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Review

Data Availability for Road Crash Valuation in Low- and Middle-Income Countries: A Case Study in Uganda

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Abstract: Road traffic crash valuation is essential for understanding the economic and social impacts of road safety, especially in low- and middle-income countries (LMICs) where data constraints hinder effective policymaking. This study aims to enhance the understanding of data requirements for road safety valuation in LMICs, using Uganda as a case study. Due to the absence of a unified crash database, secondary data were collected through institutional reports, interviews with key personnel, and referrals to access unpublished datasets. This study examines key cost components for effective valuation and explores three main methods: Restitution Cost, Human Capital, and Willingness-to-Pay, highlighting their data requirements and constraints in the LMIC context. It identifies existing data sources, evaluates their accessibility and relevance, and maps stakeholders involved in data collection and management. Despite challenges such as fragmented data and underreporting, this study underscores the importance of accurate crash valuation for evidence-based policymaking and resource allocation. The findings offer actionable recommendations to improve data collection, integration, and accessibility, highlighting the need for unified databases and standardised terminologies. By addressing these gaps, Uganda and other LMICs can reduce road crash impacts, enhance safety outcomes, and foster sustainable socio-economic development, contributing to global road safety efforts.

Keywords: road safety; road traffic crash; valuation; low- and middle-income countries; data quality; economic impact

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1. Introduction

Road traffic crashes pose a significant global health and development challenge, particularly in low- and middle-income countries (LMICs), where they account for 92% of global road traffic deaths [1]. Over 3200 fatalities occur daily, with the majority affecting people of working age, resulting in profound health, social, and economic impacts [1]. Road traffic injuries remain the leading cause of death among individuals aged 5–29 years in LMICs, with the African region experiencing a 17% increase since 2010 [1]. In low-income countries, the risk of death from road crashes is three times higher than in high-income countries, despite the former having fewer than 1% of all motor vehicles [1]. These figures underscore the urgent need for road safety interventions and highlight the importance of accurate road crash valuation to inform policy and investment decisions in LMICs.

Road crashes result in both direct and indirect costs. Direct costs include medical expenses, property damage, administrative costs, and friction costs, while indirect costs encompass productivity losses, congestion, environmental impacts and intangible costs, such as the value of pain and suffering [2–4]. The financial strain is particularly severe in LMICs, where limited resources amplify the burden on affected individuals and societies [5–7]. Investing in road safety not only reduces the frequency and severity of crashes but also promotes socio-economic development by alleviating poverty and stimulating economic growth [5].

In LMICs, data availability and accuracy remain significant challenges, limiting the effectiveness of road safety valuation studies [5,8]. The lack of comprehensive and reliable data impedes the ability to justify investments in road safety [9] and address the disproportionate burden of road crashes in these countries. Uganda, as a typical LMIC, exemplifies these challenges, with limited studies on road safety valuation and significant gaps in data availability [6,10].

This study aims to highlight any limitations in data availability while enhancing the understanding of data requirements for road safety valuation in LMICs, using Uganda as a case study. It aims to identify existing data sources, evaluate the accessibility, format, and relevance of available data, and map key stakeholders involved in data collection and management. By addressing these aspects, this research will provide a qualitative understanding of the opportunities and constraints in conducting comprehensive road safety valuations in Uganda. Furthermore, this study aims to provide actionable recommendations for enhancing data collection, integration, and accessibility, with broader implications for other LMICs. By establishing a robust data collection strategy, it seeks to support policymakers, investors, and decision-makers in developing effective measures to reduce road crashes and their socio-economic impacts.

2. Materials and Methods

2.1. Key Cost Components for Effective Road Safety Valuation

Accurate road safety valuation is essential for understanding the socio-economic impacts of road crashes and ensuring the effective prioritisation of interventions [11]. A recent 2023 systematic review by Nankunda and Evdorides [10] identified three primary valuation methods for assessing the economic costs of road crashes: the Restitution Cost (RC), Human Capital (HC), and Willingness-to-Pay (WTP) methods.

The data requirements for road safety valuations vary significantly depending on the method used for different cost components [2,3,10]. Road crash costs are broadly categorised into direct, indirect and other costs, which can further be classified as casualty-related or crash-related [2,4]. The following sections examine these cost categories, their data requirements, and the most suitable valuation methods for each component, highlighting key data elements essential for comprehensive road safety valuations.

2.1.1. Direct Costs

Direct costs related to road crashes refer to the quantifiable expenses directly associated with the occurrence of a road crash [2,4,12]. These costs are typically monetised using the RC method, discussed in Section 2.2.1 [2,11]. They include:

Medical Costs: Casualty-related expenses incurred for the treatment of road crash victims, including fatalities that receive hospital care. These costs include first aid and transportation, emergency services, inpatient and outpatient treatment, non-hospital treatment, aids and appliances [12].

Property Damage: Crash-related costs associated with repairing or replacing vehicles, infrastructure, personal belongings, and cargo damaged in a road crash. It has been observed that excluding property damage-only (PDO) crashes from economic impact analyses of road crashes can result in an underestimation of the total cost of crashes [2,13].

Administrative Costs: Crash-related costs incurred in addressing the consequences of a road crash, such as police investigations, fire service, legal costs, and insurance processing [2,3]. These often contribute a low share to the total cost of a road crash [3].

2.1.2. Indirect Costs

Indirect costs refer to those costs that arise as secondary consequences of road crashes and do not involve immediate monetary transactions. These costs are more challenging to quantify than direct costs because they often lack clear market prices, yet they are essential for understanding the broader economic and social impacts of road crashes [2]. The HC and WTP methods are commonly used to estimate these costs [2,3], which include:

Production Loss: These casualty-related costs result from the inability of crash victims to work due to temporary or permanent disability, death, or reduced capacity. They also include losses related to unpaid activities such as household work and voluntary contributions. For businesses, production losses may encompass expenses associated with recruiting and training replacement workers, known as friction costs. This category includes lost wages, reduced productivity, and the broader impact on economic output [12]. These costs are usually monetised using the HC method, discussed in Section 2.2.2 [2,3].

Human Costs: These are casualty-related intangible costs associated with the pain, grief, and suffering experienced by crash victims and their families, as well as the loss of quality of life. Although these costs are non-economic and not directly monetary, they represent a significant portion of the overall impact of road crashes. These include emotional and psychological trauma and intangible costs that highlight the profound human impact of road crashes, extending beyond measurable financial losses [11]. These costs are typically estimated using the WTP method, discussed in Section 2.2.3 [2,4].

2.1.3. Other Costs

This category is known to contribute a small share to the overall economic impact of road crashes [5,12]. Casualty-related costs include funeral costs, house adaptations or relocation for injured victims, and travel and time costs for hospital visits by relatives. Crash-related costs include vehicle unavailability (such as hiring replacement vehicles or time loss), congestion costs (including time loss, travel unreliability, behavioural adaptations and extra fuel), and environmental damage costs (such as the cost of restoring the environment, for example, removing pollutants).

Congestion costs are typically estimated based on time lost in traffic jams caused by road crashes and the value of time, which can be monetised using the WTP method. Other items, such as funeral costs, vehicle unavailability and environmental damage, can be calculated using the RC method [3,12].

2.2. Road Safety Valuation Methods

This section provides an overview of the three primary road safety valuation methods commonly used for road crash cost estimation, along with a comparison of their key features.

2.2.1. The Restitution Cost (RC) Method

This method estimates direct costs incurred to restore victims, their friends, and relatives to a condition in which they would have been had the road crashes causing an injury not occurred [3]. It relies on current market prices or proxy prices to evaluate costs when available. The data requirements for implementing this method are outlined in Table 1. The success of the RC method depends on the availability and quality of data [2,10]. Additionally, the RC method can also be used to estimate friction costs by calculating the actual expenses associated with resources spent on recruiting and training replacement personnel [2]. The direct costs can be computed as shown in Equation (1) [3].

$$TDc = Mc + PDc + Ac + Fc + Oc \quad (1)$$

where TDc—total direct costs, Mc—medical costs, PDc—property damage cost, Ac—administrative costs, Fc—friction cost, and Oc—other costs.

Table 1. Data requirements for the RC method [2].

Cost Component	Cost Item	Cost Element
	Casualty-related costs	
Medical cost	First aid and transportation	Ambulance and helicopter
	Emergency services	
	In-patient and out-patient hospital treatment	
	Non-hospital treatment	Rehabilitation centres, general practitioners, physiotherapy, and home care
	Aids and appliances	
Other casualty-related costs	Funeral costs	
	Costs for house adaptation or relocation	
	Visiting people in hospitals	Time and travel costs of relatives
	Crash-related costs	
Property damage	Vehicle damage	
	Infrastructure	Road surface, fixed roadside objects, and buildings
	Freight carried by lorries	
	Personal property	
Administrative costs	Police operations	
	Fire services	
	Insurance administration	Vehicle, health, accident, and legal expenses insurance
	Legal costs	
Other crash-related costs	Vehicle unavailability	
	Environmental damage	

2.2.2. Human Capital (HC) Method

The HC method estimates the economic value of an individual to society and quantifies the loss of that value in the event of an injury or fatality [2,14]. Injuries from road crashes could result in temporary or permanent disabilities, potentially causing victims to leave their jobs or significantly reduce their productivity [15]. The HC method estimates the cost of discounted future production loss, representing the income that would have been earned had the road crash not occurred [16]. Data requirements for implementing the HC method are summarised in Table 2, and Production Loss can be computed using Equation (2) below [10,17].

$$\text{Production Loss} = \sum_{k=0}^{n-1} \frac{y(1+r)^k}{(1+t)^k} \quad (2)$$

where r—growth rate of the economy, t—discount rate, y—average annual GDP per capita, and k—average number of years of lost production per fatality.

Table 2. Data requirements for the HC method [2,3].

Cost Component	Cost Item	Cost Item
	Casualty-related costs	
Production Loss	Loss of future market production	Gross production loss Net production loss
	Loss of non-market production	Household work, childcare, and voluntary work

2.2.3. Willingness-to-Pay (WTP) Method

This method estimates an individual's willingness to pay to minimise the risk of occurrence and severity of a road crash [2,3,14]. It is used to estimate human costs such as pain, grief, suffering, and the loss of quality of life. The results of WTP studies are utilised to determine the Value of a Statistical Life (VSL), serving as a foundation for calculating human costs as expressed in Equation (3) [3]. This method aligns with the theory of welfare economics, making it the preferred approach for estimating human costs and VSL since there are no market values for these impacts [3,17]. However, its implementation may be challenging in contexts where reliable data are unavailable. Data requirements for implementing this method are outlined in Table 3.

Table 3. Data requirements for the WTP method [3,12].

Cost Component	Cost Item	Cost Item
	Casualty-related costs	
Human costs	Loss of quality life	Human costs for injured persons, relatives, and friends
	Pain, grief, and suffering	Human costs for fatalities, injured persons, relatives, and friends
	Crash-related costs	
Other crash-related costs	Congestion costs	Time loss, additional fuel costs, and specific indirect costs

The value transfer technique can be employed to overcome any data gaps by adapting data from countries where it is available [5].

$$\text{VSL} = \frac{\text{WTP for change in fatality risk}}{\text{Change in the fatality risk}} \quad (3)$$

Each valuation method assesses distinct cost components, but when combined, they provide a more comprehensive understanding of the overall socio-economic impact of road crashes [2,3,10]. However, these methods rely on specific data inputs, such as road crash statistics, casualty details, and economic indicators, highlighting the significance of data availability and quality in ensuring accurate cost estimations. When the required data are unavailable, the value transfer method can be applied, allowing findings from previous studies in similar economic contexts to be used in crash cost analysis [2,5]. A summary comparison of the key valuation methods is presented in Table 4.

Table 4. Brief comparison of the road safety valuation methods.

RC Method	HC Method	WTP Method
Estimates direct costs such as medical costs and property damage [18]	Yields estimates for indirect costs like production loss [2]	Produces estimates for intangible costs such as loss of quality of life [3]
Cost-effective, as it relies on market or proxy prices to reflect real economic conditions [2]	Relatively cheaper to use, as it primarily relies on existing data, making it suitable when primary data are unavailable [19]	Costly to implement, requiring sophisticated survey methods and heavy reliance on individual preferences [3,17]
Could produce inconsistent values due to reliance on subjective human judgement in case of court-awarded or insurance compensation payments [15]	Generates more consistent estimates by leveraging existing data [20]	Yields inconsistent values influenced by factors like age, wealth, GDP, dependents, sex, and education [20]
Yields lower VSL estimates as it assumes victims can be fully "restored", which may not be realistic for human losses like disabilities [12]	It undervalues life for children and the elderly who do not contribute to economic growth, hence yielding relatively lower estimates [21].	Provides higher estimates for VSL, prompting prioritisation of life value by countries [18]

2.3. Methodology

This study employed a systematic approach to collect secondary data required for road crash valuation in LMICs, focusing on Uganda as a case study. While the primary goal was to utilise published or online data, the absence of a unified road crash database in Uganda necessitated direct engagement with various institutions between May and June 2023. The methodology initially identified and collated data requirements for three road crash valuation methods: RC, HC, and WTP. This was followed by the identification of relevant organisations likely to possess the required datasets, including police, healthcare providers, insurance sector, road authorities, statistical agencies, legal services sector, automotive repair centres, and formal employers.

Data collection began by reviewing institutional websites and annual reports to extract available information. For inaccessible or unclear data, approvals were sought from institutional heads to facilitate direct engagement with responsible departments. Secondary data interviews were conducted with key personnel to gain insights, clarify uncertainties, and access unpublished reports. This iterative process involved referrals to additional contacts, ensuring comprehensive coverage of available datasets.

A checklist was prepared prior to each meeting to evaluate the types and quality of data provided. Despite challenges such as fragmented data sources, inconsistent recording practices, underreporting, and incomplete datasets, this methodology facilitated the acquisition of diverse information necessary for comprehensive road crash valuation in Uganda. However, the actual computation of road crash costs was beyond the scope of this study.

The checklist was developed with reference to recent European projects, including the In-Depth Understanding of Accident Causation for Vulnerable Road Users [3] and SafetyCube (Safety CaUsation, Benefits, and Efficiency) [2], which aimed to enhance the understanding of road crash cost estimation and valuation methodologies across different European countries. As this study does not extend to estimating road crash costs, these projects provide valuable insights into the practical application of valuation methods and cost component monetisation.

Furthermore, the 2023 systematic review by Nankunda and Evdorides [10] provides a comprehensive overview of studies that have monetised road crash cost components using different valuation methods.

3. Results and Discussion

3.1. Overview of Potential Sources of Road Crash and Casualty Data in Uganda

A broad analysis of road crash costs in Uganda relied on data from various sources, including the police, health sector, insurance companies, road authorities, government institutions, legal services sector, automotive repair centres, and formal employers. However, challenges in accessing and integrating these data arose due to fragmentation and inconsistent reporting practices. This section reviews these data sources, their contributions, and the obstacles to improving data quality.

3.1.1. The Police

The Uganda Police Force plays a central role in road crash data collection, ensuring extensive coverage across diverse crash scenarios in both urban and rural areas. Coordination between the Directorate of Traffic and Road Safety and the Directorate of Fire Prevention and Rescue Services enhances their response capabilities, particularly in severe crashes. Despite their emergency assistance, limited ambulance services, especially in remote areas, could delay medical care for victims, which is consistent with findings by Alanazy et al. [22]. Several studies have also underscored the significance of the police as the primary source of road crash data [23–26]. In Uganda, police data are obtained through various specialised units, including the following:

- Directorate of Traffic and Road Safety;
- Inspectorate of Vehicles (IOV);
- Fire Brigade.

Each unit contributes distinct, yet interconnected data that form the basis of road crash statistics and cost analyses. A summary of the data types collected from each police unit is presented in Table 5.

Table 5. Overview of data categories gathered from the police.

Data Source	Summary of Key Data Available
Directorate of Traffic and Road Safety	Crash details such as severity (slight, serious, or fatal), location, and time of occurrence; casualty information, including number, age, gender, and classification (such as driver, passenger, or pedestrian); and police resources used, including the average number of officers attending and time spent per crash, categorised by severity.
Inspectorate of Vehicles	Details of vehicles involved in crashes, classified by type and class, including aggregated data on ownership and mechanical condition. Also, data on average personnel needed for vehicle inspections.
Fire Brigade	Data on crash response, such as the percentage of crashes attended, categorised by severity, as well as resource allocation details, for example, the average number of fire service officers and response time per crash, both classified by severity.

The Directorate of Traffic and Road Safety serves as the primary unit for documenting road crashes across Uganda [27]. As first responders, they collect essential data, forming the foundation of national crash statistics. These data are important for estimating the economic impacts of road crashes, including medical costs, property damage, administrative costs, and productivity losses.

Underreporting remains a persistent issue, especially in rural areas where follow-up mechanisms are limited. Police records may fail to document fatalities if victims succumb to their injuries weeks or months after a crash, unless families notify authorities. This was especially common where relatives handled fatalities privately, bypassing official procedures. This aligns with findings by Muni et al. [26]. Additionally, towing data were incomplete due to the reliance on private service providers, whose activities were not consistently documented, creating data gaps and reducing the reliability of crash statistics.

The Inspectorate of Vehicles (IOV) assesses the mechanical condition of vehicles involved in road crashes, determining the extent of damage, identifying potential mechanical failures, and verifying compliance with roadworthiness standards. The data collected are essential for estimating property damage costs and identifying the technical causes of road crashes. However, in Uganda, the IOV provides limited data on these crash specifics, such as the extent of each vehicle's damage. Furthermore, minor incidents often go unreported due to private settlements or efforts to avoid inspections [26], leading to gaps in crash data.

The Fire Brigade responds to incidents involving vehicle fires, trapped victims, and hazardous materials. While relevant data were provided, personnel noted that underreporting remains a significant issue, particularly for less severe crashes where local police handle basic rescues without involving the fire brigade, leading to omissions in official records. The fire brigade is typically utilised in complex cases, such as trapped victims, high-risk fires, or overturned vehicles in water. Additionally, the uneven distribution of fire rescue services, especially in rural areas, often results in delayed responses, reducing survival chances and worsening injuries, a common issue in LMICs [1].

3.1.2. Health Sector

The health sector is a fundamental source of road crash data in Uganda, essential for estimating medical costs associated with road crashes. Table 6 summarises different data categories collected from the health sector. Several studies have recommended linking police and hospital data to obtain improved data, especially for serious injuries, as hospitals have been found to possess more accurate injury-related data [23,25,28]. Key sources include the following:

- Hospitals;
- Ministry of Health;
- Mortuaries.

Table 6. Overview of data categories gathered from the health sector.

Data Source	Summary of Key Data Available
Hospitals/Ministry of Health	Number and demographics of casualties, types of injuries, costs of treatment, duration of hospital stays, and data on ambulance service.
Mortuaries	Number of fatalities, cause of death (crash-related incidents), post-mortem outcomes, and costs associated with body preparation.

Hospitals, particularly Mulago National Referral Hospital, provide data essential for estimating direct medical costs of road crashes and understanding the healthcare system's burden. As Uganda's largest referral hospital, Mulago receives a significant portion of road crash victims, offering valuable data on injury types, treatment costs, and patient outcomes. However, its Accident and Emergency (A&E) unit frequently operates at twice its capacity [29], impacting both quality of care and data accuracy, as overburdened staff prioritise treatment over detailed record-keeping. The lack of specialised trauma centres and rehabilitation units further limits the hospital's ability to track long-term crash-related outcomes.

Limitations in emergency response capacity exacerbate these issues, as ambulance services are scarce and distant from crash scenes, leading to delayed and poorly documented emergency responses, a concern also noted in previous studies [22,30]. Additionally, Mulago's reporting system categorises patient data into broad demographic groups (for example, 0–4 years and 5+ years), which restricts analytical depth and hinders a comprehensive understanding of crash-related injuries and their economic implications. This limitation is particularly significant as the HC method assigns zero productivity to individuals outside the working population, further affecting cost estimations [31].

The Ministry of Health (MoH) gathers health data from hospitals, clinics, and healthcare facilities across Uganda, providing nationwide insights into road crash injuries and fatalities. However, manual record-keeping systems, especially in rural areas, increase the risk of errors, data loss, and inconsistencies. Additionally, the absence of a dedicated road crash injury database necessitates manual extraction from general medical records, often hindered by bureaucratic barriers and limited archival access.

Mortuaries provide data on road crash fatalities, helping to resolve discrepancies in death statistics and enhance data accuracy, especially in countries where death certificates are not mandatory. Their records are essential for estimating direct medical and funeral costs and understanding the broader economic impacts of road crashes.

3.1.3. Insurance Sector

The insurance sector provides valuable data presented in Table 7 for estimating property damage, medical, and administrative costs associated with crashes. Key data sources within the insurance sector include the following:

- Motor insurance companies;
- Insurance Regulatory Authority (IRA);
- Uganda Insurers Association (UIA).

Table 7. Overview of data categories gathered from the insurance sector.

Data Source	Summary of Key Data Available
Insurance sector	Data on claims, including the number filed, crash severity (minor, serious, or fatal), and compensation amounts; policy details (third-party or comprehensive insurance coverage); and financial information (such as premiums, payouts, and administrative costs).

Insurance companies record comprehensive data on claims, payouts and premiums, which are needed for estimating road crash costs. However, data sensitivity and confidentiality concerns pose significant hindrances to data collection. Many insurance providers were reluctant to share detailed or even anonymised information due to regulatory restrictions and proprietary concerns. Additionally, aggregated claims data often combined various claim types, making it difficult to isolate crash-specific records, thereby reducing the accuracy of cost analysis.

The Insurance Regulatory Authority (IRA) oversees Uganda's insurance sector by collecting, auditing, and compiling data from various insurance companies. While the IRA aggregates insurance-related data from these companies, individual insurance providers are recommended for more detailed records. However, a significant proportion of vehicles remain uninsured [32], leaving many road crash costs unrecorded, which distorts the economic impact assessment of road crashes [17]. A centralised, comprehensive database with standardised and up-to-date insurance data would enhance the accuracy of road crash cost estimation.

The Uganda Insurers Association (UIA) serves as an umbrella organisation representing the collective interests of insurance companies. While the UIA aggregates data from its members, it currently lacks detailed, crash-specific data. Therefore, individual insurance companies remain the recommended source for the detailed data required for road crash cost analysis.

3.1.4. Road Authorities

Road authorities collect data essential for estimating property damage and environmental costs resulting from road crashes. However, incompleteness and lack of specificity in the recorded data limit its effectiveness for comprehensive analysis. A summary of the data collected from road authorities is presented in Table 8. Key institutions include the following:

- Uganda National Roads Authority (UNRA);
- Ministry of Works and Transport (MoWT).

Table 8. Overview of data categories gathered from the UNRA.

Data Source	Summary of Key Data Available
UNRA	Number of road crashes that caused damage to infrastructure and traffic volume per day on national roads.

The Uganda National Roads Authority (UNRA) manages and maintains the country's road infrastructure, recording essential data to estimate infrastructure-related damage costs and assess the impact of road crashes. However, much of the required road crash data had not been previously recorded, and the available data were limited to national roads, making it unrepresentative of the entire country. Efforts to obtain additional data from city councils were constrained by time limitations and the absence of a centralised database. It is recommended that future efforts prioritise collecting additional data from city councils to enhance comprehensiveness.

The Ministry of Works and Transport (MoWT) oversees infrastructure development, transport policy, and regulatory frameworks in Uganda. It collects data on vehicle ownership, road design, maintenance, and safety regulations, collaborating with stakeholders like the police and UNRA to produce road safety reports for evidence-based policy decisions. Initially regarded as a potential source for comprehensive road crash data, the ministry was found to lack the specific data required for detailed analysis. Consequently, UNRA and the police were recommended as alternative sources; however, the data obtained from these entities were also incomplete, underscoring significant gaps in the availability and integration of road safety data across the country.

3.1.5. Government Statistical and Financial Institutions

These institutions, such as the Uganda Bureau of Statistics (UBOS), the Ministry of Finance, and the Bank of Uganda, provide macro-level data for road safety economics. Their datasets offer key insights into economic indicators, demographic trends, and national expenditure, essential for estimating productivity and consumption losses, which help assess the broader economic impacts of road crashes. However, data collection is hindered by several challenges, including discrepancies with international datasets, ambiguities in classification, and bureaucratic approval processes. UBOS, which compiles data from multiple institutions such as the central bank, the police, government authorities, and various ministries, produces comprehensive reports, requiring significant effort to extract relevant road safety data.

3.1.6. Legal Services Sector

This sector, consisting of legal courts and prisons, records data essential for understanding the legal and administrative costs of road crashes.

Legal courts, such as chief magistrates' courts, record judicial processes related to road crashes, providing insights into the effectiveness of the legal system in managing traffic violations and their implications for road safety studies. However, inconsistencies in record-keeping across different courts, due to varying documentation formats, hinder the standardisation and reliability of crash-related case data. Additionally, confidentiality and data privacy concerns limit access to sensitive personal and financial information, further restricting data availability.

Furthermore, delays and inefficiencies in judicial proceedings also affect the quality and timeliness of court data. Road crash-related cases often experience significant backlogs, leading to data lag in reflecting current trends. Discussions with key personnel highlighted high levels of underreporting, partly due to the substantial costs of legal representation and court fees, which discourage victims from seeking legal redress.

Prisons contribute valuable data on the legal and punitive aspects of traffic-related offences, detaining individuals convicted of violations such as reckless driving, driving under the influence, and vehicular manslaughter. However, most offenders opt to pay fines rather than serve prison sentences, resulting in limited records on detained offenders. Furthermore, the absence of a centralised database for road crash-related offences across prisons restricts efforts to compile comprehensive legal data for road crash analysis.

3.1.7. Auto Garages

Auto garages record data regarding vehicle repairs and maintenance costs due to road crashes, highlighting the extent and nature of vehicle damage. These insights are relevant in calculating property damage costs, a significant portion of the total economic impact of road crashes [2]. However, most garages in Uganda, especially small independent ones, rely on paper-based systems with limited emphasis on detailed record-keeping. Available records primarily focus on technical repair details rather than the circumstances of the crash. For instance, while the cost of replacing a damaged bumper may be documented, information on whether the damage resulted from a major or minor collision is rarely recorded. The absence of contextual details reduces the usefulness of garage data for comprehensive cost analysis.

Additionally, auto garages in Uganda operate independently, with minimal coordination with other key institutions involved in road crash data collection, such as police and insurance companies. This lack of integration results in fragmented, siloed data, limiting opportunities for cross-referencing or validation against other sources and ultimately reducing the reliability of garage data for road crash analysis.

3.1.8. Formal Employers

Formal employers, defined as organisations with structured employment arrangements, provide useful data for assessing friction costs and productivity losses from road crashes involving employees. These figures highlight the economic impact of workforce disruptions caused by injuries, fatalities, or incapacitation, which imposed financial burdens on businesses.

However, many organisations are hesitant to share sensitive information due to concerns over data security breaches and competitive risks. Additionally, some do not recognise the relevance of HR data to road crash research, leading to low participation. As a result, data remains incomplete and insufficiently detailed, limiting the scope and accuracy for comprehensive economic analyses.

3.2. Obstacles and Constraints in Road Safety Data Management and Valuation in Uganda

The 2023 Global Status Report identified significant challenges in aligning road safety data, establishing standardised definitions, and transitioning from paper-based data systems in various countries, including Uganda [1]. In Uganda, discrepancies between local and international definitions of road safety terminologies, as set by the International Road Traffic and Accident Database (IRTAD) [33], hinder effective data integration and comparison [1]. According to the 2020 Uganda Police Report [34], road safety terminology is defined as follows: a minor injury is one that does not require further medical attention beyond the initial assessment, while a serious injury necessitates additional care. Similarly, a minor crash is defined as one without injuries; a serious crash involves at least one injury, and a fatal crash is classified as one resulting in death at the scene or within a year and a day due to injuries sustained in the crash.

Additional challenges in road crash data collection, specific to institutions, are summarised in Table 9 below.

Table 9. Challenges in collecting road crash data, which was summarised by institutions.

Data Source	Key Challenges
Police	Underreporting in rural areas and incomplete towing data. Limited documentation of crash context. Fragmented reporting and uneven rural coverage.
Health Sector	Not all victims seek formal medical attention, especially in rural areas. Overburdened facilities like Mulago Hospital struggle to prioritise data recording. Manual record-keeping and lack of road crash-specific databases. Broad injury categorisation complicates detailed analysis
Insurance Sector	Reluctance to share detailed data due to confidentiality concerns. Aggregated claims data hinders crash-specific analysis. Many uninsured vehicles leave costs unrecorded.
Road Authorities	Data focuses on repair costs, lacking crash-specific details. Reliance on police data which are underreported. Absence of a centralised database for road infrastructure damage.
Statistical and Financial Institutions	Discrepancies with international datasets complicate interpretation. Bureaucratic delays and challenges accessing unpublished data. Aggregated reports require extensive effort to extract relevant road crash data.
Legal Services	Lack of standardisation in data recording formats across courts. High legal costs discourage victims from pursuing action. Judicial process delays result in cases taking months or years to resolve.
Automotive Repair Centres	Minimal record-keeping, focusing only on technical repairs without crash context. Lack of coordination with other crash-related institutions limiting data utility.
Formal Employers	Reluctance to share HR data due to privacy concerns. Low engagement due to perceived irrelevance to road crash research.

3.3. Overcoming Road Crash Data Collection Challenges from Key Institutions

Based on the challenges observed during data collection, improving the quality of road crash data in Uganda will necessitate a collaborative approach among key stakeholders, including the police, health sector, insurance sector, road authorities, statistical and financial bodies, legal sector, automotive repair centres, and formal employers. Adopting uniform data collection protocols across these institutions would be fundamental to achieving consistency, reliability, and comprehensive coverage of data.

Transitioning to digital systems from manual record-keeping should improve the accuracy and accessibility of road crash records. Digital solutions reduce errors, safeguard data from potential loss, and facilitate quicker retrieval of information. Establishing a unified, real-time database where stakeholders can seamlessly input and retrieve data would greatly enhance the comprehensiveness and effectiveness of road crash data management.

Fostering inter-agency cooperation and formal data-sharing frameworks is essential to bridge existing data gaps and gain a more complete understanding of road crashes. Additionally, incorporating data from informal sources, such as independent healthcare providers and small vehicle repair shops, could complement official records and provide a broader perspective on road crash impacts.

Adequate resource allocation is crucial for upgrading infrastructure, including the implementation of electronic health records (EHR) with specific provisions for road traffic crashes and the deployment of enforcement technologies such as traffic surveillance cameras. Capacity-building initiatives, such as training personnel across law enforcement, healthcare, and insurance sectors in standardised data entry and reporting protocols, should further enhance the accuracy and reliability of records.

Ensuring data confidentiality through robust privacy policies would be important for fostering stakeholder confidence while enabling data sharing. Additionally, simplifying administrative procedures for data access could enhance availability for researchers and policymakers.

Implementing these strategies will enable Uganda to address current data collection challenges and establish a more coordinated framework for analysing road crashes.

3.4. Policy and Developmental Implications of Accurate Safety Valuation

The implementation of road safety interventions depends on various factors, including public awareness and governmental accountability. When citizens understand the negative consequences of road crashes on their lives and livelihoods, they are more likely to request effective safety measures and accountability from their governments. Accurate road safety valuation has significant and multifaceted implications for policy and development [35–37]. For instance, accurate safety valuation enables policymakers to allocate resources more effectively [11]. By understanding the economic costs associated with different safety measures or interventions, governments could prioritise investments in initiatives that offer the greatest potential for reducing crash-related costs [35,37]. Additionally, this valuation facilitates robust cost–benefit analysis for proposed infrastructure projects or safety initiatives. With a clearer understanding of the anticipated benefits relative to the costs, decision-makers can make more informed and strategic policy choices [35].

Consequently, the ability to value road crashes could lead to an informed regulation and infrastructure planning. With a precise understanding of the economic implications of safety measures, policymakers can enact regulations that strike an optimal balance between safety benefits and regulatory compliance costs. This approach promotes improved safety outcomes without imposing excessive burdens on businesses or society. Furthermore, urban and transportation planners could use safety valuation data to inform the design and layout of infrastructure. This includes decisions about road geometry, traffic control devices, pedestrian facilities, and bicycle lanes. By prioritising safety enhancements in areas with the highest potential for crash-related costs, planners could create safer environments for all road users [37].

Beyond infrastructure, safety valuation directly informs behavioural interventions targeting road user behaviour. By quantifying the monetary value of safety improvements, policymakers can tailor interventions such as education campaigns, enforcement efforts, or incentives to encourage safer practices effectively [37]. Additionally, accurate valuation could influence insurance premiums and liability assessments. Insurers may adjust premiums based on the expected safety performance of insured entities, while liability judgements may reflect the economic impacts of safety lapses [38]. These mechanisms incentivise individuals and organisations to prioritise safety and mitigate financial risks.

Enhanced safety could contribute to economic development by reducing productivity losses associated with crashes, injuries, and fatalities [37]. Businesses may benefit from lower healthcare costs, reduced absenteeism, and improved employee morale in safer transportation environments. Ultimately, accurate safety valuation serves as a cornerstone for evidence-based policymaking, enabling governments, businesses, and communities to implement targeted interventions that maximise safety benefits while optimising resource utilisation and promoting sustainable development.

However, the availability of complete, accurate, and comprehensive data on road crashes, alongside relevant socio-economic indicators, remains a critical challenge, particularly in LMICs [5,10,21]. The absence of reliable data limits the understanding of the true economic and social impacts of road crashes. Similarly, insurance companies may avoid paying the full compensation if the value of life and property destroyed in a crash are underestimated [17]. This challenge is more pronounced in LMICs, hindering meaningful citizen-driven efforts to demand proactive government approaches to the road safety crisis. Addressing these data deficiencies is essential for unlocking the full potential of safety valuation in shaping effective and equitable road safety interventions.

4. Conclusions

Road safety valuation is essential for assessing the socio-economic impact of road crashes and guiding the development of effective interventions to enhance road safety and community well-being. This framework not only evaluates crash probability and severity but also identifies high-risk areas and populations while considering broader economic impacts, such as healthcare costs, insurance premiums, transportation efficiency, and productivity losses. By evaluating existing policies and interventions, safety valuation enables evidence-based decision-making, ensuring that resource allocation is directed towards high-impact safety initiatives that maximise both economic and public health benefits.

In Uganda, multiple institutions collect road crash-related data useful for road crash valuation. However, these data often have limitations and vary significantly between institutions, posing challenges for comparability with local and global data. For example, the definition of a fatality in Uganda differs from the international guidelines set by the International Road Traffic and Accident Database (IRTAD) [33], leading to discrepancies in crash valuation outcomes.

While the police appear to be the most comprehensive and reliable source of crash data, their records primarily consist of statistics rather than cost information. Therefore, supplementary data, such as medical costs, property damage, administrative costs, and economic growth indicators, are needed from sources like hospitals, insurance companies, and statistical bodies. However, underreporting, fragmented databases, and reliance on manual records significantly limit the accuracy and reliability of these estimates, requiring the use of assumptions and proxy values in crash cost computations.

Despite these challenges, the available data could support road crash cost estimation using the RC and HC methods. The WTP method is often costly, methodologically complex, and requires sophisticated survey techniques, making its application challenging and time-consuming in low-income countries like Uganda. As an alternative, where data are scarce, the value transfer method can be used. Since each method captures distinct cost components, such as direct costs, production loss, and human costs, integrating estimates from all three approaches provides a more comprehensive assessment of the economic burden of road crashes. This integrated approach is essential for cost–benefit analyses of road safety interventions, guiding policymakers in prioritising strategies to reduce crash frequency and severity.

Recommendations

To enhance the quality, reliability, and applicability of road crash valuation data, the following recommendations may be proposed:

Unify Definitions: LMICs should standardise road safety terminologies, including injury and crash severity categories (slight, serious, fatal). This will enhance data comparability and reliability across countries.

Develop a Comprehensive Database System: Establish a dedicated digital system for real-time data collection, integration, and access, reducing fragmentation and inconsistencies in crash reporting.

Implement Interconnected Databases: Create an interconnected system that synchronises updates across all data sources to improve consistency and accessibility.

Improve Data Accessibility: Make road crash data more transparent and readily available to encourage further research and support evidence-based policy development.

Implementing these recommendations in Uganda and other LMICs could significantly enhance road safety outcomes, reduce economic burdens, and improve public health and safety. By addressing shared challenges, these measures provide a pathway for scalable solutions that extend beyond individual countries, fostering a global approach to road safety and economic resilience.

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