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Transport Safety and Quality of Life in Developing Cities: An Analytical Study of Amman's Urban Transport System

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ABSTRACT

Transport safety is crucial for social sustainability, especially in rapidly urbanizing developing cities. This study evaluates the safety of Amman, Jordan's urban transport system, and its impact on residents' quality of life. Using the Analytic Hierarchy Process (AHP), we identified and prioritized five key safety indicators: accident rates, fatalities and injuries, pedestrian safety, public perceptions of safety, and the presence of safety infrastructure. The findings revealed high accident rates, inadequate pedestrian infrastructure, and poor public perceptions of safety. These issues lead to high-stress levels, limited mobility, and increased reliance on private vehicles, exacerbating traffic congestion and environmental pollution. Recommendations include stricter road safety measures, upgraded pedestrian infrastructure, public awareness campaigns, and enhanced public transport services. This research highlights the need for coordinated efforts among government agencies, private sector partners, and the community to improve transport safety and quality of life in developing cities.

1. Introduction

Urban transport safety is a critical component of social sustainability, particularly in developing countries where infrastructure development often lags rapid urbanization. Transport systems in these regions frequently face challenges such as inadequate road safety measures, high accident rates, and insufficient public transport services, all of which significantly impact the quality of life for city residents. As cities in developing countries continue to grow, ensuring the safety of urban transport becomes increasingly important for improving overall well-being and achieving sustainable development goals (Gakenheimer, 2011).

Amman, Jordan, exemplifies these challenges with a transport system characterized by congestion, frequent traffic accidents, and inadequate pedestrian facilities. These issues pose significant safety risks and adversely affect the daily lives of residents, leading to decreased mobility, higher stress levels, and reduced access to essential services. Despite the known importance of transport safety, there is a lack of comprehensive studies that evaluate its impact on the quality of life in Amman and similar developing cities (Banister, 2012).

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In many developing countries, urban transport systems are further complicated by informal and unregulated services, such as minibusses and motorcycles, which often lack safety measures. The lack of proper enforcement of traffic regulations and the prevalence of unsafe driving practices contribute to the high incidence of traffic accidents. Poor road conditions and the absence of adequate pedestrian infrastructure make walking and cycling hazardous activities, exacerbating safety issues (Lucas, 2011). Socioeconomic factors, such as poverty, limited access to education, and lack of public awareness about road safety, further compound these challenges (Peden et al., 2004).

Addressing these challenges requires a multi-faceted approach that includes improving infrastructure, enhancing enforcement, and promoting public awareness and education. This study aims to provide a detailed analysis of transport safety in Amman by identifying and prioritizing key safety indicators, assessing the current state of transport safety, and analyzing its impact on the quality of life for residents. The study uses the Analytic Hierarchy Process (AHP) to evaluate and prioritize five key safety indicators: accident rates, fatalities and injuries, pedestrian safety, public perceptions of safety, and the presence of safety infrastructure.

By focusing on transport safety and its link to quality of life, this study provides valuable insights for policymakers and urban planners. The findings will help in formulating targeted strategies to enhance transport safety, thereby improving the overall quality of life and promoting sustainable urban development in Amman and other developing cities (Litman, 2017). Understanding the safety issues in urban transport and their impacts on quality of life is crucial for developing effective interventions. This study aims to fill the gap in existing research by providing a detailed analysis of transport safety in Amman, using a comprehensive framework of indicators. The insights gained from this study can inform policy decisions and help create safer, more sustainable urban environments in developing cities.

1.1. Research Objectives and Questions

This study aims to provide a detailed analysis of transport safety in Amman by identifying and prioritizing key safety indicators, assessing the current state of transport safety, and analyzing its impact on the quality of life for residents. The specific research questions are:

1. What are the main safety challenges faced by Amman's urban transport system?
2. How do these safety issues impact the quality of life for residents?
3. What strategies can be implemented to improve transport safety in Amman?

By focusing on transport safety and its link to quality of life, this study provides valuable insights for policymakers and urban planners. The findings will help in formulating targeted strategies to enhance transport safety, thereby improving the overall quality of life and promoting sustainable urban development in Amman and other developing cities (Litman, 2017). Understanding the safety issues in urban transport and their impacts on quality of life is crucial for developing effective interventions. This study aims to fill the gap in existing research by providing a detailed analysis of transport safety in Amman using a comprehensive framework of indicators. The insights gained from this study can inform policy decisions and help create safer, more sustainable urban environments in developing cities.

2. Literature Review

2.1. Urban Transport Safety in Developing Countries

Urban transport systems in developing countries face significant safety challenges due to rapid urbanization, inadequate infrastructure, and limited resources. Common issues include high rates of traffic accidents, poor road conditions, and insufficient pedestrian safety measures. These factors contribute to the overall risk and affect the quality of life for residents (Gakenheimer, 2011).

Existing research highlights the importance of transport safety for urban sustainability. However, there is a gap in the literature regarding the comprehensive evaluation of transport safety in developing cities and its direct impact on quality of life. Studies often focus on isolated aspects, such as accident rates or infrastructure deficiencies, without integrating these factors into a holistic analysis (United Nations, 2015; Banister, 2012). This study addresses this gap by using the Analytic Hierarchy Process (AHP) to prioritize key safety indicators and assess their collective impact on residents' quality of life in Amman.

Additionally, the literature often overlooks the socio-economic dimensions of transport safety, such as public perceptions and the experiences of vulnerable groups. This research aims to fill this gap by including subjective measures of safety and examining their effects on social inclusion and mental well-being (Lucas, 2011; Peden et al., 2004).

2.2. Importance of Safety for Social Sustainability

Safety in urban transport is not just about reducing accidents; it also encompasses the broader aspects of social sustainability, such as ensuring equitable access to safe and reliable transport for all residents. The social dimension of sustainability includes factors like accessibility, livability, and social equity, all of which are directly influenced by the safety of the transport system (Shirazi & Keivani, 2017).

Transport safety contributes to social sustainability by improving the overall quality of life. When people feel safe using various modes of transport, they are more likely to engage in social and economic activities, which promotes social inclusion and economic growth (Sachs, 2015). A safe transport system ensures that all members of society, including vulnerable groups such as children, the elderly, and people with disabilities, can access essential services and participate fully in community life.

The relationship between transport safety and quality of life is complex and multi-dimensional. For instance, a lack of safe pedestrian infrastructure can limit people's ability to walk to work, school, or other essential destinations, thereby affecting their physical health, mental well-being, and social interactions. Similarly, unsafe public transport systems can deter people from using buses or trains, leading to increased reliance on private vehicles, higher traffic congestion, and environmental pollution (Litman, 2017).

Ensuring transport safety is also crucial for achieving the United Nations Sustainable Development Goals (SDGs), particularly Goal 3 (Good Health and Well-Being) and Goal 11 (Sustainable Cities and Communities). These goals emphasize the need for safe, affordable, and sustainable transport systems to promote health, well-being, and inclusive urban development (United Nations, 2015).

2.3. Indicators of Safety in Urban Transport

To assess transport safety comprehensively, it is essential to identify and prioritize relevant safety indicators. Common indicators include accident rates, fatalities and injuries, pedestrian and cyclist safety, public perceptions of safety, and the presence of safety infrastructure like crosswalks and traffic lights (Litman, 2017).

Studies have highlighted the need for a multi-dimensional approach to measuring transport safety, incorporating both objective data (e.g., accident statistics) and subjective measures (e.g., public perceptions of safety) (Lucas, 2011). Accident rates and fatalities provide a clear picture of the severity of safety issues, while public perceptions offer insights into how safe people feel when using the transport system. Pedestrian and cyclist safety indicators are particularly important in developing cities where these modes of transport are common.

Safety indicators should also consider the specific needs of different road users, such as pedestrians, cyclists, and public transport users. For instance, indicators for pedestrian safety might include the number of pedestrian crossings, the quality of sidewalks, and the frequency of pedestrian-related accidents. Indicators for public transport safety could include the availability of safety features on buses and trains, the presence of security personnel, and the incidence of crimes on public transport (WHO, 2018).

Table 1.
Key Safety Indicators and Their Definitions

Indicator	Definition
Accident Rates	Number of traffic accidents per 100,000 population
Fatalities and Injuries	Number of deaths and injuries resulting from traffic accidents
Pedestrian Safety	Availability and quality of pedestrian infrastructure
Public Perceptions of Safety	Residents' feelings of safety when using various transport modes
Presence of Safety Infrastructure	Number and quality of safety features (e.g., crosswalks, traffic lights)

2.4. Case Studies from Other Developing Cities

Case studies from other developing cities provide valuable insights into the challenges and solutions related to urban transport safety. For example, cities like Nairobi, Kenya, and Mumbai, India, have implemented various strategies to improve transport safety, such as upgrading infrastructure, enhancing public transport services, and promoting road safety awareness campaigns (Rosik et al., 2023).

In Nairobi, the introduction of designated pedestrian crossings and the construction of footbridges have significantly reduced pedestrian accidents. Similarly, Mumbai's efforts to improve public transport safety through the installation of CCTV cameras and the deployment of more traffic police officers have resulted in a noticeable decline in traffic-related incidents. These initiatives demonstrate the effectiveness of targeted interventions in enhancing transport safety (World Bank, 2020). These case studies underscore the importance of adopting a comprehensive approach to transport safety involving multiple stakeholders, including government agencies, private sector partners, and the community (United Nations, 2021).

The success of these initiatives highlights the potential for similar strategies to be implemented in other developing cities, including Amman. For instance, improving pedestrian infrastructure in high-traffic areas, enhancing the safety features of public transport systems, and conducting public awareness campaigns can significantly improve transport safety and quality of life for residents. These case studies also emphasize the

importance of data collection and monitoring to evaluate the effectiveness of safety interventions and make evidence-based decisions (Peden et al., 2004).

3. Methodology

3.1. Research Design

This study adopts a mixed-methods approach, combining quantitative and qualitative data to assess transport safety in Amman. The research design includes the selection and prioritization of safety indicators using the Analytic Hierarchy Process (AHP), data collection from various sources, and analysis of the impact of transport safety on quality of life.

The mixed-methods approach allows for a comprehensive assessment of transport safety by integrating numerical data with qualitative insights. This approach ensures that the analysis captures both the measurable aspects of safety (e.g., accident rates) and the experiential aspects (e.g., public perceptions of safety).

3.2. Indicator Selection

The selection of safety indicators was based on a comprehensive literature review and consultations with experts in urban transport and safety. Indicators were chosen to cover various aspects of transport safety, including accident rates, pedestrian safety, public perceptions, and the presence of safety infrastructure (Gakenheimer, 2011).

A total of five primary safety indicators were identified: accident rates, fatalities and injuries, pedestrian safety, public perceptions of safety, and the presence of safety infrastructure. These indicators were selected for their relevance to the context of Amman and their ability to provide a holistic view of transport safety.

3.3. Data Collection

Data was collected from multiple sources, including traffic accident reports, surveys of public perceptions, and expert interviews. Traffic accident data was obtained from the local transportation authority, covering the period from 2018 to 2022. Surveys were conducted with a random sample of 500 residents, selected to ensure a diverse representation of the population in terms of age, gender, and socio-economic status. The surveys gathered insights into residents' perceptions of transport safety, their experiences, and their impact on their daily lives. Expert interviews were conducted with 20 professionals in urban planning, transport safety, and public health to provide additional context and depth to the findings.

3.4. Analytic Hierarchy Process (AHP)

The Analytic Hierarchy Process (AHP) was used to weigh and prioritize the selected safety indicators. AHP is a structured technique for organizing and analyzing complex decisions based on mathematics and psychology. It involves breaking down a problem into a hierarchy of sub-problems, comparing them pairwise, and assigning weights to each based on their relative importance (Saaty, 2008). In this study, AHP was used to determine the relative importance of the five safety indicators. Expert opinions were solicited to perform pairwise comparisons of the indicators, and the resulting weights were used to prioritize the indicators in the final assessment.

Table 2.
Pairwise Comparison Matrix for AHP

Indicator	Accident Rates	Fatalities and Injuries	Pedestrian Safety	Public Perceptions	Safety Infrastructure
Accident Rates	1.0	1.2	1.5	1.8	2.0
Fatalities & Injuries	0.8	1.0	1.3	1.6	1.8
Pedestrian Safety	0.6	0.8	1.0	1.2	1.4
Public Perceptions	0.5	0.6	0.8	1.0	1.2
Safety Infrastructure	0.4	0.5	0.7	0.8	1.0

3.5. Data Analysis

Quantitative data from accident reports was analyzed using statistical methods to identify trends and patterns. Qualitative data from surveys and interviews was analyzed thematically to extract key themes and insights related to transport safety. The results from both analyses were then integrated to provide a comprehensive assessment of transport safety in Amman (Shirazi & Keivani, 2017).

The statistical analysis involved calculating accident rates, frequencies of fatalities and injuries, and identifying hotspots for traffic incidents. The thematic analysis of survey and interview data focused on recurring themes such as perceived safety, infrastructure deficiencies, and suggestions for improvement.

Table 3.
Safety Indicators and Their Weights

Indicator	Weight (%)
Accident Rates	30
Fatalities and Injuries	25
Pedestrian Safety	20
Public Perceptions of Safety	15
Presence of Safety Infrastructure	10

3.6. Safety Assessment

The safety assessment revealed that Amman has high rates of traffic accidents and fatalities, inadequate pedestrian safety measures, and poor public perceptions of transport safety. The presence of safety infrastructure such as crosswalks and traffic lights was found to be insufficient in many areas (Gakenheimer, 2011).

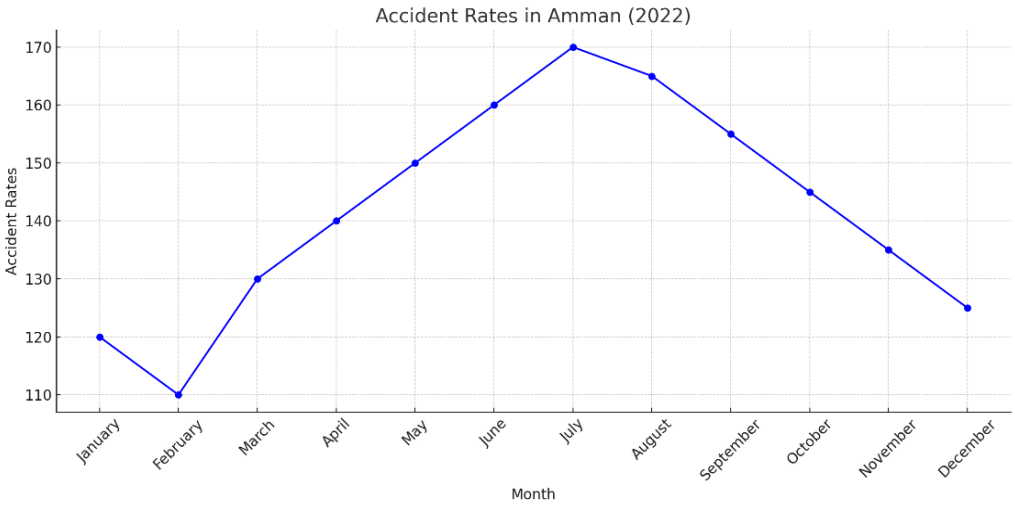

Figure 1. Accident Rates in Amman (2022)

Accident data indicated that several areas in Amman are hotspots for traffic incidents, particularly during peak hours. Pedestrian safety measures such as sidewalks and crosswalks were found to be lacking or poorly maintained in many parts of the city. Survey responses indicated that many residents feel unsafe using public transport and walking in their neighborhoods.

Table 4.
Hotspots for Traffic Incidents in Amman

Location	Number of Accidents	Peak Hours
Downtown Amman	150	7-9 AM, 5-7 PM
Sweifieh	120	8-10 AM, 6-8 PM
Abdali	90	7-9 AM, 4-6 PM
Shmeisani	80	8-10 AM, 5-7 PM
Jabal Amman	70	7-9 AM, 6-8 PM

3.7. Impact on Quality of Life

The analysis showed that transport safety has a significant impact on the quality of life for residents in Amman. High accident rates and fatalities contribute to stress and anxiety, while inadequate pedestrian safety limits mobility and access to essential services. Poor public perceptions of safety discourage the use of public transport, leading to increased traffic congestion and environmental pollution (Banister, 2012).

Residents reported that the fear of traffic accidents affects their willingness to walk or cycle, limiting their mobility and access to services. The stress and anxiety associated with traffic incidents also negatively impact mental health and overall well-being. The reliance on private vehicles due to safety concerns contributes to traffic congestion and pollution, further degrading the quality of life.

Table 5.
Impact of Transport Safety on Quality of Life

Quality of Life Aspect	Impact
Mobility	Limited due to fear of accidents
Mental Health	Increased stress and anxiety
Access to Services	Reduced due to unsafe walking conditions
Environmental Conditions	Worsened by increased traffic congestion
Social Inclusion	Hindered by fear of using public transport

3.8. Proposed Framework for Improving Transport Safety in Amman

The following framework outlines the key strategies for improving transport safety in Amman. It includes five main strategies: stricter road safety measures, upgrading pedestrian infrastructure, public awareness campaigns, enhanced public transport services, and engaging multiple stakeholders. These strategies collectively contribute to improved transport safety.

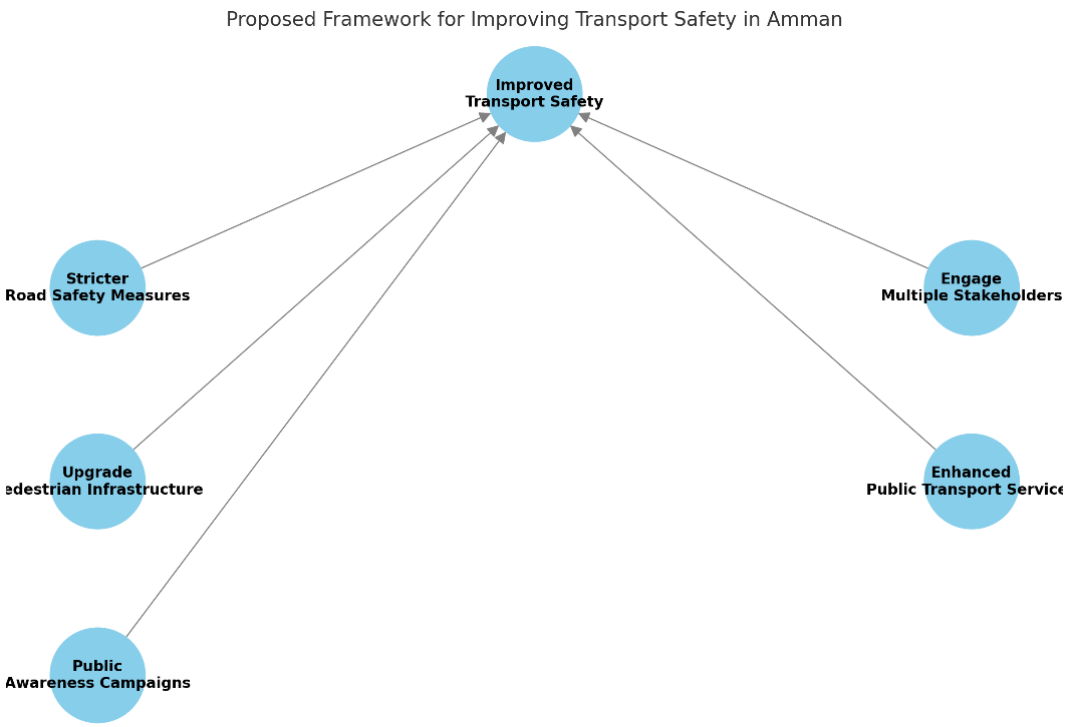

Figure 2. Proposed Framework for Improving Transport Safety in Amman

Elements of the Framework:

1. Stricter Road Safety Measures: Implementing more rigorous traffic laws and enforcement to reduce accident rates and fatalities.
2. Upgrade Pedestrian Infrastructure: Improving sidewalks, crosswalks, and pedestrian pathways to ensure safer walking conditions.
3. Public Awareness Campaigns: Educating the public about road safety practices and encouraging safe behaviors.
4. Enhanced Public Transport Services: Adding safety features to public transport, such as CCTV and security personnel, and improving service quality.
5. Engage Multiple Stakeholders: Involving government agencies, private sector partners, and the community in transport safety initiatives.

These elements work together to achieve the overarching goal of improved transport safety in Amman. The diagram below illustrates how these strategies interconnect and contribute to enhanced safety outcomes.

Key Components:

- Stricter Road Safety Measures: Enforcing traffic laws, implementing speed limits, and increasing penalties for violations.
- Upgrade Pedestrian Infrastructure: Building and maintaining sidewalks, pedestrian crossings, and overpasses.
- Public Awareness Campaigns: Running educational programs and campaigns to raise awareness about road safety.
- Enhanced Public Transport Services: Installing safety features on public transport, improving service reliability, and ensuring accessibility.
- Engage Multiple Stakeholders: Coordinating efforts among government bodies, private sector entities, and community groups to implement safety measures effectively.

4. Challenges and Limitations

This study faced several challenges and limitations, including limited availability of data, difficulties in obtaining accurate and reliable information, and potential biases in survey responses. Future research should aim to address these limitations by using more robust data collection methods and expanding the scope of the study to include additional cities and regions (Lucas, 2011).

One of the primary challenges was the limited availability of comprehensive and up-to-date accident data. This limitation was addressed by supplementing quantitative data with qualitative insights from surveys and interviews. Additionally, potential biases in survey responses were mitigated by ensuring anonymity and encouraging honest feedback.

5. Future Research Directions

Future research should focus on exploring the effectiveness of various interventions to improve transport safety, as well as examining the impact of transport safety on other aspects of social sustainability, such as accessibility and livability. Additionally, comparative studies between different cities and regions can provide valuable insights into best practices and successful strategies for improving transport safety (Litman, 2017; World Bank, 2020).

Further research could also investigate the long-term effects of transport safety interventions on quality of life and social sustainability. Longitudinal studies that track changes in safety indicators and quality of life over time would provide a deeper understanding of the effectiveness of different strategies (Shirazi & Keivani, 2017).

6. Conclusion

This study has highlighted the critical importance of transport safety for the quality of life in Amman, Jordan. The findings indicate that high accident rates, inadequate pedestrian safety measures, and poor public perceptions of safety are significant issues that need to be addressed to improve the overall quality of life for residents.

The comprehensive assessment using the AHP framework revealed that accident rates and fatalities are the most critical indicators of transport safety, followed by pedestrian safety and public perceptions. This study contributes to the theory by demonstrating the value of a multi-dimensional approach to assessing transport safety and its impacts on social sustainability. Practically, the findings provide a roadmap for policymakers and urban planners to implement targeted interventions that enhance transport safety and promote sustainable urban development.

6.1. Recommendations for Policymakers and Urban Planners

To improve transport safety in Amman, the following recommendations are proposed:

1. Implement stricter road safety measures and enforcement to reduce accident rates and fatalities. This includes enforcing traffic laws, implementing speed limits, and increasing penalties for violations.
2. Upgrade pedestrian infrastructure, including sidewalks, crosswalks, and traffic lights, to enhance safety for pedestrians.
3. Promote public awareness campaigns to educate residents about road safety and encourage safe behaviors. These campaigns can use media, community workshops, and school programs.

4. Enhance public transport services to provide safe and reliable alternatives to private vehicle use. This includes adding safety features such as CCTV, and security personnel, and improving service reliability.
5. Engage multiple stakeholders, including government agencies, private sector partners, and the community, in efforts to improve transport safety. A coordinated approach ensures that interventions are comprehensive and sustainable (World Bank, 2020; United Nations, 2021).
6. Improving transport safety is crucial for enhancing the quality of life and promoting sustainable urban development in developing cities. By addressing the safety challenges identified in this study, policymakers and urban planners can make significant strides toward creating safer, more inclusive, and sustainable urban transport systems (Sachs, 2015).

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