in simple words, refers to the processes and structures through which decision are taken and implemented. Beyond traditional government institutions, it involves various actors including private and non-government entities. Governance plays an important role in addressing complex social issues like road safety by coordinating various stakeholders, ensuring accountability and mobilizing resources effectively (Kooiman, 2003). In the context of road safety, governance can contribute in coordination, collaborations and accountability across

DOI: 10.47505/IJRSS.2024.12.5

multiple levels of decision making. The role of governance in addressing road safety challenges can be understood through three prominent frameworks of governance i.e. network governance, collaborative governance and multi-level governance.

Network governance advocates for creating networks or partnerships among various actors like public, private and civil society. Network governance favors decentralized governance wherein in each actor contribute its expertise, resources and bring legitimacy to achieve a common goal or address specific challenges (Provan & Kenis, 2008; Rhodes, 1997). Similarly, **collaborative governance** advocates for active involvement of multiple stakeholders in decision-making process. It emphasizes on inclusion of diverse perspectives of government agencies, local communities, non-government organizations and private sector in implementation and formulation of policies and programmes. Collaborative governance focusses on consensus building and shared ownership which contributes in legitimacy and sustainability of policy decision (Ansell & Gash, 2008). **Multi-level governance** recognizes the role of various levels of the government i.e. local, regional and national. It stresses on coordination among these levels for effective implementation of policy decisions. Multi-level governance focuses local needs while aligning them with national strategies and international frameworks (Hooghe & Marks, 2001).

These theoretical frameworks can contribute effectively in addressing complex challenges posed by road accidents. The multi-dimensional and inter-dependent nature of stakeholders involved in road safety aligns with network governance principles. Collaboration among public and private sectors along with civil society can equitably contribute in policy formulation and implementation. Similarly, multi-level governance can facilitation aligning global goals like SDGs and UN's five-pillars with national strategies and local needs.

Thus, integration of governance and road safety requires a dynamic approach which can integrate, multi-stakeholder collaboration, multi-level coordination and evidence-based decision making. With the evolution of concept of road safety and governance, these principles are becoming essential in addressing systemic challenges, ensuring equity and achieving sustainable reductions in traffic injuries and fatalities.

3. METHODOLOGY

The Systematic Literature Review (SLR) method was used for "locating, selecting, appraising, synthesizing and reporting evidence" (Denyer & Tranfield, 2009) to draw conclusions about what is known and documented and to identify areas that require further exploration.

3.1 Search Strategy and Screening for Inclusion

To make the study feasible without excluding relevant literature, three broad keywords – 'Road', 'Safety' and 'India' were used for literature search. These keywords were chosen to ensure both comprehensiveness and relevance. The keywords road' and/or 'safety' ensured inclusion of studies using these anywhere in the study (maintaining comprehensiveness) and the keyword 'India' limited the search to the studies conducted in Indian context. This approach ensured retrieval of literature relevant to the research objective and also to the governance framework.

Three databases—Science Direct, PubMed, and JSTOR—were selected to cover a broad range of peer-reviewed journals. While these databases offer substantial coverage, relevant studies from other sources may have been excluded. The search was restricted to publications written in English due to feasibility constraints. The timespan of 2010–2020 was chosen to focus on the period influenced by the United Nations' Decade of Action for Road Safety (2011–2020). To ensure inclusivity, references cited in the selected articles were also screened to identify any additional relevant studies.

A clearly defined inclusion and exclusion criteria was applied to identify the most relevant articles (Table 2). The screening of articles was done at two levels. First, titles and abstracts were reviewed to assess preliminary relevance based on the criteria. Duplicate studies appearing across multiple databases were removed during this stage. As a result, out of 6,293 screened articles, 112 (38 from Science Direct, 61 from PubMed, and 13 from JSTOR) met the inclusion criteria. In the second stage, full-text articles were reviewed to confirm relevance. Articles for which full text was inaccessible were excluded. After this final screening, 53 articles were selected for analysis (25 from Science Direct, 21 from PubMed, and 7 from JSTOR). Additionally, 33 articles identified from the references of the selected papers were included, bringing the total to 86 articles for analysis.

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Table 2
Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Studies dealing with five pillars of road safety (as defined by the UN) in India, including:	• Technical papers (e.g., modeling of road accidents, safety risk perception)
• Trends in road accidents	• Papers on allied fields without a primary focus on road safety (e.g., travel patterns)
• Safe road design	• Program/project descriptions without data
• Safer vehicle design	• Book chapters (if full text was inaccessible)
• Road user behavior/perception	• Non-research articles (e.g., editorials, newsletters, commentaries)
• Road safety laws	• Non-English publications
• Risk factors (speed, alcohol, seatbelt/helmet use)	• Studies published before 2010
	• Studies conducted outside India

3.2 Data Extraction and Analysis

Each study was evaluated based on its thematic alignment with the five pillars of road safety as defined by the United Nations: Road Safety Management, Safer Roads and Mobility, Safer Vehicles, Safer Road Users and Post-Crash Care. Data was extracted from the objectives, major findings, and suggestions of the studies for improving road safety governance. The themes were analyzed to identify patterns and gaps in the existing literature.

4. RESULTS: PILLAR-WISE INSIGHTS INTO ROAD SAFETY CHALLENGES

The studies were categorized under five themes: Road Safety Management, Safer Roads and Mobility, Safer Vehicles, Safer Road Users and Post-Crash Care which are discussed as under:

4.1 Road Safety Management (Pillar 1)

A total of thirty-eight studies were categorized under the theme of road safety management, primarily focusing on the analysis of epidemiological factors related to road accidents. These studies examined variables such as the time, day and month of accidents, the location of crashes, the age and gender of victims, types of vehicles involved and collision types (e.g., head-on, overturning). These factors were used to identify patterns and causes of accidents, as well as the severity of injuries sustained. Notably, studies also assessed the accuracy and quality of accident data. For example, (Raban et al., 2014) evaluated the quality of police data on road accidents, while (Bhalla et al., 2017) evaluated accuracy of official government statistics on road accident data by comparing it to the FIR records. Additionally, Menon et al. (2010) explored the feasibility of integrating accident data from multiple sources to enhance reporting and quality of data.

The findings of the several studies highlighted the involvement of motorized two-wheelers in majority of road accidents in India. Also, the majority of the victims of these accidents belonged to economically active age group of 18-45 years (Kar et al., 2016; Pathak et al., 2014). The main causes of these accidents were driver error, poor road infrastructure and design and weak enforcement of traffic rules leading to speeding and drunk driving (Kumar et al., 2020; Pathak et al., 2014; Ponnaluri, 2012). Delays in timely access to emergency care further exacerbated the impact of the accidents (Pathak et al., 2014).

To address these challenges several studies recommended multi-sectoral approach. Collaboration among policy makers, enforcement agencies, urban planners and healthcare providers is of utmost importance for developing effective road safety strategies (Kar et al., 2016; R. Roy et al., 2014; M. Tripathi et al., 2014). Road safety measure need to be focused on standardizing road designs, providing clear signage and sufficient lighting to ensure visibility to reduce accidents (Bayan et al., 2013; Bhoi et al., 2018; Dhanoa et al., 2019). Development of safe infrastructure like

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separate lanes and pedestrian crossings is essential to ensure safety of vulnerable road users (Barffour et al., 2012; Bhoi et al., 2018; Ghosh & Paul, 2013). Additionally, importance of quality construction practices is also emphasized for durability and safety of the roads (Ponnaluri, 2012). Specific recommendation for public transport vehicles included the adoption of low-floor buses with mechanical doors (Kharola et al., 2010).

Strict enforcement of traffic rules and regulation is another critical area for improvement. Studies emphasized the need for strict measures against speeding, drunk driving and non-compliance with safety regulations like seatbelts/helmets. Strict enforcement can contribute in fostering responsible behavior among road users (Chandrasekharan et al., 2016; Howley et al., 2017). Further, awareness campaigns to educate people about road safety practices are also vital in encouraging compliance with safety regulations (Ghosh & Paul, 2013; Hadaye et al., 2020). Such campaigns should adopt a targeted approach for diverse groups to ensure broad-reaching impact.

In the post-crash scenario, development of robust emergency response system, with special focus on pre-hospital care is of utmost importance for reducing fatalities and long-term disabilities (Chandrasekharan et al., 2016; Hsiao et al., 2013; Kanchan et al., 2012). Many studies found that improving the quality of emergency response system can significantly improve survival rates and prevent complications.

Finally, for effective and targeted road safety interventions, the importance of comprehensive and quality road accident data was emphasized. As accident data is collected by various stakeholders like police, hospitals, transport departments etc. creating a unified database by interlinking various data sources, can enhance accuracy and facilitate effective evidence-based interventions (Barffour et al., 2012; Dandona et al., 2020). Thus, this integration of the data collected by various stakeholders will not only contribute in better understanding of road safety trends but also in designing road safety programmes to address specific issues or target groups.

4.2 Safer Roads and Mobility (Pillar 2)

Sixteen studies evaluated the features of road design and their impact on safety and mobility. These studies examined the road infrastructure to understand the safety issues at intersections and/or pedestrian safety at midblock sections (Chaudhari, Gore, et al., 2020b, 2020a; Lal et al., 2016; Mukherjee & Mitra, 2020; Priyadarshini & Mitra, 2018; S. Siddiqui et al., 2013). Other studies analyzed the role of build environment (road infrastructure) in influencing pedestrian risk perception (Goel et al., 2018; Mitra & Bhowmick, 2020; Rankavat & Tiwari, 2015, 2016b), road infrastructure near educational institutions (Enrichson et al., 2018; Shettar & Patil, 2016) and road design considerations for vulnerable users such as the elderly, cyclists, and pedestrians (Gonawala et al., 2013). Additionally, sustainable transportation in urban areas was examined (Chakroborty, 2011; Mohan, 2013; Verma, Sreenivasulu, et al., 2011), with a specific focus on public transportation systems like BRTS (Mahadevia et al., 2013).

Key road design elements—such as carriageway width, zebra-crossing dimensions, and median presence—were found to significantly influence pedestrian safety (Priyadarshini & Mitra, 2018; Rankavat & Tiwari, 2016b). The type of road, traffic volume, and land use also shaped pedestrian behavior (Chaudhari, Gore, et al., 2020b). Features like bus stops, parking facilities, sidewalks, and road markings were identified as critical factors in reducing fatality risks (Goel et al., 2018; Rankavat & Tiwari, 2015). Arterial roads with high traffic volumes and multiple lanes were associated with higher crash risks (Rankavat & Tiwari, 2015). Intersection analysis revealed that factors like non-motorized traffic, visibility of road markings, and countdown timers significantly impacted crash frequency and severity (Anjana & Anjaneyulu, 2015; Mitra & Bhowmick, 2020).

For enhancing safety and mobility in urban areas, researchers emphasized on improving public transport systems and using intelligent transportation systems. Land use planning including integration of sidewalks, pedestrian crossing and signalization at intersection were recommended to ensure safer and efficient mobility (Lal et al., 2016; Mahadevia et al., 2013; Mohan, 2013).

4.3 Safer Vehicles (Pillar 3)

Despite the important role of vehicle design and technology in ensuring safety, only a single study explicitly examined vehicle design from the safety perspective (Moran et al., 2017). This study found that improved front-end vehicle designs significantly lowered pedestrian fatalities and injury severity in high-income countries. Similar design adaptations can be useful in India, where pedestrians constitute a large proportion of accident victims. However, the adoption of vehicle safety standards in India has been slow and limited to minimal regulatory requirements.

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The review of global studies revealed vehicle safety technologies like electronic stability control, anti-lock braking system and advanced driver assistance systems have significantly reduced risk of road accidents and injury severity in countries with stringent safety regulations (The International Transport Forum & OECD, 2019; World Health Organization, 2018). In India lack of robust enforcement mechanisms and cost consideration have limited the adoption of these features in Indian vehicles. Further, in India behavioral interventions and infrastructure improvements are given priority, leaving vehicle safety underexplored (GOI Ministry of Road Transport & Highways, 2021, 2022).

4.4 Safer Road Users (Pillar 4)

Twenty-six studies were categorized under the theme safer road users (Pillar 4). These studies evaluated education, knowledge, behaviour, awareness and perception of road users (Dandona et al., 2020; Kulkarni et al., 2013; Raj et al., 2011; Salve et al., 2014; Sreedharan et al., 2010; N. Tripathi et al., 2019). Role of behavioural risk factors i.e. alcohol consumption (Das et al., 2012; Tetali et al., 2016), helmet use/seatbelt use (Karuppanagounder & Vijayan, 2016; S. Siddiqui et al., 2013; Sreedharan et al., 2010; Swaroop et al., 2014; Wadhwaniya et al., 2017) was also examined. Pedestrian behavior and utilization of safety infrastructure was also analyzed (Chaudhari et al., 2019b, 2019a; Chaudhari, Arkatkar, et al., 2020; Ferenchak, 2016; Kadali & Vedagiri, 2019) (Rankavat & Tiwari, 2016a, 2020). (Verma, Velumurugan, et al., 2011) focused on understanding psycho-physical traits of drivers along with education and enforcement measures and (Verma et al., 2016) investigated the effect of visual capabilities of drivers on safe driving.

Finding revealed road users perceived dangerous road environment (poor roads and inadequate infrastructure, and heterogeneous traffic), lack of awareness of laws, absence of strong political will and limited public participating as the key factors contributing in poor road safety (Jacoby et al., 2017; Tetali et al., 2013; N. Tripathi et al., 2019). The awareness about road safety i.e. knowledge of traffic signs and safety laws was poor (Kulkarni et al., 2013; Raj et al., 2011). In India, the motorized two-wheeler riders are the most affected vulnerable road users. Helmet and seatbelt usage among motorized two-wheeler riders remained low despite legal mandates, (Gururaj et al., 2014; S. M. Siddiqui et al., 2016; Sreedharan et al., 2010) with factors such as comfort, education, gender, marital status, and enforcement influencing compliance (Chaudhary et al., 2013; S. Siddiqui et al., 2013; Sreedharan et al., 2010; Wadhwaniya et al., 2017). Use of pedestrian facility was influenced by perceptions of risk, safety, and convenience (Rankavat & Tiwari, 2016a, 2020).

Interventions such as mass media campaigns, school-based programs and stricter enforcement of laws were recommended to promote safe behavior (Kulkarni et al., 2013; S. Siddiqui et al., 2013). Reforms in driver licensing systems by incorporating international practices like graduated licensing, formal education and hazard perception tests were also suggested as measure to improve road users behavior (Verma et al., 2016; Verma, Velumurugan, et al., 2011).

4.5 Post-Crash Response (Pillar 5)

Post-crash care in India is an important yet underserved pillar of road safety. Only five studies evaluated post-crash response systems in India, focusing on trauma care facilities including pre-hospital and in-hospital care (Babu et al., 2020; N. Roy et al., 2010; Shah et al., 2015; Uthkarsh et al., 2016a; Wesson & Kwong, 2017).

Findings revealed significant deficiency in pre-hospital care. The ambulances served as mere transport vehicles rather and were not equipped properly with resources and trained paramedics (Lashoher et al., 2017; Uthkarsh et al., 2016b). Long transport time further adversely affected the care required within the ‘golden hour’ (Wesson & Kwong, 2017). Similarly, in-hospital trauma care was also constrained by lack of adequate physical and human resources i.e. equipment and specialized and trained staff to handle poly-trauma cases. Further gaps in recommended and available human and material resources hindered quality care (Babu et al., 2020; Shah et al., 2015; Uthkarsh et al., 2016a; Wesson & Kwong, 2017).

These studies recommended specialized trauma care training for paramedics, nurses and doctors involved in trauma care. Further there is need of standardized trauma care guidelines and protocols and well equipped facilities with adequate infrastructure and other equipment (Babu et al., 2020; Wesson & Kwong, 2017). Establishment of an integrated and centralized trauma care system was also recommended for effective post-crash response (Babu et al., 2020; Uthkarsh et al., 2016b).

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5. DISCUSSION AND LESSONS FOR EFFECTIVE GOVERNANCE

Road safety is a complex, multi-sectoral and multi-dimensional issue. To address the challenges posed by rising number of accidents there is need for an integrated and coordinated approach. Historically, road accidents were perceived as a negative externality of road transport development rather than a critical governance and public health issue. The UN's conceptualization of road safety through the five-pillar framework provided a much-needed comprehensive perspective, enabling governments to address the core of the problem systematically (United Nations, 2010).

The findings from this review revealed that, consistent with global trends, the majority of road crash victims in India were economically active males (18-45 years), with vulnerable road users such as pedestrians, cyclists and motorcyclists being disproportionately affected. Driver error, poor road engineering and insufficient enforcement of traffic laws were the primary contributors to road crashes, with over-speeding and drunk driving accounting for 73.7% of accidents in 2022 (GOI Ministry of Road Transport & Highways, 2023). Furthermore, the lack of timely emergency care exacerbated fatalities, highlighting gaps in post-crash response system.

India faced unique road safety challenges due to its diverse traffic mix, which included motorized vehicles, non-motorized transport, and pedestrians sharing the same infrastructure. These necessitated interventions that, while inspired by global best practices, were tailored to address India's specific context. For example, Sweden's Vision Zero (Belin et al., 2012) offered insights into designing safer road systems, but adapting these measures required accounting for India's socio-economic diversity and infrastructural constraints.

As road safety involves multiple actors and stakeholders including government agencies, urban planners, vehicle manufacturers, enforcement authorities and healthcare providers, the effective road safety governance depends on multi-sectoral coordination through integrated framework. Establishment of cohesive multi-sectoral organization like lead agency is required to strengthen institutional mechanism for road safety efforts. In Sweden, the Transport Administration (lead agency under Vision Zero framework) exemplified such a model. It acts as a point for collaborative networks, ensuring that various stakeholders worked together towards the common goal. This agency has been successful in ensuring coordinated multi-stakeholder efforts and integration of road safety efforts into national policies and priorities. This resulted in 50% reduction in road accident fatalities between 2000 to 2020 (Belin et al., 2010; Government Offices of Sweden, n.d.; Kim et al., 2017). Similarly, the Motor Vehicle Amendment Act 2019 provides for a National Road Safety Board and similar bodies at state level. It is a step in right direction. However, there is need to empower these agencies with adequate resources and authority to ensure road safety gets its due attention.

Road infrastructure plays a pivotal role in both preventing accidents and mitigating their impact. Safety needs to be embedded as a core aspect of infrastructure projects, supported by regular audits and compliance reviews. Collaborative frameworks and policies play a crucial role in this process by ensuring the integration of public health considerations into infrastructure safety standards, fostering a holistic approach to road safety. For instance, the Netherlands' Sustainable Safety vision demonstrated how public health and road infrastructure safety could be integrated. Through its lead agency, the Dutch Ministry of Infrastructure and Water Management, the Netherlands implemented systemic measures such as self-explaining roads and the separation of traffic types, resulting in a significant reduction in road fatalities—from approximately 1,200 deaths in 1997 to approximately 509 in 2021 (European Commission, 2024; Wegman & Elsenaar, 1997). Presently, urban road designs in India prioritized motorized vehicles, often neglecting the needs of vulnerable road users. Land-use planning and inclusive urban design are critical for creating safer environments for all road users. While the Indian Roads Congress had updated road design standards, strict enforcement and localization of these standards are imperative to ensure their effectiveness.

The behavior of road users remains a significant determinant of road safety outcomes. Research has found that in India there is widespread ignorance of traffic rules, lack of awareness of safety practices and low adherence to safety laws. To address these challenges, governance strategies establishing multilevel interventions targeted at various socio-economic groups through public private partnerships by leveraging community resources are required. For instance, THINK! Campaign in UK has been a successful in using social marketing strategies for inducing safer behavior. The campaign used targeted messaging and media campaigns to bring change in attitudes and behaviors related to

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speeding, seatbelt use and drinking and driving (Angle et al., 2012). Further innovative solutions involving AI-driven monitoring and behavior targeted interventions can also complement traditional enforcement mechanisms to improve compliance and awareness.

The importance of collaborated and integrated governance and evidence based policy making has been successful in addressing road safety challenges worldwide. Governance theories like collaborative models have the potential to provide actionable frameworks to enhance coordination and address capacity gaps in road safety efforts in India. By leveraging these approaches road safety governance in India can be aligned with broader public health goals, ensuring an integrated and sustainable impact.

6. CONCLUSION

Road Safety has been recognized as a public health and governance challenge in India. By integrating road safety into broader development and health strategies, India is committed to contribute to global goals like SDG 3 – Good Health and wellbeing and SDG 11 – Sustainable Cities and communities. Road accidents disproportionately affects the vulnerable road users especially the poor, exacerbating social and economic inequalities. The responsibility of addressing challenges of road safety should be shared among all the stakeholders to build safer, healthier and equitable society. Multi-sectoral approach involving road infrastructure, vehicle safety, enforcement and emergency response system, with establishment of an independent lead agency are the need of the hour. Effective road safety governance through a lead agency can coordinate the efforts of various stakeholders and ensure optimum utilization of resources in achieving road safety targets. In addition, road safety challenges require context-specific solutions which should be inspired from international experiences but tailored to the unique traffic mix and socio-economic realities of India. Adopting internationally recognized road design and vehicle design standards can contribute in creating safer roads and improving road safety outcomes. Further, strengthening of road safety governance will create a robust framework which will contribute in management of future mobility needs and make road safety integral part of urban planning, economic development and public health strategies. By fostering the culture of safety and responsibility, road accidents and fatalities can be reduced, contributing to a more sustainable and equitable future.

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