



Road Safety in Pakistan: Vulnerable Road Users, Challenges and Policy Implications

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ABSTRACT

Road safety is a serious public health challenge in Pakistan and in the world. It costs thousands of deaths, injuries and disabilities due to road traffic accidents (RTAs) per year. This study analyzed existing literature to identify the key factors contributing to road traffic crashes. It is a content analysis carefully done from the existing body of knowledge. This analysis emphasis on areas such as driver behavior, infrastructure deficiencies, weak traffic law enforcement/legislation gaps and associated risks for vulnerable road users. The results indicated that main determinants of RTAs in Pakistan were road conditions, lack of traffic law enforcement, risky driving behavior, road rages and limited or no post emergency response. Some urban centers have adopted technology driven solutions: safe city monitoring, automated traffic monitoring, speed check cameras but their implementation remains inconsistent. This article concludes with recommendations aimed at improving road safety conditions: strengthening law enforcement/ upgradation, promoting public awareness campaign, education of road safety and expanding emergency services in Pakistan. It also recommends insights into effective policy interventions that could significantly reduce the incidence of RTAs and protect vulnerable road users in Pakistan.

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1. Introduction

Road safety is one of the pressing public health challenges in Pakistan. It has thousands of fatalities, crashes and injuries per year. Pakistan continues to populate and urbanize rapidly. Motorized vehicles also grew exponentially (Sherin, 2021). This led likelihood of traffic accident, road crash and fatal incidents on highways, motorways and cities. Current statistics place road traffic injuries as one of the leading causes of death among youth (Ahmed et al., 2023). Particularly, those aged 15–29 years were more victim of these crashes (Organization, 2019). These figures underline importance of addressing road safety as a national priority. Pakistan's road safety landscape is with full of challenges. Poor infrastructure, weak law implementation of traffic, risky driving behavior and inadequate emergency response system contributed to the high rate of traffic accidents. Vulnerable road users: pedestrians, cyclists and motorcyclists were at risk. They were at risk due to insufficient protective infrastructure and noncompliance with safety laws/ regulations (Dasanayaka et al., 2020). Pakistan has some technology led solutions in some urban spaces like e-ticketing and automated traffic monitoring. However, these solutions have not been implemented uniformly across the country (Pervez & Oad, 2023). The complexity of these issues is a lack of comprehensive data on traffic accidents in Pakistan (Fatima et al., 2024). In rural areas, law implementation is weaker and resources are scarcer. Rural regions face greater challenges in ensuring road safety. They have limited infrastructure, poor road conditions and a lack of access to healthcare facilities in the event of accident. This study seeks to explore the major factors contributing to road traffic accidents in Pakistan (Aati et al., 2024). It is to evaluate the effectiveness policy interventions in addressing these issues in the country. This paper aims to provide a comprehensive overview of the road

safety challenges in Pakistan. It offers actionable recommendations for policymakers (Habib et al., 2024). The focus will be on four key areas: driver behavior, road infrastructure, law enforcement and emergency response system in Pakistan. The study's findings may help to identify gaps in current road safety strategies. It may also provide a framework for future research and policy development.

2. Literature Review

Rapid rise in motorization, particularly in developing nations, has multiplied this issue, leading to higher rates of road traffic accidents (RTAs) and fatalities across the globe. The following literature review shed lights on key risk factors contributing to road traffic accidents. It also evaluates policy and regulatory policies aimed at improving road safety and the role of technological advancements/ innovation (Ali et al., 2022). Specific focus is placed on the road safety situation in Pakistan and the region. It presents the current challenges and potential interventions in order to save the roads.

2.1. Global Perspectives on Road Safety

Globally approximately 1.35 million people were dying per year due to RTAs. Millions of people were suffering injuries (Ibrahim, Kumazhege, & L'Kama, 2023). Technological advance countries have seen reductions in traffic fatalities due to stricter regulatory policy/ law and technological innovation. However, low and middle income countries continue to struggle with disproportionate numbers of road traffic accidents, injuries and deaths. According to Ahmed et al. (2023), nearly 93% of global road traffic deaths occur in developing countries but they only 60% of the world's vehicles on road. Here are key factors of the road safety:

1. **Human Factors:** Human error is consistently identified as the leading cause of RTAs across the world. Speeding up, distracted driving, impaired driving due to alcohol or drugs and noncompliance with safety rules like seatbelt and helmet use were prominent causes of traffic accidents in the world (Abdul Hamid et al., 2023). Studies suggest that around 90% of road crashes were due to driver error or behavioral factor in developing nations (Rashmi & Marisamynathan, 2023).
2. **Environment and Infrastructure Problems:** Poor Road conditions, inadequate road signage, limited lighting and adverse weather conditions accelerated risk of traffic accidents in various parts of the world. These issues are particularly prevalent and contributing to increased accident rates in Pakistan (Jalilian et al., 2019).
3. **Vehicle Safety:** Vehicle safety standards play a significant role in mitigating the severity of crashes in different countries. Adoption of advanced safety features like airbags, anti-lock braking systems (ABS) and electronic stability control has reduced the number of fatalities on roads in developed countries. However, in many developing nations, outdated and poorly maintained vehicles contribute to increased risk (Hernandez et al., 2024).

2.1. Policy Approaches

Sweden have demonstrated significant reductions in road traffic fatalities due to its unique approach. Sweden's Vision Zero policy framework that focuses on designing safer road system, implementing stringent traffic law and improving vehicle safety were often cited as a model for reducing traffic deaths (Abebe, 2022). Similarly, countries that implement road safety laws: including seatbelt usage, helmet mandates for motorcyclists and strict penalties for drunk driving have improvement in road safety. Low and middle income countries, however, face significant challenges in implementing these policies. Limited financial resources, weak enforcement of traffic laws, and corruption are common barriers to successful road safety interventions in parts of the world (Blanco et al., 2021). Increasing public awareness, improving infrastructure and enhancing traffic implementation were necessary for improving safety (Syed Ahmad et al., 2021).

2.2. Technological Innovations in Road Safety

Technological advancements have transformed road safety in the technologically advanced countries. Advanced Driver Assistance Systems (ADAS) and autonomous vehicle technologies have the potential to reduce human error. Lane departure warnings, automatic emergency braking and collision avoidance system were integrated into modern vehicles. It helped to prevent accidents (Neumann, 2024). Autonomous vehicles remain in the early stages of deployment and potential to reduce road traffic injuries and fatalities is substantial in those

societies. Technological innovation like e-ticketing, speed camera and automated traffic monitoring systems have shown promise in improving road safety (Gherardini & Cabri, 2024). However, the widespread adoption of these technologies has been slow, largely due to financial and logistical constraints in low and middle income societies.

2.3. Road Safety in Pakistan

Pakistan has experienced a serious road safety problem. Over 30,000 fatalities, hundreds of thousands of people were disabled due to RTAs in Pakistan. It has one of the highest road traffic fatality rates in the region (Nazir, Nadeem, & Véronneau, 2016). This section discusses key determinants of road safety in Pakistan. This included but not limited to infrastructure problem, driver behavior, law implementation and risks for vulnerable road users.

1. **Road Safety Situation:** The road safety landscape in Pakistan is characterized by poor road conditions, weak traffic law implementation and widespread risky driving behavior. The lack of law implementation, corruption and limited resources in rural area accelerated these problems. The use of outdated vehicles lacking essential safety features further contributes to higher accident rate.
2. **Behavioral and Enforcement Issues:** Risky driving behaviors, including speeding, failure to use seatbelt and the use of mobile phones during driving were prevalent in Pakistan. Having existence of traffic laws, implementation remained inconsistent. Corruption within the traffic laws implementation system weakened road safety efforts. Overloading vehicles and reckless driving among commercial drivers increased risk of accidents.
3. **Infrastructure and Environmental Problems:** Broken and fractured roads were a major contributor to RTAs in Pakistan. Inadequate maintenance, potholes, lack of proper training and poor lighting were common issues that increased the risk of accidents. Meanwhile, environmental factors like heavy rain, fog and poor visibility also contributed to accidents on highways.
4. **Vulnerable Road Users:** Vulnerable road users like pedestrians, cyclists, and motorcyclists were disproportionately affected due to RTAs in Pakistan. Motorcyclists contributed 70 to 80% road accidents and they were at high risk due to low helmet usage rates and reckless driving habits. Pedestrians were similarly vulnerable especially in urban areas where sidewalks and pedestrian crossings were inadequate or non-existent in urban sphere.
5. **Emergency Response and Post-Crash Care:** Emergency response services in Pakistan were under resourced. The time it takes to reach crash victims and transport them to medical facilities is often delayed. While urban spaces have seen improvements with the introduction of emergency services like Rescue 1122. However, rural regions still lack coordinated emergency response system in Pakistan.

Several research gaps remained unaddressed in Pakistan. These included a lack of comprehensive data on RTAs in rural areas. There is also limited research on the effectiveness of recent technological intervention/ innovation. Insufficient attention to vulnerable road users was another research gap. This study is an effort to investigate vulnerable road users' problems in this research.

3. Theoretical Framework and Application

Theoretical frameworks on road safety research provided understanding of the factors contributing to road traffic accidents (RTAs) in parts of the world. These frameworks helped in identification of risk factors, development of intervention and design of policies aimed at reducing traffic injuries and fatalities. In the Pakistani context, these theoretical models can provide valuable insights into addressing the complex issue of road safety. This section discussed key theoretical frameworks commonly applied in road safety research. It also provided relevance to the challenges faced in Pakistan.

3.1. Haddon's Matrix Framework

Haddon's Matrix developed by William Haddon in (Haddon Jr, 1968). It is one of the widely used in road safety research. This matrix categorized the factors contributing to road traffic injuries into three phases: pre-crash, crash and post-crash. Each phase is analyzed through three elements: human factors (driver and road user behavior), vehicle factors (vehicle

design and maintenance) and environmental factors: infrastructure and road conditions (Haddon Jr, 1980).

In Pakistan, Haddon's Matrix provided a systematic approach to understanding the multifaceted causes of RTAs. Somehow, it can be used to design targeted interventions.

1. **Pre-Crash Phase:** This phase focuses on preventing crashes addressing factors like traffic law enforcement, driver education and public awareness campaign. Negligence to traffic laws, lack of driver training and limited public awareness of road safety (as helmet and seatbelt usage) has been significant contributors to road traffic accident. Widespread public health campaigns and improving enforcement of traffic laws would help reduce the incidence of risky driving behavior in Pakistan (Qureshi et al., 2020).
2. **Crash Phase:** The crash phase emphasizes mitigating severity of crashes through safety measures. These measures can be vehicle design improvements (e.g., airbags, crumple zones) and road infrastructure safety (e.g., barriers, signage). Many vehicles are outdated and lack proper safety features in Pakistan (Goel et al., 2024). It is making crash impacts more severe. Especially in rural areas lacks adequate safety barriers and road markings. This increased the likelihood of severe crashes. Addressing vehicle safety standards and improving road infrastructure on highways and in rural regions, could reduce the severity of road accidents in Pakistan.
3. **Post Crash Phase:** The post crash phase highlighted the importance of timely emergency medical services. Post-crash cared to reduce fatalities and injuries after a road accident. In rural areas, emergency response system was inadequate. Victims often faced significant delays in receiving medical care (Khalique, Ahmad, & Ahmad, 2020). Expanding emergency and improving trauma care facilities would be essential in reducing fatalities after accident in the country.

By applying Haddon's Matrix in the Pakistani context, policymakers can design interventions targeted at each phase of the RTA lifecycle. These life cycles were prevention, mitigation and response. They may address both human and environmental factors to improve road safety condition.

3.2. Safe System Approach

Safe System approach was initially developed in Sweden. It is a contemporary road safety model that emphasizes creating an inherently safe transportation system. It is capable of accommodating human error without leading to severe injuries, deaths or fatalities. Unlike traditional approaches that focus on individual road user responsibility, the Safe System approach promotes shared responsibility among stakeholders. These stakeholders are road users, infrastructure designers, vehicle manufacturers and policymakers (Khan & Das, 2024). Driver error is a significant contributor to RTAs in Pakistan. Safe System approach provided an opportunity to develop safer road system that may be more forgiving of human mistakes.

1. **Safe Road:** A road should be designed to minimize the consequences of human error. It should incorporate features like rumble strips, median barriers, pedestrian crossings and roundabouts. Many roads in Pakistan are not designed with user safety in mind. They are increasing the likelihood of crashes (Ehsani, Michael, & MacKENZIE, 2023). Redesigning high risk roads with safety features can help and accommodate driver mistakes. These measures can reduce the severity of accidents in a country like Pakistan.
2. **Safe Vehicle:** Ensuring that vehicles on the road are equipped with essential safety features. These features are airbags, ABS brakes and stability control. They are critical to reducing fatalities (Hung & Yazdanifard, 2015). Older vehicles without these safety features were widespread in Pakistan. Regulations regarding vehicle safety standards were not enforced in the country. A focus on more stringent safety regulations and promoting consumer awareness of vehicle safety features would help improve road safety in Pakistan.
3. **Safe Road Users:** The Safe System approach emphasizes that road users should not bear the full responsibility for road safety and if they neglect it may have a cost. Unsafe behaviors like speeding, reckless driving and failure to wear helmets or seatbelts were common. Strengthening traffic law implementation, educating drivers with awareness

and promoting compliance with safety regulations were necessary steps to protect road users. This is important for vulnerable groups e.g motorcyclists and pedestrians.

The Safe System approach encourages a shift from blaming individual drivers to creating a safer overall road environment in Pakistan. This approach would require coordination among policymakers, engineers, and law enforcement agencies to improve road safety in the country.

3.3. Theory of Planned Behavior

The Theory of Planned Behavior (TPB) explained that an individual's behavior is shaped due to intention. Behavior is shaped by attitudes, subjective norms and perceived control (Ajzen, 2020). This framework has been widely used to predict and understand road user behavior. This is important to understand the behavior of speeding up, seatbelt use and compliance with traffic laws. The Theory of Planned Behavior is useful for addressing risky behaviors among Pakistani road users. It is used to understand low rates of helmet use among motorcyclists. TPB suggests that motorcyclists' behavior can be changed in following ways:

1. **Attitude:** Motorcyclists' beliefs about helmet use like discomfort or reduced visibility, negatively impact their likelihood of wearing helmets. Public health campaigns that emphasize the lifesaving benefits of helmet usage. It should address common misconception that may help shift these attitudes in a positive direction in Pakistan.
2. **Subjective Norms:** Social norms heavily influence behavior in Pakistan. Helmet use is not socially acceptable among peers. Many motorcyclists may be less likely to comply with helmet laws. Awareness campaign that promotes helmet use socially desirable behavior can promote helmet usage. It should also couple with strict enforcement that may improve compliance.
3. **Perceived Behavioral Control:** Motorcyclists may perceive that they can evade traffic enforcement. They may be less likely to comply with helmet law. Improving implementation measures and ensuring that noncompliance results in penalties can influence motorcyclists' perception of control over their behavior in a society.

The application of the Theory of Planned Behavior can inform the design of targeted interventions. This intervention should address specific attitudes, norms and control perceptions influencing driver behavior in societies like Pakistan. This framework is relevant for designing public awareness campaigns. It may reduce risky driving practice. This section provides a theoretical foundation for understanding the complex road safety issues in Pakistan. Each framework Haddon's Matrix, Safe System approach and Theory of Planned Behavior offered unique. By applying these frameworks to the Pakistani context, policymakers may develop targeted, evidence based interventions. They may address behavioral, infrastructural and systemic factors contributing to the high rate of road traffic accidents in the country.

4. Methods

In order to understand the road user's behavior this study employs a systematic literature review to synthesize the existing body of knowledge on road safety in Pakistan. By following a qualitative exploratory research design the study aims to identify recurring themes, gaps in research and factors contributing to road traffic accidents (RTAs) in Pakistan. This methodology was designed to provide a comprehensive analysis of the existing literature on road safety. Its focus is on infrastructure challenges, driver behavior, traffic law implementation and emergency response system.

4.1. Research Design

The research follows a qualitative, exploratory design to review and analyze current literature on road safety in Pakistan. A content analysis approach was used to systematically examine various academic studies, government reports, and policy documents to identify common themes and highlight gaps in the literature. The focus of the analysis was on understanding the underlying causes of RTAs and examining the effectiveness of current road safety measures in Pakistan. This research aims to capture a broad spectrum of factors influencing road safety. This approach allows for an in-depth understanding of the challenges Pakistan faces and provides actionable insights for policymakers.

4.2. Data Collection

4.2.1. Literature Search Strategy

The literature review was conducted through a structured search of academic databases. These were online repositories including Google Scholar, JSTOR, PubMed, and governmental and nongovernmental reports related to road safety in Pakistan and in region. A systematic search strategy was employed using relevant keywords such as:

- "Road safety in Pakistan"
- "Road traffic accidents (RTAs) in Pakistan"
- "Driver behavior in Pakistan"
- "Traffic law enforcement in Pakistan"
- "Infrastructure challenges in Pakistan"
- "Vulnerable road users in Pakistan"
- "Emergency response in Pakistan"

To ensure the relevance of results only studies published between 2010 and 2021 were included in research. The literature search also extended to reports and publications from international organizations. They were World Health Organization (WHO), government agencies, and non-governmental organizations involved in road safety initiatives in Pakistan.

4.2.2. Inclusion and Exclusion Criteria

To maintain the focus and rigor of the study inclusion and exclusion criteria were applied during the data collection process.

4.2.3. Inclusion Criteria

- Peer reviewed studies conducted in Pakistan. They were focusing on road safety or related themes (e.g., RTAs, driver behavior, traffic law enforcement).
- Government reports and policy documents published between 2010 and 2021. This was empirical data and analyses relevant to road safety.
- Studies discussing vulnerable road users.
- Articles that explore the effectiveness of road safety interventions, public awareness campaigns or technological solutions to protect roads usage.

4.2.4. Exclusion Criteria

- Studies conducted outside of Pakistan without relevant cross comparative analysis.
- Articles published before 2010 unless deemed critical for contextual understanding.
- Studies that lacked substantive data or were primarily theoretical without practical insights or evidence-based findings.

This study ensured that the sources reviewed provided the most up-to-date. They were contextually relevant insights into road safety challenges of Pakistan.

5. Data Analysis

5.1. Content Analysis

A content analysis approach was employed to systematically examine the selected studies. Content analysis is a widely used qualitative research technique for making inferences. In this study, content analysis was used to identify and quantify key themes related to road safety in Pakistan. The literature was manually coded to capture recurring themes:

- Driver behavior and enforcement issues (speeding, helmet use, seatbelt compliance).
- Infrastructure challenges (road conditions, lighting, and signage).
- Vulnerable road users (pedestrians, cyclists, motorcyclists).
- Emergency response and post crash care (access to healthcare, response times).
- Vehicle safety standards (outdated vehicles, lack of safety features).

Each of these themes was analyzed to determine the frequency with which they appeared across the reviewed literature. This allowed an understanding of which factors were most commonly discussed. It also identified areas of road safety required further research.

5.2. Thematic Analysis

Thematic analysis was conducted to organize the findings into key themes and sub-themes. This helped deeper understanding of how these factors interact to influence road safety in Pakistan. The thematic analysis focused on the interrelationships between infrastructure, law implementation and driver behavior, as well as the specific risks faced by vulnerable road users. Each theme was explored to identify the systemic issues contributing to the high incidence of RTAs. Beside this thematic analysis was applied to examine the effectiveness of road safety policies and technological interventions in improving safety in Pakistan. Special attention was given to the implementation of the National Road Safety Strategy 2018–2030 and its impact on addressing road safety challenge.

5.3. Comparative Analysis

A comparative analysis was conducted to explore the differences in road safety issue between urban and rural areas of Pakistan. The literature review identified distinct issues persisted in these regions. Urban areas tend to suffer from traffic congestion and high vehicle density. However, rural areas face inadequate infrastructure, limited access to emergency services and weaker law implementation in Pakistan. In anyway, this study provides a nuanced understanding of the varying road safety across Pakistan.

5.4. Reliability and Validity

This study included only peer reviewed articles and reputable policy reports for content analysis. Data from multiple sources were cross referenced to ensure consistency and to verify the accuracy of reported statistics of Pakistan. The content analysis process was carefully documented and reported (Ajzen, 2020). The purpose was to maintain transparency and allow for replication of the study. Manual coding process used in the content analysis was reviewed by a second researcher to reduce potential bias. It validated that key themes were accurately identified and categorized properly.

5.5. Limitations

I acknowledge several limitations of this study:

1. **Limited Data Availability:** A significant limitation of this study is the lack of authentic and reliable data on road traffic accidents. Especially underreporting of accidents is common rural region. This data gap restricts the ability to draw a complete picture of the road safety landscape of Pakistan.
2. **Secondary Data Reliance:** The study relied on secondary data sources. These were previously published academic articles, government reports and organizational documents. This study results depend on the accuracy and reliability of the existing data only.
3. **Lack of Primary Research:** No primary data collection was conducted for this study. This limits the ability to gather real time insights into the effectiveness of current road safety interventions in Pakistan.
4. **Language and Access Barriers:** The study focused on English language publications only. This may have excluded relevant studies published in Urdu or other regional language of Pakistan.

Systematic review and content analysis offer a solid foundation for understanding the key challenges and opportunities for improving road safety in Pakistan in anyway.

6. Results

The content analysis of the literature on road safety in Pakistan revealed several themes. This also revealed key factors that contribute to the high rate of road traffic accidents (RTAs) and fatalities of Pakistan. The following section summarizes the findings across the primary themes identified during the literature review: driver behavior, infrastructure, law enforcement, vulnerable road users, emergency response systems, and vehicle safety. This analysis highlighted gaps in current road safety interventions and policies in Pakistan.

6.1. Driver Behavior and Law Enforcement

One of the most prominent themes that emerged from the literature is the significant impact of unsafe driver behavior on road. Speeding up, failure to use seatbelts or helmets, distracted driving (mobile phone use) and driving under the influence of alcohol or drugs were identified as major contributors to RTAs in Pakistan. Mandatory traffic laws on helmet usage

and seatbelt use but compliance remain low. It was lowest among motorcyclists and commercial vehicle drivers. The literature consistently emphasizes the weak implementation of traffic laws. Some studies noted the lack of resources available to traffic police in rural Pakistan. This result is inconsistent implementation of law. Corruption was also frequently mentioned in the literature.

6.2. Infrastructure and Environmental Problems

Another contributing factor of road traffic accidents in Pakistan is poor state of road. Numerous studies highlighted inadequate road maintenance, lack of proper repair, insufficient lighting and poorly designed roads were significant contributors to RTAs (Mohsin & Nazeer, 2024). Urban Pakistan is victim of traffic congestion and high vehicle density. This increased the risk of collisions. Environmental factors like heavy rain, fog, smoke/ smog and poor visibility were also found to play a role in road traffic accidents. Vehicles tend to travel at higher speeds on highways and motorways of Pakistan and these resulted crashes too. The lack of safety features like barriers and road markings increased risks associated with adverse weather conditions of Pakistan.

6.3. Vulnerable Road Users

Vulnerable road users including pedestrians, cyclists and motorcyclists were found to be disproportionately victim of RTAs in Pakistan. Motorcyclists account for a large share of road traffic fatalities due to low rates of helmet use and risky driving behaviors. Motorcyclists contribute 70 to 80% road crashes. Pedestrians are also at high risk. Pedestrian infrastructure is inadequate or nonexistent in urban spheres. Studies noted that the lack of sidewalks, pedestrian crossings and other safety features leaves pedestrians particularly vulnerable to road accident.

The literature highlights the need for targeted interventions to protect these vulnerable road users. Implementation of safer road design, promotion of helmet uses and enforcement of regulations aimed at protecting pedestrians and cyclists in Pakistan.

6.4. Emergency Response and Post Crash Care

The inadequacy of emergency response system and post crash care in Pakistan was another theme originated from the data. The literature indicates that delays in emergency medical response increased fatality rate and road traffic accidents. Studies found that the time taken to transport crash victims to medical facilities is often prolonged. This due to lack of access to healthcare services, poor road conditions and insufficient trauma care facilities in Pakistan. While urban areas have seen improvements in emergency response services with the introduction of Rescue 1122. However, rural regions remain underserved in Pakistan. This disparity in access to emergency services contributes to higher mortality rates in rural areas following road crashes in Pakistan.

6.5. Vehicle Safety Standards

Another factor of road traffic accidents in Pakistan is the lack of modern safety features in vehicle. The literature consistently pointed to the widespread use of outdated vehicles. They lack essential safety features: airbags, anti-lock braking systems (ABS) and electronic stability control (ESC). The lack of stringent regulations on vehicle safety standards allows older, less safe vehicles to remain on the roads (Organization, 2019). They increased the risk of severe injuries and fatalities in the event of a crash in Pakistan (Mansoor et al., 2023). Studies also noted the limited public awareness of vehicle safety features. Many drivers are unaware of the importance of safety features. There is little enforcement of vehicle safety regulation in the country.

6.6. Technological Solutions and Policy Implementation

The literature reviewed highlighted the potential of technological solutions. They are e-ticketing, speed cameras and automated traffic monitoring system in order to improve road safety in Pakistan. However, adoption of these technologies has been limited. Financial and logistical constraints prevent widespread implementation in rural Pakistan (Saleem et al., 2023). The National Road Safety Strategy 2018–2030 was cited in several studies. This perceived promising policy framework for reducing RTAs in Pakistan. However, its implementation has been slow, largely due to limited political will and resource constraints (Memon et al., 2024). The results of this study reveal several key factors contributing to the high rate of road traffic accidents in Pakistan. They included unsafe driver behavior, inadequate

infrastructure, weak traffic law enforcement and insufficient emergency response system of Pakistan. Vulnerable road users were disproportionately affected. Outdated vehicles lacking modern safety features contribute to the severity of injuries in crashes in the country. Despite the existence of promising policies such as the National Road Safety Strategy 2018–2030. Implementation of these interventions has been slow due to resource constraints and lack of political commitment. Technological solution/ innovation were promising. They have not been widely adopted in the country. The study identifies several areas where future research and policy interventions were needed Improve emergency response system, enforcing vehicle safety standards, protecting vulnerable road users and expanding the adoption of technological solutions in traffic monitoring and law implementation in Pakistan.

7. Discussion

The findings of this study illustrate the intersection of multiple factors that enhanced road traffic accidents (RTAs), They were inadequate law implementation, risky driving behaviors, underdeveloped emergency response system, and the vulnerability of specific road user group in Pakistan. A sociological examination of these findings underscores road safety as more than a transportation issue in the country. It reflected broader social inequalities, institutional weaknesses and governance failures. The absence of comprehensive road safety policies and a fragmented implementation framework only worsen the crisis. This left vulnerable populations disproportionately exposed to road hazards (Dodman et al., 2023). One of the most significant contributors to road accidents is driver behavior. Reckless driving, speeding up, mobile phone use, and failure to comply with helmet and seatbelt laws were serious problems in the country. Studies indicate that human error is responsible for approximately 90% of road accidents globally and Pakistan is not exception of it. However, these behaviors do not exist in a vacuum. They were shaped broader social and cultural attitudes. In Pakistan, traffic violations are often perceived as minor infractions rather than serious threats to public safety.

Infrastructure plays an equally vital role in shaping road safety in any country. Poorly maintained roads, inadequate signs, weak lighting and an absence of pedestrian crossings contribute significantly to RTAs in Pakistan. Accident rates tend to be higher due to unpaved roads, lack of safety barriers and limited emergency response services were observed. This imbalance in infrastructure development mirrors broader urban and rural disparities in Pakistan. Investment in road infrastructure is often focused on major highways and expressways that cater to commercial and private vehicle owners. However, pedestrian infrastructure, public transport routes and rural roads receive far less attention. These disparities reflected class stratifications in mobility, where affluent, car owning populations benefit from state investment. Meanwhile, lower-income groups who dependent upon o motorcycles, bicycles, or walking navigates hazardous road conditions on daily basis in Pakistan.

A vulnerable group within Pakistan's road crisis consists of pedestrians, cyclists and motorcyclists. Motorcyclists account for a significant proportion of road fatalities; injuries largely due to low rates of helmet use and unsafe riding practices. Despite legal mandates requiring helmet use, compliance remains low, often influenced by social perceptions, discomfort, and weak implementation of law. Similarly, pedestrians suffer due to inadequate urban planning that prioritizes motorized transport over pedestrian safety in this country. The lack of pedestrian crossings, sidewalks, and traffic measures forces people to navigate unsafe roads, increasing the likelihood of accidents. The systemic neglect of vulnerable road users highlights broader patterns of exclusion in transportation planning, where policies cater primarily to motorists while disregarding those who rely on alternative forms of mobility. Another critical finding in this study is the inadequacy of emergency response service in Pakistan. In cases of RTAs, medical intervention can significantly reduce fatalities and the severity of injuries. However, emergency medical services in Pakistan remain fragmented and under resourced especially in rural Pakistan where access to healthcare facilities is limited to privileged class. Delayed response times, lack of trauma care facilities and poorly equipped ambulances contribute to preventable deaths following road accidents. Urban centers have improvement with introduction of services like Rescue 1122. This resource is often unavailable to populations living in remote or peri urban areas. This disparity in emergency care services further reflects systemic inequalities in healthcare access and rural communities are left at a disadvantage in Pakistan.

Technological interventions hold significant potential for improving road safety yet Pakistan has been slow to integrate modern solution/ innovation. Developed nations have successfully implemented intelligent traffic systems, automated enforcement mechanisms and vehicle safety regulations that reduce accident risks. Pakistan's adoption of such technologies has been uneven and they were limited to only a few metropolitan areas. Expanding these innovations to other regions requires substantial investment, political will and public awareness campaigns. Addressing Pakistan's road safety crisis requires a multifaceted approach that integrates policy reform, infrastructural investment, technological advancements and behavioral change initiatives. The Safe System Approach and Vision Zero, successfully implemented in countries like Sweden offered a useful framework for Pakistan (Raheem & Issa, 2016). This model acknowledges human error as inevitable and focuses on designing a transportation system. Implementing these kinds of approaches in Pakistan would require a paradigm shift in road safety governance (Awan et al., 2020). This would be moving away from punitive measures toward proactive interventions that address systemic failures.

8. Conclusion and Policy Implications

The findings of this study highlighted that road traffic accidents (RTAs) were not merely isolated incidents but symptoms of deeper systemic issues. This is a challenge of governance inefficiencies and social and economic disparities. Vulnerable road users (motorcyclists, cyclists, and pedestrians) were disproportionately affected. Cities have seen some improvements with the introduction of automated traffic monitoring and emergency response services in Pakistan. These advancements remain unevenly distributed, leaving rural areas significantly underserved in this society. A sustainable solution to Pakistan's road safety crisis requires a multi-pronged approach that integrates stricter enforcement of traffic laws, investment in safer road infrastructure. Expansion of emergency medical services and widespread public awareness campaigns is inevitable. Policy reforms must shift from reactive, punitive measures to proactive strategies seems a solution. Prioritize accident prevention through better road design, vehicle safety and behavioral interventions (Commission, 2019). The Safe System Approach acknowledges human error. It seeks to minimize the consequences of accidents, provides a promising framework for Pakistan. This can significantly reduce road traffic fatalities through these policies. It may create a safer, more equitable transportation system.

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