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TITLE:

Epidemiology and Patient-Reported Outcomes of Polytraumatised Patients Involved in Road Traffic Accidents in Namibia.

By

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Thesis presented in fulfilment of the requirements for the degree of Master of Health Sciences at the Namibia University of Science and Technology (NUST)

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I, Hertlinda Munkanda (Student Number: 9862609), hereby declare that the work contained in the thesis titled "*Epidemiology and patient-reported outcomes of polytraumatised patients involved in road traffic accidents in Namibia*" is my own original work and that I have not previously, in its entirety or in part, submitted it at any university or other higher education institution for the award of a degree.

I further declare that all sources used or quoted have been duly acknowledged and referenced, and that this thesis was conducted in accordance with the ethical principles provided by Namibia University of Science and Technology (NUST).

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DISCLOSURE OF GENERATIVE ARTIFICIAL INTELLIGENCE USE

I acknowledge that Generative Artificial Intelligence (AI) tools (Quilbot, Copilot) were used to support the preparation of this thesis. The assistance provided included language refinement, formatting suggestions, and drafting of sections for improved clarity and coherence. All substantive intellectual contributions, including the design of the study, data collection, analysis and interpretation of findings and conclusion, are my own. The AI was limited to enhancing readability and presentation and did not replace my responsibility for originality, accuracy and the integrity of the work presented.

ABSTRACT

Introduction: Road Traffic Accidents (RTAs) are a leading cause of death and disability among children and young adults aged 5–29 years, with many Low- and Middle-income Countries (LMICs) bearing a disproportionate burden. Polytrauma, defined as an Injury Severity Score (ISS) ≥ 15, carries significant clinical and socioeconomic consequences, yet the epidemiology and long-term outcomes of polytrauma remain underexplored in Namibia. This study examined the prevalence and epidemiological profile of persons aged 5–29 years with polytrauma (ISS ≥ 15) involved in RTAs in Namibia from 2019 to 2022 and assessed patient-reported outcomes (Health-Related Quality of Life (HRQoL)) following RTA-related polytrauma.

Methods: A dual-phase design was employed. Phase 1 involved a retrospective review of cases drawn from the MVA Fund database. Cases meeting the inclusion criteria were RTA victims aged 5–29 years who sustained polytrauma (ISS ≥15) between 2019 and 2022 and completed the six-month rehabilitation milestone, regardless of survival status. Data on injury severity, crash type, transport mode, and demographics were analysed using descriptive and inferential statistics.

Phase 2 consisted of a cross-sectional survey of survivors from the cohort which met the Phase 1 inclusion criteria. Data were collected using the EQ-5D-5L instrument, supplemented by a demographic data form, to capture participants' characteristics and HRQoL across five domains: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Survivors were recruited through convenience sampling for telephonic interviews, with proxy consent obtained for minors. All data were anonymised, validated and archived in accordance with institutional protocols, and ethical approval was obtained before implementation.

Results: For Phase 1, 150 cases (26.0%) sustained polytrauma among the 559 RTA patients reviewed. The majority were male (62.7%), with prevalence highest in the 25-29 year age group. Regional distribution showed Khomas (22.7%) and Otjozondjupa (21.3%) contributing the largest proportions of cases. Ambulance services were the predominant mode of transport (75.3%), though notable regional disparities in emergency response were observed. The linear regression analysis revealed that head/neck and extremity injuries were most frequent, while thoracic and abdominal injuries emerged as the strongest predictors of trauma severity. Rollover (42.0%) and pedestrian vehicle accidents (23.3%) were identified as significant contributors to higher ISS scores.

During phase 2, 90 survivors (60% of eligible cases) participated in the survey. Socioeconomic data indicated high unemployment (31.1%) and low educational attainment (42.2% less than high school) among participants. EQ-5D-5L responses showed moderate self-rated health (EQ-VAS mean, 69.9), with pain/discomfort (82.0%, slight to extreme) and anxiety/depression (56.6%, slight to extreme) as the most affected domains. Pearson's correlation analysis demonstrated that greater functional limitations were associated with lower EQ-VAS scores. Multiple linear regression further indicated that demographic and clinical variables did not significantly predict HRQoL outcomes, highlighting the role of contextual and social factors in shaping recovery trajectories.

Conclusion: This thesis integrates clinical severity scoring with patient-reported HRQol outcomes in Namibia, demonstrating that recovery following an RTA is shaped less by anatomical injury patterns than by socioeconomic vulnerability. While thoracic/abdominal and head/neck injuries predict initial clinical severity, regression analysis showed that recovery trajectories were not explained by demographic or clinical variables alone. Instead, contextual and socioeconomic factors, such as high unemployment, low educational attainment, rural residence, and gendered social roles, appear central to long-term outcomes.

The study recommends anatomically guided triage, development of a national trauma registry incorporating social indicators, strengthened rural emergency systems and community-based, gender-sensitive rehabilitation to promote equitable trauma care and improved recovery outcomes.

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LIST OF ABBREVIATIONS

AAAM	Association for the Advancement of Automotive Medicine
ACI	Agency for Clinical Innovation
BAC	Blood Alcohol Concentration
CBR	Community-Based Rehabilitation
CDC	Centres for Disease Control and Prevention
DALY	Disability-Adjusted Life Years
EDA	Exploratory Data Analysis
EMR	Emergency Medical Responders
EMS	Emergency Medical Service
GCS	Glasgow Coma Scale
GDP	Gross Domestic Product
GRSF	Global Road Safety Facility
GBD	Global Burden of Disease
HCU	High Care Unit
HIC	High-Income Country
HMIC	High- and Middle-Income Countries
HRQoL	Health Related Quality of Life
HUI3	Health Utilities Index-Mark 3
ICU	Intensive Care Unit
INT$	International dollars
ITF	International Transport Forum
IHME	Institute for Health Metrics and Evaluation
ISS	Injury Severity Score
ITIM	Institute of Trauma and Injury Management
LMIC	Low- and Middle-Income Countries
LSS	Level Sum Score
MDGs	Millennium Development Goals
MODS	Multiple Organ Dysfunction Syndrome
MOHSS	Ministry of Health and Social Services
MVA Fund	Motor Vehicle Accident Fund
NRSC	National Road Safety Council

NRSCO	National Road Safety Coordination Office
NSW	New South Wales
NSA	Namibia Statistics Agency
OOP	Out-of-Pocket
PEPFAR	United States President's Emergency Plan for AIDS Relief
PVA	Pedestrian Vehicle Accidents
PHC (Census)	Population and Housing Census
PHC (Health)	Primary Health Care
PIARC	Permanent International Association of Road Congresses
PPP	Purchasing Power Parity
PTSD	Post-Traumatic Stress Disorder
QoLQ	Quality of Life Questionnaire
RCR	Retrospective Chart Review
RTA	Road Traffic Accident
RTF	Road Traffic Fatality
RTI	Road Traffic Injury
SF-36	Short Form 36 Health Survey
SPSS	Statistical Package for the Social Sciences
SSA	Sub-Saharan Africa
STROBE	Strengthening the Reporting of Observational Studies in Epidemiology
UHC	Universal Health Coverage
UN	United Nations
UNECE	United Nations Economic Commission for Europe
USA	United States of America
WHO	World Health Organisation
WHOQOL-BREF	World Health Organisation Quality of Life Questionnaire
WRA	World Road Association
YLD	Years Lived with Disability
YLLs	Years of Life Lost

LIST OF DEFINITIONS OF TERMS

Abbreviated Injury Scale (AIS) classifies injuries by anatomical location and allocates a severity score ranging from 1 (minor) to 6 (maximum severity). AIS is utilised for rating injury severity and forms the basis for calculating the Injury Severity Score (ISS) (Association for the Advancement of Automotive Medicine, 2025).

Disability-Adjusted Life Years (DALYs): Assess the illness burden by aggregating years of life lost (YLLs) due to premature mortality and years lived with disability (YLDs). Injury-related DALYs precisely measure the effects of injuries on mortality and chronic disability (Global Burden of Disease Collaborative Network, 2023).

Glasgow Coma Scale (GCS): An essential clinical assessment instrument for determining a patient's level of consciousness after a traumatic brain injury. It emphasises three principal responses: eye-opening, verbal, and motor responses (Institute of Trauma and Injury Management, 2023).

Health-Related Quality of Life (HRQoL): Represents an individual's or a collective's assessment of their physical and mental health over a period. It is frequently employed in public health, clinical research, and healthcare policy to evaluate the effects of diseases, injuries, and treatments on total well-being (Kaplan & Hays, 2024; Rissanen et al., 2020).

Injury Severity Score (ISS): A recognised medical metric for evaluating trauma severity. It is associated with mortality, morbidity, and hospitalisation duration following trauma. It serves to delineate the term 'serious trauma.' A significant trauma (or polytrauma) is characterised by an ISS ≥ 15 (Dehouche, 2022; Hung et al., 2021).

International Dollars (INT$): A theoretical currency unit utilised to assess purchasing power across different nations. It is predicated on Purchasing Power Parity (PPP), indicating the purchasing capacity of a U.S. dollar would buy in the United States at a given point in time (Ryan-Coker et al., 2021).

Out-of-Pocket (OOP) Expenses: Pertain to the expenditure individuals are obligated to pay for healthcare services, as opposed to those covered by insurance or government programmes. These fees may contain deductibles, copayments, and coinsurance, in addition to costs for services excluded from a health plan (Massito & Hinju, 2025).

Polytrauma: A medical term denoting the condition of an individual who has sustained multiple traumatic injuries, including a major head injury, alongside a subsequent injury. The term is defined by an ISS ≥ 15 (Ciechanowicz et al., 2020; Girshausen et al., 2024).

Road Traffic Accident (RTA): Is defined as any occurrence involving a minimum of one moving vehicle on a public or privately accessible road that results in injury or fatality to at least one individual (WHO, 2023).

Road Traffic Fatality (RTF): Refers to a death occurring from an RTA. Fatalities can occur immediately at the crash site or later, secondary to injuries sustained from a crash (WHO, 2023).

Road Traffic Injury (RTI): Any fatal or non-fatal injury sustained due to an RTA on a public road involving at least one moving vehicle (WHO, 2023c).

Sweden's Vision Zero: A road safety effort designed to reduce RTFs and serious injuries. Established in 1995 and officially adopted by the Swedish Parliament in 1997, Vision Zero is based on the premise that fatalities are preventable and should not be tolerated in the transportation system (Belin et al., 2022; Khayesi, 2022).

Universal Health Coverage (UHC): UHC guarantees that all persons can obtain essential health services without experiencing financial distress. It encompasses preventive, curative, rehabilitative, and palliative care – all aspects of patients' care throughout an individual's life (Endalamaw et al., 2025).

Years Lived with Disability (YLDs): Indicate healthy years lost due to disability or illness. They are determined by the prevalence of injuries and their severity (IHME, 2021).

Years of Life Lost (YLLs): Quantify premature mortality, quantifying years lost due to early death relative to an optimal life expectancy (IHME, 2021).

CHAPTER 1: INTRODUCTION

1.1 Background

1.1.1 Global Context and Burden of Road Traffic Accidents (RTAs)

Road Traffic Accidents (RTAs) are defined as any occurrence involving at least one moving vehicle on a public or privately accessible road that results in injury or fatality to at least one individual (United Nations Economic Commission for Europe, 2019; WHO, 2023). RTAs together with suicide and homicide are globally predominant causes of injury and violence-related fatalities among young and middle-aged individuals worldwide (WHO, 2023). RTAs account for approximately 1.3 million fatalities each year and represent the primary cause of death for individuals aged 5–29 years (Endalamaw et al., 2025). Approximately 92–93% of Road Traffic Fatalities (RTFs) happen in Low- and Middle-income Countries (LMICs), where inadequate trauma treatment infrastructure and socioeconomic vulnerabilities intensify mortality risks (WHO, 2023; Kamabu et al., 2023; Peralta-Santos et al., 2022).

While these results underscore the significant public health risks posed by RTAs, it is essential to recognise that broader mental health and socioeconomic factors contribute to these issues (Papadakaki et al., 2024). Socioeconomic adversity, poverty and inadequate infrastructure, high-risk behaviours, including excessive speed and substance abuse, and mental health issues, together with impaired judgement, significantly increase the likelihood of RTAs. Addressing these fundamental challenges is crucial for effective prevention strategies (Konlan & Hayford, 2022). The mechanism through which these factors increase RTA risk will be elaborated on in Chapter 2.

RTAs substantially exacerbate global healthcare issues, resulting in hospitalisations, fatalities, and social and economic costs. The global incidence of Road Traffic Injuries (RTIs) reached 103.2 million in 2019, with a significant rise in injuries among cyclists and motorcyclists (Xu et al., 2022). The economic ramifications of RTI in Sub-Saharan Africa (SSA) are considerable, with estimated expenditure ranging from International Dollars (INT$) 119 to INT$178,634 per injury. Hospitalisation costs exacerbate this effect, ranging between INT$486 and INT$12,845 per patient (Ryan-Coker et al., 2021). These statistics emphasise the broad range of expenses linked to RTIs while revealing differences in injury severity, healthcare accessibility, and response capabilities throughout the region. Despite diversity in costing methodologies, extended hospitalisation, surgical materials, and injury severity emerged as the predominant factors linked to cost (Ryan-Coker et al., 2021). Globally, numerous regions have experienced declines in mortality and Disability-Adjusted Life Years (DALYs);

yet structural issues and challenges such as inadequate infrastructure, ineffective road safety enforcement, and inequitable access to healthcare continue to exacerbate the impact of RTIs in LMICs (Wan et al., 2023).

Recent findings from the Global Burden of Disease Study in 2021, published by the Institute for Health Metrics and Evaluation (IHME), reveal that RTIs continue to be a leading cause of global health loss (Global Burden of Disease Collaborative Network, 2024). This finding aligns with prior forecasts by Murray et al. (2012), which cautioned that in the absence of effective interventions, RTAs could become the fifth leading cause of death in the world by 2030, due to increasing DALYs and fatalities from injuries.

Despite considerable advancements in understanding RTIs, the necessity for comprehensive strategies to tackle this public health concern persists, especially in underserved regions (Ahmed et al., 2023). Moreover, the growing burden of RTIs reflects a wider global transition in health priorities from communicable to non-communicable diseases.

1.1.2 Causes of RTAs

The main causes of RTAs include inadequate upkeep of the road system and ineffective, inconsistent law enforcement. Other variables that lead to RTAs involve driving while intoxicated, reckless or fatigued driving, hazardous road conditions, inattention, and a lack of reaction time (WHO, 2023a).

Mitigating RTIs and RTFs necessitates a well-considered strategy integrating both preventative and response measures. Preventive approaches, including safer road design, rigorous law enforcement, public awareness initiatives, and improved vehicle safety, have reduced the risk and severity of RTAs. Safeguarding vulnerable road users through dedicated infrastructure decreases injury rates, while enhancing trauma care systems facilitates prompt treatment, reducing long-term disability and mortality (Akbari et al., 2024).

1.1.3 Systemic Deficiencies and Health-System Challenges

Systemic inadequacies in emergency care, rehabilitation services, and social protection systems exacerbate the effects of RTIs in LMICs. Adverse healthcare incidents, including postponed surgeries, misdiagnoses, and drug errors, result in around 2.6 million fatalities each year (Kumah, 2025). Rehabilitation services are severely limited, typically featuring fewer than 10 qualified practitioners per million, with access further constrained by financial barriers, geographical distance, and inadequate awareness (Magnusson et al., 2019). Community-Based Rehabilitation (CBR) approaches often encounter fragmentation, insufficient funds, and a deficiency of robust,

scalable evidence to support their extensive implementation (WHO, 2021). The gap between service availability and demand underscores the necessity for implementing inexpensive and sustainable rehabilitation programmes.

Social safety nets, including financial assistance, disability benefits, and legal recourse, are largely inaccessible for RTA survivors. A report by the Access to Medicine Foundation illustrates that a large portion of the population in LMICs lacks access to essential follow-up care and prescription medications. The study examined 41 methods to enhance drug accessibility and their impact on costs for disadvantaged populations. Only 14 of these methods directly addressed affordability challenges (Access to Medicine Foundation, 2023).

LMICs were already struggling with a high prevalence of diseases and an acute shortage of healthcare providers before the onset of the COVID-19 pandemic. Additionally, the health system faced overwhelming challenges in delivering affordable, equitable, and acceptable quality care. A study conducted between January 2018 and April 2019 across 47 African countries found an uneven distribution of healthcare workers, with 85% in the public sector. The regional density of doctors, nurses, and midwives was 1.55 per 1000 people, with only South Africa, Namibia, Seychelles, and Mauritius exceeding the 4.45 density required for Universal Health Coverage. This scarcity and inequitable distribution obstruct access to universal healthcare in Africa (Ahmat et al., 2022). Universal Health Coverage seeks to guarantee that all individuals and communities obtain the necessary health services without incurring financial distress. The programme encompasses a comprehensive array of critical, high-quality health services, ranging from health promotion to prevention, treatment, rehabilitation, and palliative care (WHO, 2023d). Addressing these systemic issues, a vital measure to enhance trauma care in LMICs is the precise evaluation of injury severity by standardised scoring systems, which are crucial for guaranteeing timely, equitable, and high-quality interventions within a strained healthcare system.

Polytrauma is a major factor in mortality and morbidity, especially in developing countries. It entails several injuries across various bodily systems, frequently necessitating critical care and surgical procedures. Research indicates that 50-60% of trauma patients succumb prior to hospital arrival, with the mortality rate for polytrauma cases potentially reaching 20%, depending upon injury severity and healthcare accessibility (Pfeifer et al., 2016). Surgical interventions are typically constrained during the prehospital phase; however, increased mortality rates during hospital admissions highlight significant deficiencies in trauma care and recovery.

Major or polytrauma entails several injuries with an Injury Severity Score (ISS) of ≥15 and necessitates sophisticated medical care and extended hospitalisation, hence influencing healthcare expenditure (Hardy et al., 2024; Höke et al., 2021). Objective evaluation of injury severity is crucial for triage, decision-making, and care management. Trauma scoring systems, like the Trauma and Injury Severity Score (TRISS), Revised Trauma Score (RTS), Abbreviated Injury Scale (AIS), and ISS, are essential for prioritising treatment and assessing injury severity (Abhinandan et al., 2025). These standardised tools aid decision-making in clinical settings and improve patient management while also being valuable in research. Despite their initial development for resource-rich settings, LMICs also employ these systems (Valderrama-Molina et al., 2017).

The Institute of Trauma and Injury Management (ITIM) in New South Wales (NSW) supports the trauma system with training, research, and data (ITIM, 2023). The ITIM uses the ISS as a key tool for assessing trauma patients in NSW. ISS is a key score linked to mortality, morbidity, and length of hospital stay severity (Abhinandan et al., 2025). Particular trends in RTIs characterise the systemic gaps in global trauma care. In High-Income Countries (HICs), stronger traffic rules, better infrastructure, and improved emergency treatment systems resulted in fewer severe RTIs and lower post-admission mortality (Van den Berghe & Christie, 2023). In contrast, Low Income Countries (LICs) face inadequate road safety and prehospital care, with an increased risk for vulnerable road users, particularly pedestrians (WHO, 2023).

In the past 50 years, healthcare has transitioned from an emphasis on disease prevention and life extension to promoting comprehensive well-being. This progress has increased focus on Health-Related Quality of Life (HRQoL), a multifaceted assessment of physical, mental, and social functioning that underscores the significance of living well rather than merely living longer (Hernández-Segura et al., 2022).

1.1.4 Economic and Demographic Impact

In numerous LMICs, young adults constitute a significant portion of the population and serve as an essential element of the workforce. As the primary employed individuals in numerous households, they play a pivotal role in sustaining family livelihoods and driving national economic productivity (Carreras et al., 2021). At a macroeconomic level, nations tend to lose the demographic dividend of human capital to RTAs, which consequently poses a serious risk to sustainable developmental efforts. This decline impedes economic growth and places a strain on national healthcare services (WHO, 2023a). Economic development and local and foreign tourism have led to increased transportation demands in LMICs, further exacerbating the burden of RTAs.

Data from 21 countries on work-related driver fatalities show the significance of deaths among people of working age and the disproportionate impact on men, with over 23% of driver fatalities resulting from work-related driving, and 12% of deaths among professional drivers such as bus drivers (WHO, 2023).

RTAs have a substantial impact on the African economy and disability rates. A Nigerian population-based survey conducted across seven states revealed that approximately 30% of individuals affected by RTIs sustained long-term disabilities (Mitra, 2023). Of those with RTI-related disabilities, 16.7% reported employment termination after the RTA, while 88.6% saw a reduction in income, highlighting the significant socioeconomic ramifications of RTAs in resource-constrained environments. Moreover, families impacted by an RTA may incur high funeral costs, extended hospital bills, and the potential loss of household income due to the illness or death of a primary earner.

Despite having more advanced emergency response systems and preventative road safety measures, HICs remain vulnerable to the negative economic effects of RTAs. HICs reported more than 40,000 RTA-related deaths and 2.1 million Emergency Department (ED) visits in 2020 alone, which reflected considerable direct healthcare costs and reduced productivity (WHO, 2023).

1.1.5 Namibian Healthcare System and the RTA Burden

Namibia has one of the lowest population densities in the world, roughly 3.7 people/km², and 48.9% of Namibians live in rural areas, making it challenging to offer healthcare services. Namibia's health system consists of both private, providing medical assistance to 18% of the population, and state sectors, serving the remaining 82% (Christians, 2020). This disparity is partly caused by the country's large income disparities, which limit most people's access to private healthcare. However, healthcare accessibility in Namibia is considered good, with 76% of the population living within a 10-kilometre radius of a healthcare centre (Christians, 2020). The distribution of medical professionals presents a dual-sector dynamic, with skilled health professionals, particularly medical practitioners, choosing to work in the private health sector, while those employed by the government allocate their time between public hospitals and private practices, thereby contributing to the strain on public sector capacity. This dual system has resulted in an imbalance in the provision of healthcare, increasing strain on public sector service delivery (Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), 2023).

The Namibian Ministry of Health and Social Services (MoHSS) administers and delivers public health services. The four-tiered healthcare system is made up of referral hospitals, district hospitals, intermediate hospitals, and Primary Health Care (PHC) clinics (Christians, 2020). When patient needs outweigh the capabilities and resources of the nearest medical facility, that facility refers the patient to a health centre, a district hospital, and eventually an intermediate hospital for specialised care. When required, intermediate hospitals refer complicated medical cases to Windhoek Central Hospital. Hospitals frequently experience overcrowding and lengthy wait times because patients avoid local clinics and health facilities in favour of distant hospitals that are thought to provide better care (Christians, 2020).

The private health sector in Namibia consists of 844 facilities, 557 medical practitioners, and 75 pharmacies, including both general and specialised hospitals and clinics (Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), 2023). Despite catering to only 15–17% of the population, it employs most health professionals. In contrast, the public sector, which serves 80% of the population, is supported by only 38% of the nation's healthcare workforce, highlighting a considerable disparity in resource allocation.

Namibia is one of five nations in SSA, the others being South Africa, Eswatini, Botswana, and Lesotho, that impose a fuel levy to assist victims of RTAs (Chatukuta et al., 2021). The fuel levy granted by the Ministry of Mines and Energy enables the Motor Vehicle Accident (MVA) Fund of Namibia to carry out its function and fulfil commitments to its clients. Through a mandated third-party compensation mechanism, in place since 1942, the Fund earns 47.7 cents for each litre of fuel sold.

The MVA Fund was established in 1991 under the MVA Fund Act 30 of 1990 to compensate people injured in RTAs or the dependents of people killed in such RTAs. The MVA Fund Act No. 10 of 2007 established a fair compensation system for all individuals involved in RTAs, subject to specific restrictions and exclusions. The fund covers medical expenses, including emergency care and transportation, hospitalisation, medication, assistive devices, and physical rehabilitation for spinal injuries. While some RTA victims in Namibia have access to private medical care, the MVA Fund is the primary source of support for most victims. MVA Fund provides a maximum of N$1,500,000 per occurrence (per RTA) in financial assistance for each injured individual to cover medical expenses. Nevertheless, when treatment surpasses these thresholds or is beyond the fund’s inclusions, victims often incur high Out-of-Pocket (OOP) costs at private facilities, leading many to depend on public health services, which are often inadequately funded and overwhelmed.

Reports on RTI patterns and severity are scarce in SSA, including Namibia, where substantial data gaps are evident, particularly with polytrauma cases in individuals aged 5 to 29. The enduring disability resulting from RTAs presents a growing threat to global health systems. This issue is acute in SSA, where the incidence of injury is disproportionately high and remains insufficiently addressed (Chichom-Mefire et al., 2018).

Namibia is one of the countries that is adversely impacted worldwide, and RTAs significantly contribute to DALYs and healthcare costs. Despite enhancements in access to rehabilitation by the MVA Fund, particularly in metropolitan areas such as Windhoek, inequities remain among rural communities, limiting equitable recovery outcomes (Chatukuta et al., 2022).

Namibia has made notable progress in tackling public health challenges, such as Human Immunodeficiency Virus (HIV), tuberculosis, and malaria, attributed to international financial support from organisations like the Global Fund and the United States President's Emergency Plan for AIDS Relief (Global Fund, 2024). However, RTAs remain a major impediment. Notwithstanding significant investments in disease prevention and treatment, Namibia's road safety system is still without a comprehensive, multi-sectoral public health strategy (Chatukuta et al., 2021).

The national effects and results of RTIs in SSA remain poorly understood due to insufficient research. Problems such as irregular data availability, underreporting, and delayed distribution frequently result in the perception of official RTI data as unreliable. Researchers employ statistical models to evaluate RTA-related morbidity and mortality; however, these models can exacerbate ambiguity and biases.

Despite the importance of accurate RTA data for directing research and shaping effective policy, empirical investigations into the reliability and comprehensiveness of such data in Namibia remain absent. This gap hinders the advancement of targeted interventions and the assessment of current road safety measures. The World Health Organisation (WHO) persists in promoting research on RTAs, emphasising their significance as a critical and growing public health concern, especially in countries like Namibia, where the effects are profound and insufficiently addressed (WHO, 2020).

1.2 Problem Statement

RTAs are a major global public health concern, disproportionately affecting young people in LMICs. Rapid economic growth, rising vehicle ownership and inadequate infrastructure contribute to increased RTIs and RTFs, with LMICs bearing the greatest health and economic burden (Ryan-Coker et al., 2021). In Namibia, RTAs are among the leading causes of death, with mortality rates estimated

at 32 people per 100,000 in 2016 and rising to 34.8 per 100,000 in 2019, and young males remain particularly vulnerable due to high exposure and their risk-prone behaviour (Jones et al., 2020).

Notwithstanding this burden, current research in Namibia predominantly focuses on immediate injury results, neglecting the long-term consequences, including a decrease in HRQoL. Polytrauma (ISS ≥15) correlates with elevated mortality and significant resource requirement, yet its prevalence, causes, and long-term effects are inadequately understood in Namibia. This gap constrains efficient planning, resource distribution and the formulation of trauma care strategies.

Although international programmes like Sweden's "Vision Zero" and Tanzania's Dar es Salaam Urban Transport Improvement Project have shown that multisectoral strategies can reduce fatalities, only 10 % of global health research funding is allocated to tackling RTIs in LMICs (Belin et al., 2022; Hyder et al., 2016; Khayesi, 2022).

Patient-reported outcomes, especially HRQoL assessments, are crucial for understanding the wider implications of RTI; however, they remain insufficiently studied in Namibia. This study sought to fill this gap by examining the epidemiological profile, including demographics, RTA characteristics and injury severity, of individuals aged 5-29 years with polytrauma, as well as evaluating HRQoL outcomes among survivors. The study was restricted to individuals aged 5-29 years, consistent with WHO evidence identifying this age group as the most vulnerable to RTA-related mortality and morbidity. This age group also represent the most socioeconomically productive demographic, making their outcomes particularly relevant for risk profiling and policy adaptation (WHO, 2023). While older age groups also experience substantial trauma burden, the focus on the youth enhances comparability with international datasets and ensures analytical coherence (Azami-Aghdash et al., 2018).

The researcher sought to correlate anatomical severity with socioeconomic and contextual factors to furnish knowledge that can guide prevention initiatives, enhance the trauma system, and develop rehabilitation policies specific to Namibia RTA response requirements.

1.3 Research Aims and Objectives

1.3.1 Research Aims

(i) The study aimed to examine the prevalence of polytrauma (ISS ≥ 15) and the epidemiological profile of persons 05–29 years of age with polytrauma involved in RTAs in Namibia from 2019 to 2022.

(ii) The study also aimed to assess the patient-reported outcomes (HRQoL) of persons aged 05-29 years following RTA-related polytrauma in Namibia.

1.3.2 Research Objectives

(i) To describe the prevalence of polytrauma (ISS ≥ 15) in persons 05-29 years of age involved in RTAs in Namibia for the period 2019 to 2022.

(ii) To review the epidemiological profile (demographics, RTA characteristics and injury severity) of persons 05-29 years of age with polytrauma (ISS ≥ 15) involved in RTAs in Namibia for the period 2019 to 2022.

(iii) To compare demographics and RTA characteristics to injury severity of persons 05-29 years of age with polytrauma (ISS ≥ 15) involved in RTAs in Namibia for the period 2019 to 2022.

(iv) To assess the patient-reported outcomes (HRQoL) of persons aged 05-29 years surviving polytrauma following an RTA in Namibia.

1.4 Research Questions

(i) What is the prevalence of polytrauma (ISS ≥ 15) in persons 05-29 years of age involved in RTAs in Namibia for the period 2019 to 2022?

(ii) What is the epidemiological profile (demographics, RTA characteristics and injury severity) of persons 05-29 years of age with polytrauma (ISS ≥ 15) involved in RTAs in Namibia for the period 2019 to 2022?

(iii) What is the relationship between demographics and injury severity, as well as the relationship between RTA characteristics and injury severity, of individuals aged 05-29 years with polytrauma (ISS ≥ 15) involved in RTAs in Namibia from 2019 to 2022?

(iv) What are the patient-reported outcomes (HRQoL) of persons aged 05-29 years surviving polytrauma following an RTA in Namibia?

1.5 Hypothesis

Existing literature shows that injury severity following RTAs is shaped by a complex interaction of demographic and RTA-related factors. Variables such as age, gender, and socioeconomic status, RTA characteristics and environmental conditions significantly affect trauma outcomes and recovery trajectories. Mannocci et al. (2019) in a systematic review found that younger and older age groups, males, socioeconomic disparities and hazardous RTA circumstances, e.g., high speed, and poor road conditions, were consistently associated with greater injury severity. These findings underscore the

multifactorial character of RTA-related polytrauma and emphasise the need to consider both individual and contextual factors of injury severity.

The study hypothesised:

- H^1: There is a significant relationship between demographic factors and injury severity among individuals aged 5 to 29 years who experienced polytrauma (ISS ≥ 15) following an RTA in Namibia.
- H^2: There is a significant relationship between RTA variables and injury severity among individuals aged 5 to 29 years who experienced polytrauma (ISS ≥ 15) following an RTA in Namibia.

These hypotheses are based on previous research that highlights the influence of socioeconomic and RTA-related factors on trauma outcomes. This study aimed to provide evidence by examining these links within the Namibian context and sought to generate evidence that can inform prevention strategies, improve trauma care systems and guide resource allocation for at-risk populations.

1.6 Research Significance

RTIs are a major public health issue in Namibia, disproportionately impacting children and young adults aged 5-29 years. The specific epidemiology and long-term effects of polytrauma in this group are inadequately documented, despite their significant influence on morbidity, mortality, and national healthcare costs. Current literature frequently neglects patient viewpoints and fails to effectively address the wider social and economic ramifications of RTIs within the Namibian setting.

This study investigated these gaps using a dual methodology, consisting of a retrospective analysis of data from the MVA Fund database and a cross-sectional evaluation of HRQoL among RTA survivors. It offered a thorough evaluation of polytrauma incidence, injury patterns, and HRQoL outcomes among young Namibians involved in RTAs. The study integrated patient-reported HRQoL data, providing a holistic perspective on trauma recovery that encompasses injury severity and the experiences of survivors. The findings expanded the limited body of trauma research in SSA and established a foundation for future epidemiological studies, regional analyses, and longitudinal assessment of RTA outcomes.

In addition to its scholarly contribution, the study provides practical significance for several stakeholders. It provides the government and the MoHSS with actionable evidence to guide national road safety policy, trauma system planning, and the design of age and context-specific rehabilitation programmes. The data can assist in prioritising funding and directing interventions for high-risk

groups, in accordance with Universal Health Coverage objectives and WHO Sustainable Development Goal (SDG) 3.6, which seeks to reduce global fatalities from RTIs by 50% (WHO, 2024).

This research offers insights that help enhance rehabilitation programmes and post-accident care routes for the MVA Fund. It facilitates risk profiling and supports preventative initiatives for economically disadvantaged groups, while providing insights into long-term survivor outcomes that transcend mere cost containment. The study emphasises discrepancies in access to emergency care, affordability of medical expenses associated with employment status, and rehabilitation outcomes. The findings can enhance system-wide quality healthcare improvement initiatives and resource reallocation, particularly in underprivileged areas where trauma recovery is severely limited.

The incorporation of patient-reported outcomes and functional limitations provides healthcare staff with valuable information on recovery trends, psychosocial requirements, and an individualised care plan. The use of survivors' narratives enhances patient voices and promotes gender-sensitive rehabilitation, similarly, raising knowledge of HRQoL for patients and families. This research underscores the socioeconomic impacts of RTIs, particularly among unemployed and rural groups that experience increased risks. The study emphasises these differences and calls for social protection mechanisms that promote sustained reintegration into community life.

1.7 Thesis Layout

This thesis is structured into six chapters, each fulfilling a distinct function in examining the epidemiology and patient-reported outcomes of polytraumatised RTA victims in Namibia, with an added focus on HRQoL.

Chapter 1 addresses RTAs as a significant public health issue in Namibia and globally. It articulates the hypotheses, outlines the study's aims and objectives, and specifies the research problem. The dual-method approach, incorporating a retrospective review and a cross-sectional HRQoL survey, aims to ascertain the prevalence, epidemiological profile, and HRQoL of polytrauma RTA victims aged 5–29 years.

Chapter 2 presents an overview of contemporary research utilising international and regional data regarding the prevalence of RTA and RTI, injury severity scores, and HRQoL assessment instruments. The study exposes important deficiencies in Namibian RTA research and examines methodological issues, particularly in LMICs, to better understand their importance

Chapter 3 details the dual-method study design, encompassing a cross-sectional HRQoL survey and a retrospective analysis of clinical, demographic, and RTA data. It also details the criteria for

inclusion and exclusion, the sampling methodology, and measurement tools, including the EQ-5D-5L instrument for assessing HRQoL is among the specified data collecting instruments. The chapter emphasises ethical considerations, including institutional approvals and data protection protocols, alongside statistical analysis methodologies utilised.

Chapter 4 presents the principal findings of the research. Following the summarisation of participants' demographic and clinical characteristics, injury patterns, severity scores, and HRQoL outcomes, which were examined for correlations. The chapter examined sociodemographic variables of post-trauma well-being and identified a significant relationship between recovery and anatomical injury outcomes.

Chapter 5 interprets the results in relation to prior studies, emphasising disparities in perceived health, gender, and geographic location. It highlights the practical and policy implications of the results, emphasising their relevance to improving equity in post-trauma rehabilitation and strengthening trauma treatment systems.

Chapter 6 encapsulates findings and provides feasible interventions for improving triage protocols, establishing national trauma registries, and improving survivor care through integrated social protection. It also advocates for future RTA-related research to include longitudinal studies on HRQoL and the requirement for trauma response strategies that take into account social and contextual vulnerabilities.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The literature review for this thesis was performed using a systematic method to affirm the relevance and applicability of the studies included. Studies were deemed acceptable for inclusion if they focused on RTIs, polytrauma, and HRQoL, specifically highlighting findings pertinent to the Namibian, SSA, or comparative LMIC contexts. The literature review for this thesis was performed using PubMed, Scopus, Google Scholar and ScienceDirect. Eligible studies included empirical research, whether quantitative, qualitative or mixed methods, as well as systematic reviews or meta-analyses published in journals between 2000 and 2025. Only papers published in full-text English were included, and each study had to include its sample characteristics and outcome measures. Contextual relevance was emphasised, with preference studies that offer insight into public health, trauma care, or rehabilitation policy in Namibia and analogous environments.

While the review prioritised recent literature, older references, dating back to 2007, were included when no updated versions were available. This exception was made only when such studies demonstrated fundamental significance, defined as providing seminal definitions, e.g. the original description of polytrauma or ISS threshold, widely adopted methodological frameworks, such as the abbreviated injury scale or EQ-5D instruments that remain relevant for contextualising current findings. These studies were not cited for currency but for their impact on trauma research and their role in framing contemporary analyses. This approach ensured comprehensive coverage of key themes while acknowledging the limited availability of research in these areas.

Studies were excluded if they were not peer-reviewed, such as editorials, commentaries and opinion pieces, did not report sample characteristics or outcome measures, were not available in full-text English or lacked direct applicability to RTA, RTI, polytrauma or HRQoL literature. Grey literature, such as government reports and unpublished theses, was excluded to maintain methodological consistency and ensure reliability and comparability of findings across included studies.

The current evidence was synthesised under the following themes: mortality and morbidity secondary to RTIs, socio-economic burden of RTIs, RTA at-risk population, polytrauma, measuring injury severity, HRQoL following RTAs and RTI data challenges.

2.2 Mortality and Morbidity Secondary to RTIs

Over 1.19 million people globally die after RTAs annually, down from 1.35 million in 2018. Half of these victims are vulnerable road users, such as cyclists, motorcyclists, and pedestrians (Ahmed et al., 2023). As such, RTIs continue to be a significant global health concern.

Over half of the UN Member States reduced RTFs between 2010 and 2021. This reduction occurred despite the global motor vehicle fleet doubling, road networks expanding, and the population increasing by nearly a billion. While road safety efforts have made progress, they fall short of the UN Decade of Action for Road Safety 2021–2030 target to halve deaths by 2030 (WHO, 2023b). Achieving this ambitious goal is unlikely despite improvements in legislation, vehicle standards, and access to road safety interventions (Sorooshian, 2024). This scenario challenges researchers and decision-makers to accelerate efforts to reduce RTIs and RTFs globally and meet SDG objectives.

RTIs are among the top 10 causes of DALYs, as they represent the total burden of disease by combining Years of Life Lost (YLLs) due to premature mortality and Years Lived with Disability (YLDs) due to non-fatal health outcomes, highlighting their significant health impact (IHME, 2021). This measure is important as it accounts for both reduced life expectancy and diminished health due to injury, unlike traditional methods that focus solely on mortality, prevalence, and incidence statistics (IHME, 2021).

While RTIs are steadily declining in HICs, many LMICs continue to experience rising fatality rates (Goel et al., 2024). RTFs in Africa rose by 17% between 2010 and 2021, with an estimated 250,000 deaths in 2021 alone. This upward trend sharply contrasts with global trends, which saw a 5% reduction in RTFs during the same period. These increases in RTFs highlight a growing disparity in road safety outcomes (WHO, 2024). Despite comprising only 15% of the global population and owning just 3% of the world's vehicles, the continent accounts for nearly 20% of global RTFs, making RTAs a leading cause of mortality across the region (WHO, 2023a).

RTA-related injuries, fatalities, and disabilities substantially hinder health and economic advancement in LMICs. Governments and healthcare systems must prioritise the formulation of tailored health policies aimed at mitigating RTFs globally (Yousefzadeh-Chabok et al., 2016). This necessitates tackling mortality disparities through effective national measures such as law enforcement, vehicle safety standards, and trauma care.

Zimbabwe recorded the highest RTF rate, at 41.2 deaths per 100,000 individuals, according to 2019 data from the WHO, followed by the Central African Republic at 37.7 deaths per 100,000 individuals

(WHO, 2023a). Ethiopia's population-based RTF recorded 26.7 per 100,000 for the same year; however, the true number may be higher due to underreporting (Baru et al., 2019). The RTF rate in Zimbabwe indicates a significant, substantial population-level burden, implying considerable exposure to dangerous roads and inequitable access to trauma care services (United Nations Economic Commission for Africa, 2021). In contrast, Ethiopia's high vehicle-specific fatality rate (114 RTFs per 10,000 vehicles) underscores significant danger among road users, mostly due to inadequate vehicle maintenance, dangerous driving behaviours, and ineffective enforcement, notwithstanding the country's comparatively low levels of motorisation (United Nations Economic Commission for Europe (UNECE), 2022).

Uganda also has high RTF rates due to poor road infrastructure, with two-thirds of RTA victims dying before reaching a hospital (Temizel et al., 2021). The Borgen analysis indicates that in 2018, one in ten deaths in Uganda resulted from RTAs, highlighting significant shortcomings in pre-hospital emergency care and trauma response systems.

RTAs persist as a prevalent concern throughout Africa, primarily due to inadequate road infrastructure, insufficient enforcement of safety regulations, and a reduced capacity for emergency responses (Bachani et al., 2017). SSA has some of the highest RTF rates globally, with the ten dangerous countries for RTAs located within the region. Since 1990, RTFs in the Western and Southern SSA have more than doubled, indicative of the cumulative impact of accelerated urbanisation, heightened motorisation, and sustained gaps in road safety funding and trauma care infrastructure. In contrast, the United States of America (USA) documented roughly 12 RTFs per 100,000 individuals yearly, while Norway, recognised for its stringent road safety regulations and infrastructure, reports fewer than 2 fatalities per 100,000 (Jones et al., 2020). This profound disparity underscores the essential importance of systemic investment in road safety, enforcement, and trauma response in the reduction of RTFs.

Namibia had an RTF rate of 35 per 100,000 population, exceeding the regional average of 26.6, rendering it one of the most unsafe African nations for traffic safety. The MVA Fund Crash Report (2022) indicates that Namibia experienced an average of 5,616 RTIs annually between 2018 and 2022 (MVA Fund, 2022). This number is notable given Namibia's modest population of 3 million, as RTA-related fatalities and disabilities lead to socioeconomic losses, potentially hindering future development initiatives.

Although prevention is essential to reducing RTIs and RTFs, enhanced post-crash care is crucial and vital, as it may decrease trauma mortality by as much as 35%. RTA's result varies from various pre-

crash factors, including vehicles, pedestrians, and road surroundings. These complicated factors require extensive research to identify and understand. The lack of research on RTIs in SSA, including Namibia, remains a significant issue. Regionally, the economic burden of RTIs is substantial, yet existing studies are few and methodologically inconsistent, limiting the generalisability and utility of findings for policy and planning.

2.3 Socio-Economic Burden of RTIs

The rise in RTIs globally has significantly impacted economies, especially in LMICs, which often face other development challenges. Disparities in economic development contribute to this gap, as wealthier nations experience greater human capital loss from RTAs but have advanced healthcare systems that reduce DALYs at higher treatment costs (Chen et al., 2019). RTIs are projected to cost the global economy $18 trillion in lost productivity and other expenses between 2015 and 2030, affecting 166 countries. The global economy could otherwise use these healthcare expenditures for development or investment (Chen et al., 2019).

Though RTIs account for 46.4% of global economic loss in LMICs, they represent 89% of DALYs worldwide (Chen et al., 2019). In HICs, trauma care systems save lives, but many LMICs lack basic infrastructure, affecting public health delivery. Furthermore, Emergency Medical Services (EMS) in Africa are underdeveloped and ill-equipped, leading to high rates of preventable post-traumatic morbidity and mortality. According to Koome et al. (2020), inadequately equipped vehicles transport over half of trauma patients without the necessary qualified staff.

Advancements in medical procedures and vehicle safety, aimed at saving lives, have not come without a cost to the patient or society. Funding of many health systems in LMICs comes from OOP expenses, which account for 39% of costs in LICs, 56% in LMICs, and 30% in Upper-Middle-Income Countries (UMICs), compared to the average global percentage of 18%. Patients and their families bear the financial responsibility for these costs during the immediate time after a severe illness or injury. In terms of Years of Potential Life Lost (YPLL), RTIs continue to be the leading cause of death among young people, outpacing malignant neoplasms, heart disease, and cerebrovascular illness due to their disproportionate impact on younger demographics.

Reliable statistics on RTI survivors living with disabilities remain limited globally, especially in LMICs, where surveillance systems are often underdeveloped. On the other hand, HICs usually have stronger systems for collecting and monitoring data, which makes it easier to keep track of what happens after RTAs (WHO, 2023a). Countries with higher income levels maintain more robust data

collection and monitoring frameworks, enabling better tracking of post-crash outcomes. Despite these disparities, global estimates suggest that for every RTI-related death, approximately 20 to 50 individuals sustain non-fatal injuries, many of which result in long-term or permanent disability. For every RTF, approximately 8 victims are hospitalised, while 100 receive emergency treatment and are subsequently released (IHME, 2021). This wide range reflects significant variability in injury severity, reporting accuracy, and access to trauma care across regions.

The Centres for Disease Control and Prevention (CDC) estimates that the lifetime medical cost of RTIs is nearly 50% higher than the $12.6 billion cost of HIV in the USA, with 75–90% of these costs incurred within the first 5 months following the RTA (Frieden et al., 2014). This suggests that the lifetime medical cost of nonfatal RTIs is significantly higher compared to other major public health issues.

SSA continues to carry a heavy burden of injury- and trauma-related deaths, compared to HICs (Mowafi et al., 2021). Yet the region's trauma care systems, both prehospital and facility-based, remain underdeveloped, leaving many patients without timely or adequate treatment. Many LMICs often allocate their limited health budgets towards infectious disease programmes due to their perceived cost-effectiveness. As a result, surgical and trauma care services are frequently underfunded, despite their growing importance in addressing the region's changing health landscape.

Recovery from trauma is not just about physical healing; it also requires psychological support and long-term rehabilitation. Yet across SSA, access to these services remains limited. An estimated one in five people, or 21 million individuals, could benefit from rehabilitation, but only 58.5% of referral hospitals in ten surveyed countries have dedicated rehabilitation departments (Alayande et al., 2022). This gap leaves many patients without the emotional and functional support they need to fully recover, especially in settings where mental health services are scarce and often overlooked.

Musculoskeletal trauma is one of the most demanding and complex types of injuries seen across SSA, where RTIs and other emergencies often stretch surgical and rehabilitation services beyond capacity. These injuries are especially common among RTA patients and place a heavy burden on orthopaedic teams, as they require urgent operations and prioritise admissions to Intensive Care Units (ICUs) or High Care Units (HCUs). Many cases require extended theatre time, and about 26% need follow-up surgeries for definitive treatment using orthopaedic implants. In addition to the clinical burden, RTIs have a 61% higher immediate financial impact on households than other emergencies, even when hospital expenses and missed workdays are similar. This highlights the

need for better-adapted trauma systems and enhanced support for families dealing with the impact of trauma (Mowafi et al., 2021).

Despite global efforts to reduce RTFs, LICs continue to experience disproportionately high rates of RTIs and related disability. Between 2013 and 2016, LICs made very little progress in lowering RTFs. In contrast, Middle-and High-income Countries (MHICs) saw improvements in trauma care systems and targeted policy reforms (Mowafi et al., 2021). RTFs have not improved in LICs, unlike MHICs, which benefited from targeted policy reforms and improved trauma care systems. Limited surveillance infrastructure and reliance on modelled estimates cause the burden of RTIs in SSA to remain underreported. Nevertheless, recent data indicate that RTIs contribute to approximately 21.6% of global DALYs, with Africa accounting for only 3% of total healthy life years lost, highlighting a disproportionate impact relative to its share of global traffic volume. Particularly affected are young males, who account for over 75% of RTFs in SSA. Furthermore, emerging evidence suggests that even low-impact collisions can result in long-term physical and psychological sequelae, exacerbating socioeconomic vulnerability and straining rehabilitation systems.

2.4 Road Traffic Accidents (RTAs) – At-risk populations

Within the behavioural sciences, one of the central challenges is understanding and measuring human behaviour, particularly among diverse and dynamic populations. Personal decision-making and risk assessment are intricately linked to driving safety, rendering transportation a vital area where behavioural insights are particularly significant. A recent study indicates that risky behaviours, including speeding, driving distractions, and substance use, are associated with over 70% of RTAs, highlighting the significant influence of human factors in crash causation (McCarty & Kim, 2024).

Gender and age substantially affect the propensity for reckless driving behaviour. Statistically, men are more prone than women to be involved in RTAs, with young males under the age of 25 constituting around 75% of RTFs, a rate nearly threefold greater than that of young females (Walugembe et al., 2020). Male drivers exhibit a heightened propensity for aggressive driving, excessive speeding, infraction of traffic regulations, and disregard for safety protocols, including seatbelt usage. Conversely, women generally display more prudent driving habits and are noted to achieve psychological maturity earlier than men, potentially resulting in reduced RTA participation. Particularly concerning is the propensity of men in their 30s to partake in high-risk activities, such

as intentional traffic infractions and intoxicated driving, which significantly increase the likelihood of accidents (McCarty & Kim, 2024).

While excessive speed and traffic law infractions are the primary causes of RTAs, further research underscores prevalent noncompliance with seatbelt regulations and disregard for speed limits as significant contributors. These behavioural tendencies markedly elevate the risk of fatal and severe injuries, particularly in LMICs, where enforcement measures are frequently underfunded or administered inconsistently (Touahmia, 2018). Empirical research has shown that not wearing seatbelts markedly elevates the risk of severe injury, but speeding is closely associated with both the incidence and severity of accidents. These findings highlight the pressing need to enhance traffic law enforcement and implement ongoing public education initiatives focused on fostering safe driving practices and decreasing avoidable fatalities (Touahmia, 2018).

Although novice drivers are disproportionately implicated in RTFs, all drivers, irrespective of age, face risk. Young individuals, constituting the majority of newly licensed drivers, generally exhibit the greatest accident rates due to their inexperience and inclination towards risk-taking (Rowe et al., 2022). Nevertheless, drivers in their thirties have higher RTA rates than older groups, indicating that maturity alone does not mitigate risk. Human factors, including inexperience, excessive speeding, and traffic law infractions, contribute to approximately 67% of RTAs, while environmental factors, such as substandard pavement, insufficient road signage, and reduced visibility, account for 29.0%. Vehicle-related issues, including mechanical failure or unroadworthy conditions, represent 4.0% (Touahmia, 2018). These findings highlight the complex nature of RTAs and the necessity for tailored interventions that tackle both behavioural and infrastructural factors contributing to RTAs.

One of the Global Road Safety Performance Targets aims to reduce the time between the occurrence of RTAs and the delivery of professional emergency care (WHO, 2021). However, in many LMICs, the initial transportation of RTA casualties is frequently carried out by untrained individuals, such as family members, taxi drivers, police officers, or passing motorists, who lack formal emergency care training. In addition, EMS are often concentrated in urban centres, leaving rural and peri-urban communities with limited access to timely, skilled prehospital care (Chatukuta et al., 2021). This disparity highlights the pressing need to broaden the reach of EMS and improve the capability of community-level first responders in underprivileged areas. The method of transportation to the hospital has shown a strong correlation with mortality among admitted patients, with studies indicating that a significant proportion of RTIs are exacerbated during extrication or transfer without proper immobilisation, procedures frequently performed by

untrained individuals (Suzuki et al., 2022; Vaughan-Huxley et al., 2023). There is an urgent need for adaptable EMS systems and community-based first responder training in LMICs, where defined emergency care is often delayed or unavailable.

Alcohol-impaired driving remains a major contributor to RTAs, with evidence consistently showing that drivers under the influence are significantly more likely to be involved in RTAs than their sober counterparts (Dong et al., 2024). Alcohol, a widely consumed euphoriant, acts as a central nervous system depressant, impairing judgment, reaction time, and motor coordination. In addition, a strong dose-response relationship has been observed between Blood Alcohol Concentration (BAC) levels and RTA risk, with estimates indicating that the odds of sustaining a fatal injury increase by approximately 1.74 times for every 0.02% rise in BAC (Haghpanahan et al., 2019). As a result, lowering the legal BAC limit for drivers has become a widely adopted public health intervention across many countries.

Impaired motor function, speech, vision, reaction time, and sensory dysfunction are among the central nervous system symptoms of alcohol consumption. These effects stem from alcohol's neurotoxic impact, which disrupts normal brain signalling and coordination and often leads to slurred speech, blurred vision, and slowed reflexes (Papalimperi et al., 2019). In addition, alcohol may induce feelings of relaxation while simultaneously impairing memory, judgement, and overall cognitive function, factors that critically undermine safe driving behaviour. Driving under the influence is often associated with failure to wear a seatbelt in the USA and 19 other HICs, a behavioural trend that markedly increases the likelihood of severe injuries in RTAs (Johns Hopkins Bloomberg School of Public Health, 2024).

The increased incidents of RTAs in LICs are attributed to rapid population growth, hastened motorisation, and the expansion of road networks, which frequently surpass the advancement of safety infrastructure. Unsafe driving habits, coupled with a general disdain for traffic regulations among road users, exacerbate these structural challenges (Heydari et al., 2019). Furthermore, many LICs lack thorough policies, integrated strategies, and sustained programs that comprehensively tackle road safety. Evidence indicates that the enforcement of rigorous drunk-driving laws, especially those mandating low BAC limits through sobriety checkpoints and random breathalyser testing, can markedly reduce alcohol-related accidents and improve overall traffic safety results (Johns Hopkins Bloomberg School of Public Health, 2024).

These insights confirm that RTAs are not solely due to individual driver errors but indicate profound systemic weaknesses that necessitate coordinated, evidence-driven interventions that prioritise

behavioural modification, policy enforcement, and equitable access to trauma care for at-risk populations.

2.5 Polytrauma

Polytrauma is a significant contributor to morbidity and mortality in both industrialised and developing nations, especially among RTA victims (Kalsotra, 2016). The term, polytrauma, refers to significant injuries impacting various body regions, frequently associated with systemic physiological impairments and a dysregulated inflammatory response. The outcome may cause dysfunction and failure of previously unaffected organs, markedly elevating the risk of complications and mortality. RTAs, particularly those involving high-speed collisions, are primary causes of polytrauma, frequently leading to Traumatic Brain Injuries (TBIs), spinal cord injuries, and complex fractures. (Niemeyer et al., 2022). Thus, the assessment, treatment, and prognosis of polytrauma markedly diverge from those of isolated injuries, necessitating prompt, multidisciplinary intervention and tailored trauma procedures to improve outcomes (Marsden & Tuma, 2023; Turculeå et al., 2021).

Polytrauma represent a significant global public health concern, responsible for approximately 9% of all fatalities and 15% of DALYs globally. Annually, over 5.8 million people succumb to injuries, predominantly from RTAs, falls, and violence, a statistic anticipated to increase in the coming decades (Van Breugel et al., 2020). Although survival rates after polytrauma have improved due to advancements in emergency and critical care, focus has increasingly turned to long-term outcomes, especially HRQoL. Numerous survivors encounter difficulties in restoring their pre-trauma functional capacity, often facing persistent medical complications such as respiratory dysfunction, paraplegia, or tetraplegia. These impairments substantially hinder social reintegration and employment, with studies estimating that up to 40% of survivors with disabilities are incapable of resuming former occupations, leading to negative socioeconomic consequences (Ritschel et al., 2021).

Besides its elevated mortality rate, polytrauma places a lasting burden on survivors, both in terms of health outcomes and the level of medical care needed (Ciechanowicz et al., 2020). RTAs, acknowledged globally as a primary contributor to polytrauma, can result in complex injuries that hinder long-term recovery. Survivors often endure chronic pain, limited joint mobility, and functional disabilities that significantly reduce their quality of life. Fractures incurred from high-impact collisions can disrupt microcirculation, resulting in injuries to both bone and surrounding soft tissues, hence complicating healing and extending rehabilitation (Lichte et al., 2024). Although isolated severe Traumatic Brain Injuries (TBI) carry a high mortality risk, studies show that mortality in polytrauma patients with moderate to severe TBI is on par with isolated TBI cases, demonstrating

overall mortality of TBIs and significantly greater resource utilisation (Hasler et al., 2021; Mateo-Sierra et al., 2025). Consequently, polytrauma patients generally require extended, multidisciplinary management encompassing orthopaedic, neurological, and psychosocial treatment.

Notwithstanding the variety in injury patterns and severity, evidence consistently indicates that up to 70% of polytrauma survivors experience significant declines in both functional and psychosocial dimensions of health-related quality of life (Zwingmann et al., 2016). The interaction of orthopaedic and systemic trauma frequently results in long-term disability and socioeconomic difficulties for RTA victims, with these negative outcomes being particularly significant.

Recent literature corroborates these conclusions. Silverstein et al. (2021) conducted a systematic review that revealed chronic pain, psychological distress, and delayed return to work as significant factors adversely affecting HRQoL in polytrauma survivors. Ritschel et al. (2021) emphasise the necessity of creating standardised instruments to evaluate HRQoL and social reintegration, noting that several patients continue to encounter considerable limitations in their daily functioning. Leijdesdorff (2022) emphasises the unequal effects of traffic-related polytrauma on vulnerable road users, associating injury patterns with extended recovery periods and reduced functional outcomes.

Empirical research demonstrates that individuals with substantial injuries, particularly those with an ISS of 12 or greater, encounter a markedly elevated risk of adverse recovery outcomes within the initial 12 months after an RTA. In younger demographics, trauma-related injuries are a primary contributor to long-term disability and diminished functional capacity (Abu & Reis, 2023; Ritschel et al., 2021). These injuries frequently result in enduring physical disabilities, psychological distress, and reduced social involvement, collectively undermining an individual's capacity to participate in occupational tasks. In more extreme cases, this trend may result in complete occupational incapacity, highlighting the necessity for focused rehabilitation programmes and strong socioeconomic support systems (Ritschel et al., 2021).

Regional variations in the incidence and prevalence of polytrauma underscore the need for context-specific trauma systems. The initial hour after a traumatic event, known as the "Golden Hour," is when most fatalities from polytrauma or multiple injuries occur. Evidence indicates that failure to commence definitive treatment within this timeframe significantly elevates the risk of morbidity and mortality (Guarino et al., 2019). Prompt access to trauma care after an RTA markedly improve survival chances. Effective emergency response systems are crucial, as timely intervention can significantly impact recovery outcomes. The primary objective in trauma management is to provide emergency care that sustains life, retains physiological functions, and reduces long-term disability.

Early assessment and resuscitation must be systematic and precise, with swift identification of individuals at immediate risk of death being crucial. A systematic, protocol-driven approach enhances survival rates and optimises patient outcomes, underscoring the need for comprehensive training and strict adherence to clinical guidelines to avert critical oversights (Guarino et al., 2019).

In 1983, Donald Trunkey found a trimodal distribution of trauma-related deaths, demonstrating that the most deaths occur during specific time frames following an injury. This trimodal distribution model has significantly impacted trauma care practices by underscoring the need for timely medical intervention and guiding the establishment of trauma systems aimed at enhancing both prehospital and in-hospital care (Valdez et al., 2016). Moreover, understanding the determinants of mortality in polytraumatised patients is essential for efficient care. Historically, Multiple Organ Dysfunction Syndrome has been regarded as the primary cause of mortality in polytrauma cases. Recent research suggests that TBI has become the leading cause of mortality, especially among severely injured patients admitted to ICUs. This epidemiological shift underscores the necessity of targeted assessment and timely management for brain injuries, as early treatment can markedly affect survival outcomes. Modified trauma management strategies to align with his trend are essential for improving prognosis and minimising long-term disability (Van Breugel et al., 2020; van Wessem et al., 2024).

Polytrauma continues to be a primary cause of hospital admission, with estimates indicating that approximately 15% of hospital and clinic beds are occupied by patients with multiple or severe injuries (Kalsotra et al., 2016). The management of these patients is intrinsically complex and requires a dynamic, multidisciplinary approach (Morgan, 2025; Nauth et al., 2021). The quick and safe fixation of fractures is a crucial aspect of care, essential for supporting the patient, minimising complications, and promoting early mobilisation. Advances in trauma surgery have highlighted the significance of individualised timing strategies, including early total care and damage control orthopaedics, to optimise outcomes and reduce systemic stress in polytraumatised patients (Kalbas et al., 2024).

Mortality and morbidity rates among polytrauma patients are markedly elevated in non-specialised facilities, mostly due to the inadequate implementation of triage protocols and the insufficient training of trauma teams (Elbaih et al., 2023). These negatively impacts, however, can be mitigated by the establishment of standardised trauma systems, improved infrastructure, and focused capacity-building initiatives. In SSA, the management of polytrauma is particularly complex due to fragmented pre-hospital care, inadequate referral pathways, and the lack of dedicated trauma

centres (Gudugbe et al., 2023; Oboirien et al., 2016). Enhancing EMS and creating regionally adapted trauma registries are critical measures for reducing preventable deaths and improving long-term outcomes in resource-constrained settings (Yost et al., 2024).

2.6 Measuring Injury Severity

The ISS is an established anatomical scoring system that integrates various trauma data into a singular numerical value indicating the overall severity of a patient's injuries. The ISS, based on the AIS, is calculated by squaring the highest AIS ratings from the three most severely wounded anatomical regions and summing these values, resulting in a score between 1 and 75 (Association for the Advancement of Automotive Medicine, 2025). The Institute of Trauma and Injury define ISS ≥ 15 as polytrauma or serious trauma, signifying a severe level of injury that requires extensive medical intervention and multidisciplinary care (Störmann, 2024). Scores are categorised as: minor (ISS 1–8), moderate (ISS 9–15), severe (ISS 16–24), extremely severe (ISS 25–50), and critical (ISS >50). This scoring approach is crucial for triage, treatment planning, and outcome forecasting in emergency and trauma scenarios (Kumar & Pandian, 2024).

The adoption of a standardised system, such as the ISS, improves communication among healthcare providers, enables better-informed treatment decisions, and ensures optimal resource allocation. This scoring method is especially valuable in epidemiological studies, as it provides essential information about injury patterns and outcomes. By understanding these patterns, healthcare providers can improve trauma care procedures and formulate more effective patient management strategies. ISS aids in individual patient evaluations and significantly enhances the overall quality of trauma care on a larger scale (Hung et al., 2021).

The ISS provides an anatomical evaluation instead of focusing on a specific medical condition. This approach is universally recognised for assessing persons with multiple injuries and is considered a global benchmark in trauma assessment (Pape & Leenen, 2021). ISS facilitates a diverse range of applications, including objective analyses of resource allocation, such as hospital length of stay and treatment costs. A critical element of ISS is its role in trauma care research; in its absence, analysis of trauma epidemiology and subsequent outcomes would be considerably hindered (Eidenbenz et al., 2025). Moreover, ISS enables facilities to compare processes and outcomes, facilitating the identification of best practices for quality improvement programmes (Mehmood et al., 2019).

RTA injury severity assessments may vary depending on the country's available data sources, but common sources include hospital records, police crash reports, and medical claims (Mehmood et

al., 2019). Among these, hospital data, especially length of stay, have shown a consistent and validated relationship with the identification of major injuries. Longer hospital stays are often associated with higher injury severity, increased resource utilisation, and poorer outcomes, making this metric a valuable proxy for trauma surveillance and health system planning (Hung et al., 2021).

Long-term disability is common among survivors of major trauma, and the ISS plays a crucial role in predicting functional abilities after discharge. Research has shown that factors such as age and ISS are significant predictors of post-injury outcomes. Specifically, a higher ISS is strongly associated with increased levels of disability and reduced HRQoL one year after the incident (Martino et al., 2020). These findings underscore the importance of incorporating ISS into trauma registries and follow-up protocols, not only for acute care planning but also for rehabilitation and reintegration strategies. When combined with hospital length of stay and sociodemographic data, ISS enables facilities to benchmark outcomes, identify high-risk groups, and refine quality improvement programmes across trauma systems.

While the ISS is a widely utilised tool in trauma assessment, it is important to acknowledge its inherent limitations. Notably, the scoring system does not incorporate physiological parameters or account for the cumulative impact of multiple injuries within the same anatomical region. These shortcomings can lead to an underestimation of injury severity in complex trauma cases. Furthermore, the ISS relies solely on anatomical descriptors, which may result in discrepancies between predicted and actual outcomes, particularly in vulnerable populations such as children, where physiological responses and recovery trajectories differ significantly from adults (Kazemi et al., 2024; Snyder & Mokdad, 2025).

Continuous improvements and adaptations in trauma scoring systems, coupled with advancements in management protocols, are essential for optimising patient care outcomes. As the landscape of trauma care continues to evolve, ISS remains a pivotal tool in guiding evidence-based clinical decision-making. Its integration into modern trauma frameworks facilitates standardised assessments and supports longitudinal research, resource allocation, and rehabilitation planning. Refining scoring methodologies, especially those that incorporate physiological and psychosocial dimensions, will be critical for keeping trauma care responsive, equitable, and outcome driven.

2.7 Health-related Quality of Life (HRQoL) following RTAs

Mortality and morbidity have historically served as fundamental indicators of health outcomes. A more holistic strategy is being developed that acknowledges the burden of illness transcends the

simple existence of disease. This wider perspective includes psychosocial factors such as pain, anxiety, limitations in everyday activities, personal and family obligations, and financial burdens. These elements significantly influence an individual's quality of life and long-term wellbeing. By recognising these factors, healthcare providers can more accurately evaluate the true effects of illness and formulate interventions that cater to both clinical and contextual requirements, thereby improving support for patients and their families (Wainiqolo et al., 2019).

While physical health frequently improves and stabilises after RTA, the psychological repercussions may persist for a considerable length of time. Many survivors may experience symptoms including post-traumatic stress disorder, anxiety, and depression, which can significantly affect their overall well-being (Másilková, 2017). The immediate and long-term impacts of an RTI may vary; however, the long-term consequences are typically encapsulated in terms of HRQoL. Research indicates that even minor injuries can result in a substantial reduction in HRQoL, especially among younger individuals. Injuries disrupt education, employment and social participation during formative years, while the expectation of full health amplifies the perceived impact of limitations. For women, mostly burdened with caregiving responsibilities, mental health comorbidities and pain interference complicate recovery trajectories (Rissanen et al., 2020).

HRQoL assessment effectively measures total health by incorporating data on individual physical and mental health states, together with the influence these health statuses have on daily functioning and overall well-being (Yin et al., 2016). HRQoL surveillance data can be pivotal in detecting populations with notable adverse health perceptions, frequently influenced by socioeconomic, demographic, or clinical factors (Nevarez-Flores et al., 2023). This information allows public health planners to design targeted interventions that assist these individuals and prevent further deterioration of their health status (Hernández-Segura et al., 2022).

Research demonstrates that injuries to the cervical, thoracic, and lumbar spine, along with those affecting the upper and lower extremities and pelvis, are markedly associated with reduced HRQoL. These injuries hinder physical functionality and adversely impact psychosocial well-being, including emotional distress, social isolation, and reduced life satisfaction (Rissanen et al., 2020). Therefore, it is imperative to implement treatment strategies that integrate both physical rehabilitation and psychological support to improve outcomes for affected individuals (Cardile et al., 2024).

Family support is essential for the rehabilitation of trauma patients with serious injuries. Strong psychosocial support leads to more favourable results, while inadequate support is associated with an increased risk of complications, including delayed recovery, emotional distress, and reduced

treatment adherence. These findings emphasise the necessity of including family involvement and psychosocial resources into treatment plans, thereby addressing both the physical and emotional requirements of patients (Audifax Kpeno, 2024; Bjørlykhaug et al., 2022; Chan et al., 2023).

Research indicates that inadequate psychological adjustment is associated with dependence on compensation systems and the perception of being “not at fault.” Individuals with these traits frequently find it challenging to acknowledge their roles in their current situations. Furthermore, persistent pain intensifies psychological challenges, hindering the process of achieving healthy adaptations. This interaction highlights the complex nature of psychological resilience and the adjustment process (Alharbi et al., 2019). A qualitative study indicated significant discontent with the compensation process among individuals injured in RTAs who subsequently participated in compensation schemes. Frequent complaints include inadequate communication and information, delays or rejections in payments, protracted treatment approvals, and cumbersome paperwork. These insurance-related factors were found to be closely associated with heightened levels of stress and anxiety, which, in turn, adversely affected the recovery process (Pozzato et al., 2022).

Women typically experience poorer HRQoL following their injuries compared to men. Researchers attribute this difference to women's tendency to evaluate their physical health and overall well-being more negatively than men. Consequently, these self-assessments could potentially contribute to the observed differences in health outcomes after an injury (Dipnall et al., 2022). While physical health outcomes are typically assessed by healthcare practitioners, HRQoL studies often rely on patient-reported measures. Gendered trauma responses are further shaped by emotional regulation and psychological defences, with women disproportionately affected by chronic and betrayal-based traumas that complicate post-injury adjustment.

Similarly, a study discovered that socioeconomic level, gender, the intent behind the harm, and the type of injury had different effects on the patterns of recovery of overall, physical, and psychosocial functioning in children and adolescents after injury (Dipnall et al., 2022). Moreover, psychological distress, often exacerbated by compensation-related delays, poor communication, and perceived unfairness, has been shown to prolong recovery and inflate claim costs, particularly among socially disadvantaged groups and women (Brooks et al., 2024; Guest, 2019). These findings demonstrate the need for gender and equity-sensitive rehabilitation frameworks that address both clinical and systemic barriers to recovery.

OOP costs significantly increase families' vulnerability to poverty, thereby exacerbating post-injury outcomes and restricting access to timely care (Dipnall et al., 2022). Various crash-related

characteristics, including passenger status, injury severity, and sustaining lower limb or spinal trauma, have been shown to predict poor physical, social, and psychological outcomes up to 12 months following the injury (Alharbi et al., 2019). Individual burdens are exacerbated by systemic challenges in LMICs, where higher injury risks, lower household income, and inadequate trauma treatment and rehabilitation services collectively hinder recovery and contribute to reduced economic productivity and development (Wainiqolo et al., 2019). Collectively, these findings underscore the necessity of establishing integrated trauma care systems that address both clinical and socioeconomic health determinants.

The List of All Deficits (LOAD) Framework provides a comprehensive perspective for understanding the complex burden of injury across individual, familial, and societal domains (Lyons et al., 2010). The Load Framework is designed to facilitate a comprehensive assessment of the effects of injuries and violence, encompassing a wider range of health and social deficiencies than many commonly used HRQoL instruments. In LMICs, the Short Form 36 Health Survey is extensively utilised; however, it corresponds to the fewest domains of the LOAD Framework in comparison to other generic measures such as the EQ-5D, Life Situation Survey (LSS), Quality of Life Questionnaire (QoLQ), Health Utilities Index-Mark 3, and the World Health Organisation Quality of Life Questionnaire (WHOQOL-BREF). Despite their limitations in conceptual scope, the Short Form 36 Health Survey and its abbreviated version, the SF-12, remain the preferred choice in global health research due to their simplicity, reliability, and widespread acceptance (Pequeno et al., 2020).

The EQ-5D is one of the most extensively utilised generic instruments for evaluating HRQoL worldwide. Structured around five core dimensions, the conceptual framework presents a holistic perspective of health, highlighting not only the medical aspects of disease but also the necessity of independent physical, emotional, and social functioning (Devlin et al., 2020). The EQ-5D captures both positive attributes, such as well-being, and negative conditions, such as illness or disability, making it suitable for a broad spectrum of health assessments. Its compact design, ease of use, and adaptability have facilitated its effective use across diverse settings, including clinical practice, health policy development, pharmacoeconomic assessment, and research trials (EuroQol Group, n.d.).

The EQ-5D utility score, representing Quality Adjusted Life Years (QALYs), is a recognised tool for obtaining evidence-based findings in cost-effectiveness assessments (Ben et al., 2022). Its capacity to measure both the quality and duration of life make it particularly valuable in the economic implications of health interventions post-RTAs. The EQ-5D, due to its adaptability and compatibility

with holistic health perspectives, is increasingly applied in economic evaluations, clinical outcome assessments, and policy decision-making across diverse healthcare settings (Devlin et al., 2020). Its integration into trauma research facilitates a more nuanced understanding of post-injury recovery and resource allocation, particularly in LMICs, where health system constraints demand efficient and equitable solutions.

2.8 RTI Data Challenge

Dependable and contextually relevant data is important for the development of safer road and transport systems. It enables the recognition of collision trends, guides strategic resource distribution, and supports evidence-based interventions designed to mitigate RTIs and RTFs (WHO, 2023). Comprehensive road safety data fulfils multiple roles, including managing hazardous locations, diagnosing systemic issues, assessing the efficacy of intervention monitoring temporal trends, prioritising preventive strategies, and benchmarking traffic-related morbidity and mortality against other public health concerns (Segui-Gomez et al., 2021).

Notwithstanding its critical significance, RTI data across many African countries remains significantly underreported and collected inconsistently. These constraints undermine the accuracy of burden assessments and obstruct the development of effective policy interventions. The absence of defined indicators and reporting systems hinders regional comparability and restricts the formulation of targeted, equity-focused initiatives.

One of the most essential elements of data collection is its validity. Mortality rates are widely regarded as the most dependable measure of road safety efficacy. However, the methodology used to compute these rates differs considerably across countries, frequently leading to disputed estimates. The WHO Global Status Report on Road Safety documented 73,854 reported RTFs across African nations in 2016, while WHO modelling estimated the actual number of fatalities to be 291,998, reflecting a discrepancy of nearly 300% (WHO, 2018). These gaps have increased since previous evaluations, highlighting ongoing challenges in accurately measuring the true impact of RTAs.

Recent assessments highlight the shortcomings of modelling methodologies based on incomplete or inconsistent data, which may not yield reliable estimates of RTAs, RTIs, and RTFs across the continent. Registry-based reporting systems are prone to significant underreporting, particularly in settings with inadequate surveillance infrastructure and fragmented intersectoral coordination (Adeloye et al., 2016; WHO, 2023).

While global reporting agencies like the WHO and the World Road Association (WRA) provide considerable data on RTAs and RTIs in Namibia, this information is often presented in generalised formats that lack country-specific granularity. National research indicates a similar trend, with existing literature primarily addressing broad trends such as the probability of sustaining injuries or fatalities in an RTA, rather than offering detailed epidemiological insights or disaggregated data (Chatukuta et al., 2021).

Accurate and contextually relevant data are essential for the formulation of successful road safety interventions, particularly in low-resource settings such as SSA. Reliable data facilitates the identification of RTA patterns, guides strategic resource distribution, and support evidence-based policymaking aimed at mitigating RTIs and RTFs (WHO, 2023). Estimating national RTI rates in SSA is methodologically challenging due to inadequate infrastructure for large-scale health surveillance. Hospital records, despite the extensive clinical information, often fail to capture population-level incidence, especially in rural and underserved areas (Segui-Gomez et al., 2021).

In Namibia, these challenges are exacerbated by fragmented data systems and underreporting. Although global organisations such as WHO and the WRA provide high-level statistics, the data are frequently generalised and lack the granularity needed for targeted interventions. National entities, including the MVA Fund and the National Road Safety Council (NRSC), separately collect data, resulting in gaps in coverage. Moreover, current datasets infrequently include disaggregated variables such as socioeconomic status, geographic location, or disability outcomes, constraining the capacity to formulate equity-conscious policies aligned with HRQoL frameworks.

RTI statistics provide a critical framework for assessing progress and evaluating the efficacy of interventions designed to mitigate RTIs. Nevertheless, several persistent challenges undermine the availability and reliability of such data, particularly in LMICs. These challenges include infrequent data collection intervals, errors in classifying RTI causes, insufficient granularity in reported data, and considerable delays in data dissemination (World Bank, 2023). It is estimated that around 85% of global RTFs and 90% of the associated disease burden occur in LMICs, however, the absence of comprehensive national data systems results in many country-level estimates being based on regional extrapolations rather than direct surveillance (Godthelp & Ksentini, 2024). This dependency on modelled data undermines the accuracy of burden estimates and limits the ability for evidence-based policy development and resource distribution.

In many SSA countries, RTI data is sourced from a fragmented array of sources, including incomplete vital registration systems, limited demographic surveillance in select populations and hospital-based

reporting. Although these sources offer fragmented insights into injury patterns, they are rarely adequate for generating credible national or regional estimates of cause-specific mortality. Generating such estimations requires considerable analytical capacity and often yields results with high levels of uncertainty (Segui-Gomez et al., 2021).

The Global Status Report on Road Safety emphasises the critical need for standardised data collection methods, especially regarding RTFs, disability outcomes, and non-fatal injuries (WHO, 2023). Underreporting continues to be a widespread concern, and global efforts have increasingly focused on standardising definitions and methodologies to enhance comparability. One key standard entail counting all fatalities that occur within 30 days of an RTA, a practice designed to reduce variation in reporting and improve the reliability of international comparisons. In SSA environments, the implementation of such standards is often hindered by inadequate infrastructure, inconsistent data flows, and poor intersectoral coordination. These challenges highlight the need for integrated, multisectoral data systems that can facilitate more accurate burden estimation and guide responsive, locally customised road safety initiatives.

2.9 Conceptual Framework

The study employed a conceptual framework linking demographic, crash, anatomical and contextual factors to explain trauma severity and post-injury recovery outcomes among young RTA victims in Namibia. The framework is informed by the public health injury prevention model, trauma system theory and the social determinants of health perspective, which collectively recognise that injury outcomes are shaped by interaction between individual characteristics, injury mechanism, health-system response and broader social context.

At the first level, demographic characteristics including age gender and socioeconomic status shape exposure to road traffic accidents and vulnerability to injury. These demographic factors influence not only the likelihood of sustaining injury but also access to resources during recovery, such as employment opportunities, social support and rehabilitation service (Ballout, 2025; Semanision et al., 2024).

The second level of the framework focuses on crash related factors, including road user type, crash mechanism and environmental conditions. In this framework, crash characteristics are conceptualised as proximal determinants of anatomical injury while acting as indicators of broader structural vulnerabilities such as road infrastructure quality, enforcement of road regulations and transport system design (WHO, 2021).

At the third level, anatomical injury severity, operationalised through ISS, reflect the immediate clinical burden of trauma. Anatomical injury severity is considered a necessary but insufficient determinant of long-term outcomes. While higher ISS is associated with increased morbidity and mortality, it does not fully account for functional recovery or HRQoL following injury (Ballout, 2025).

The final level of the framework incorporates contextual and health-system factors, including EMS access, mode of transport to the hospital, geographic location, availability of rehabilitation, and socioeconomic support. These factors modify the relationship between injury severity and recovery by influencing the timeliness of care, continuity of treatment and post-discharge support. In resource-constrained settings such as Namibia, disparities in prehospital care and rehabilitation access are expected to significantly shape long-term outcomes (Yaw et al., 2025).

The framework culminates in HRQoL as the primary outcome, recognising recovery as a multidimensional construct encompassing physical functioning, psychological well-being and social participation. By positioning HRQoL as an endpoint influenced by both clinical severity and contextual vulnerability, the framework moves beyond survival-based models of trauma burden. It provides structure for examining why individuals with similar injury severity may experience markedly different recovery trajectories.

Overall, the conceptual framework clarifies the hypothesised pathway linking RTAs to injury severity and long-term outcome, guides variable selection and analysis, and supports the interpretation of findings within a broader health-system and equity lens. It also underscores the study's emphasis on integrating clinical and social dimensions of trauma to inform more comprehensive and context-responsive trauma care and rehabilitation strategies in Namibia.

2.10 Conclusion

The literature reviewed indicates that RTIs constitute a major public health concern, more so in LMICs such as Namibia and the wider SSA region. Despite global trends indicating a reduction in RTFs, SSA is witnessing an increase in RTA rates, reflecting ongoing disparities in road safety results. This is attributed to rapid urbanisation, increased motorisation and systematic gaps in road safety investment and trauma infrastructure.

A comparative study reveals that while coordinated government initiatives and policy reforms have produced positive outcomes in some contexts, there is no universal consensus on the most effective solution for resource-limited settings. For example, whereas law enforcement and vehicle safety standards are often regarded as critical elements, the literature highlights the role of trauma care

systems and post-crash response. Countries with comprehensive EMS and trauma registries demonstrate better survival rates and long-term outcomes, whereas those with fragmented systems experience higher morbidity and fatalities.

Despite the extensive study, significant gaps remain. There is a scarcity of longitudinal studies examining the long-term HRQoL of RTI survivors in Namibia and SSA, a constraint for the development of targeted rehabilitation programmes. The absence of harmonised data collection and reporting frameworks hinders accurate burden estimation and evidence-based policy formulation. Many studies depend on modelled estimates due to inadequate surveillance, resulting in high levels of uncertainty and limited comparability across regions.

The review also highlights methodological inconsistencies, especially in the assessment of injury severity and outcomes. Although instruments like the ISS are widely used, their limitations, such as the exclusion of physiological information, may result in an underestimation of the burden of polytrauma. Literature highlights the necessity for gender and equity-sensitive approaches as young males and socially disadvantaged populations are disproportionately affected by RTIs and their sequelae.

The findings underscore the critical need for multisectoral strategies that integrate prevention, enforcement and post-crash care. Strategic investment in traffic law enforcement, driver education and emergency response systems is crucial for risk mitigation and improved road safety outcomes. Future research must prioritise longitudinal studies, standardise data and critically evaluate existing interventions to address the most pressing gaps and inform the development of responsive policies.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter outlines the methodology used in the analysis of polytrauma and its long-term impacts on Namibian young people. It outlines a two-phase study strategy that evaluates HRQoL using a descriptive cross-sectional survey and retrospective data from RTA records. The dual-phase approach enables both epidemiological profiling and survivor HRQoL assessment, offering a comprehensive understanding of trauma burden and recovery.

Detailed descriptions are provided of the study population, study setting, sampling strategies, data collection techniques, and methods of analysis. The chapter also outlines reporting guidelines followed, dissemination strategies, study limitations, and ethical considerations. These components collectively enhance the reliability, credibility and contextual relevance of the findings.

3.2 Study Design

This research employed a two-phase design to examine the burden and long-term consequences of polytrauma in individuals aged 5 to 29 years in Namibia between 2019 and 2022. The study used both a retrospective review and a descriptive, cross-sectional survey to analyse trends in RTIs and the health status of survivors. This dual approach was selected to capture both clinical severity and lived experiences, allowing for the combination of quantitative and self-reported data.

The retrospective analysis, Phase 1 of the study, examined RTA records obtained from the MVA Fund of Namibia's data management system. This phase described the prevalence of polytrauma and examined epidemiological profiles and relationships. Polytrauma was defined as an ISS of ≥15, consistent with international trauma classification standards. The inclusion criteria established and implemented during Phase 1 were also applied in Phase 2, ensuring consistency in participant selection and alignment across phases.

The descriptive cross-sectional survey, Phase 2 of the study, collected demographic data and employed the EQ-5D-5L questionnaire (Appendix A) to evaluate HRQoL among polytrauma survivors. This phase provided demographic information and self-reported well-being using the five-tiered dimensions of the EQ-5D-5L questionnaire. The EQ-5D-5L framework is particularly suitable for trauma victims, as it allows for age-appropriate self-reporting and captures individual recovery experiences (Dams et al., 2021).

3.3 Study Setting

Namibia (Figure 1), located in Southern Africa, spans 824,300 km² and has a low density of 3.7 persons per km² (NSA, 2023; Christians, 2020). Its unique geographic and demographic profile influences trauma exposure and healthcare access, with uneven community distribution and socioeconomic disparities presenting challenges for health resource allocation and emergency response (Christians, 2020). Access to timely trauma care in LMICs is a critical determinant of trauma survival, while systemic constraints also affect long-term recovery and HRQoL (Chatukuta et al., 2022; Tansley et al., 2015).

Figure 1: Map of Namibia (https://www.mapsland.com/africa/namibia/large-political-and-administrative-map-of-namibia-with-roads-cities-and-airports)

Namibia has a predominantly young population, with 71.1% of the estimated 3.02 million residents under 35 years (Namibia Statistics Agency, 2023). Young people are disproportionately affected by RTA due to increased mobility and risk-taking behaviour (Tiwari, 2024). This study, therefore, focused on polytrauma among youth aged 5-29 years, using both retrospective clinical data and a cross-sectional survey (EQ-5D-5L) to assess both clinical aspects of injury and HRQoL of survivors. Contextual factors such as injury type, gender, socioeconomic status, and regional disparities, as

well as anatomical injury patterns were considered to provide evidence for more equitable trauma care in Namibia.

Urbanisation has shifted population distribution, with rural residence declining from 57.2% in 2011 to nearly equal rural-urban distribution by 2023 (Namibia Statistics Agency, 2023). This rural-urban migration increased pressure on healthcare systems, transport networks, and housing, resulting in deeper disparities in RTA exposure and emergency care access. Urban centres experience higher traffic volumes and RTAs, contributing to overcrowded emergency departments and increased demand for trauma care (Chatukuta et al., 2021). Meanwhile, rural areas face logistical barriers such as long transport distances and limited ambulance coverage, which delay critical care and worsen patient outcomes (Jones et al., 2020). Regional disparities are evident, with Khomas region accounting for 41.0% of RTAs in 2022, followed by Erongo (11.0%), Oshana (10.0%), Otjozondjupa (8.0%), and Oshikoto (7.0%) (MVA Fund, 2022).

The MVA Fund and the NRSC are central to road safety governance in Namibia. The NRSC, funded through national budget allocations, leads road safety oversight, research, and prevention initiatives. The MVA Fund oversees the post-accident care system, from emergency response to rehabilitation, by maintaining a centralised database for the analysis of injury severity, treatment access, and rehabilitation pathways (MVA Fund, 2025; Shifotoka, 2014).

Between 2019 and 2022, RTA-related medical expenditures increased sharply, with claims reaching N$205.7 million in 2021 (MVA Fund, 2022). These escalating costs highlight the urgency of monitoring HRQoL outcomes and reinforce the rationale for the use of both a retrospective evaluation and a cross-sectional survey in this study.

3.4 Phase 1: Retrospective Review

Building on the foundational aspects of the study design, this section outlines the retrospective review conducted, focusing on polytrauma cases among young RTA victims.

3.4.1 Study Population and Sampling

The retrospective review focused on young RTA victims who sustained polytrauma between 2019 and 2022. The inclusion criteria were individuals aged 5-29 years at the time of the RTA, with documented ISS ≥ 15, whose RTAs occurred between 2019 and 2022 and who had completed the six-month rehabilitation milestone. The study period of 2019 to 2022 was selected primarily due to the availability and completeness of injury data. It is acknowledged that mobility patterns were

significantly disrupted during 2020 and 2021 because of COVID-19 restrictions. Accordingly, the findings are contextualised against the broader pandemic-related shifts in mobility.

Eligible cases were drawn from all 14 regions of Namibia and included clinical records captured from the date of the accident up to one-month post-injury. The timeframe aligns with international trauma assessment standards and ensures consistency in evaluating acute care and early rehabilitation outcomes.

All participants received medical care coordinated and tracked through the MVA Fund's case management system, which includes standardised procedures such as hospital visits, rehabilitation planning, and progress monitoring. This uniform process ensured consistency in the care delivery and outcome tracking, thereby enhancing the integrity and comparability of the retrospective data (MVA Fund, 2023).

The rehabilitation period was calculated from the date of the RTA, in accordance with the MVA Fund's goal attainment framework, which monitors recovery based on functional restoration. The primary aim of rehabilitation is to support survivors in regaining their pre-accident level of function, whether through returning to work, resuming education or reintegrating into their communities. This approach acknowledges that recovery extends beyond physical healing; it encompasses restoration of independence, dignity, and the ability to participate meaningfully in everyday life (MVA Fund, 2023).

Records were excluded if they contained insufficient data, comorbidity information or presented confounding factors that compromised data validity. A total population sampling method was employed to include all individuals meeting these criteria. The method was selected due to the relatively small and well-defined target population, which allowed for comprehensive coverage while minimising biases often associated with convenience or random sampling. By incorporating all eligible individuals, the statistical power of the study was enhanced, ensuring a robust representation of the trauma population under review (Memon et al., 2025; Rahman et al., 2022).

3.4.2 Data Collection and Quality

Data were obtained from the MVA Fund's case management database, including Google spreadsheets and Siebel records. Data extraction was conducted in collaboration with the Fund's in-house statistician to ensure alignment with the study's defined population criteria. The researcher, an employee of the MVA Fund, critically assessed the completeness and quality of the extracted data.

To promote clarity and consistency, the study began with the identification and definition of key variables (Appendix B). A glossary supported these definitions, ensuring uniform understanding among the researcher and the in-house statistician who contributed to data acquisition and preliminary coding. The statistician's role included ensuring data completeness and accuracy, while final analysis, interpretation and conclusion rested with the researcher. This glossary informed the basis for a standardised data extraction format, which helped organise information systematically, reduce errors, and maintain uniformity across cases. The systematic and structured approach made data interpretation easier and ensured a smooth transition into analysis.

Records with missing essential variables, such as age, gender, ISS, injury region, or rehabilitation milestone, were excluded from the final sample to preserve analytical validity. Since the data was sourced electronically, the risk of input and transcription errors was minimal. This streamlined evaluation process reduced the need for extensive data checks, which created a more reliable foundation for the retrospective review. Information was already organised in a way that supported consistent analysis across cases.

Records were considered valid if they included key identifiers such as the case serial number, age, sex, crash details, and injury profile. The case serial number was a system-generated number unique to each individual, which supported anonymisation. Data extraction focused on cases involving polytrauma, defined as ISS ≥ 15, which were then grouped by the year the RTA occurred. Before analysis, the overall population size was reviewed to ensure it was complete and large enough to support meaningful statistical interpretation.

To protect participant confidentiality, all identifiable information, such as names and physical addresses, was excluded during data extraction. Each case was tracked using the system-generated serial number, which also reflected the region where the accident occurred. This maintained a consistent classification system while safeguarding privacy throughout the review process.

3.4.3 Data Management

A structured, centralised approach to data management was used throughout the study to uphold data integrity and scientific rigour. The researcher maintained exclusive oversight of the entire data lifecycle, from extraction to analysis, ensuring consistency, confidentiality and methodological soundness. Digital data was securely stored with access restricted to authorised personnel. Following data entry and verification, original records were archived in accordance with institutional record management protocols, ensuring compliance and traceability.

To reduce security risks, all data was stored securely on a dedicated laptop, and access was strictly controlled to prevent unauthorised use. For verification purposes, the dataset was also shared with the study supervisors and the in-house statistician, allowing them to review the data and confirm its accuracy.

3.4.4 Data Analysis

Data for the retrospective review were obtained from the MVA Fund case management database. Data were extracted and initially processed in Microsoft Excel for organisation and cleaning (Godino, 2023). Statistical analysis was done with the assistance of the MVA Fund in-house statistician, who ensured accurate handling of clinical variables and analytical methods. Quantitative analyses were performed using IBM SPSS Statistics for Windows (Version 28) (Rahman & Muktadir, 2021), enabling efficient data management and facilitating both descriptive and inferential statistical procedures. The variables list for the retrospective review provided a structural framework to guide the organisation and management of variables within SPSS (Appendix C).

The data analysis was structured to address the study objectives, which included determining the prevalence of polytrauma (ISS ≥ 15), reviewing demographic and epidemiological characteristics, and comparing these factors among individuals aged 5–29 years involved in RTAs in Namibia from 2019 to 2022.

The burden of polytrauma was quantified by assessing the overall and year-specific prevalence of ISS ≥ 15, with 95% Confidence Intervals (CIs). Descriptive statistics were also used to summarise demographic and injury-related trends through frequency distributions (absolute and relative frequencies), means, medians, Standard Deviations (SDs), and Interquartile Ranges (IQRs). Significance thresholds were set at $\alpha = 0.05$ for all inferential tests.

Inferential statistics, including cross-tabulation and contingency tables, were used to identify significant correlations among transportation methods, injury severity, and demographic factors. The incidence of polytrauma was analysed over the past four years and across geographic locations, revealing epidemiological trends that provide predictive insights for policy formulation and healthcare interventions. The ISS predictors were assessed using the Generalised Linear Model (GLM), while the assessment of model fit included deviation, Pearson chi-square, and information criteria, Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC).

A multivariate regression analysis was performed to evaluate predictors of trauma severity, with collinearity diagnostics confirming model stability. The study used tables to present trends in gender

disparities, injury severity levels, and modes of transportation. The integration of percentiles and quantile distributions enhanced the statistical rigour of the investigation.

3.5 Phase 2: Cross-sectional Survey - HRQoL Questionnaire

Building on the retrospective analysis of polytrauma RTA cases, this phase shifted focus to understanding the HRQoL of the same cohort through a structured cross-sectional survey.

3.5.1 Study Population and Sampling

The descriptive cross-sectional survey phase of the study targeted the same cohort identified in the retrospective review, i.e., RTA survivors aged 5–29 years at the time of the injury with ISS ≥15 who had completed their six-month rehabilitation milestone and whose RTAs occurred between 2019 and 2022. Due to the time lapse between the injury and the administration of the survey, some participants were aged 30-31 years at the time the survey data was collected. These individuals were retained in the survey sample based on their age at the time of injury to ensure consistency and completeness of the original cohort for Phase 1.

Individuals unable to provide consent due to cognitive impairment or legal restriction were excluded from direct participation. However, in cases where participants were legally incapacitated but had a recognised guardian or carer, proxy consent was used in line with the Namibian National Research Ethics Guidelines (UNAM, 2019). This ensured ethical inclusion of minors and vulnerable individuals while maintaining data quality. A convenience sampling approach was used to collect the HRQoL data. This method was selected due to logistical constraints and the dispersed nature of the survivor population. Although this approach was not random, it facilitated timely data collection and maintained focus on the study's primary objectives. The researcher is cognisant that convenience sampling and telephonic recruitment raise the possibility of selection bias, and this is duly discussed in the study limitations.

3.5.2 Data Collection and Quality

To assess the HRQoL among polytrauma RTA cases, the EuroQol EQ-5D-5L instrument (Appendix A) was selected and administered telephonically. This widely used questionnaire is recognised for its reliability, sensitivity to health changes, and broad international relevance across different clinical and demographic settings (Verstraete et al., 2020).

The instrument comprises two components. Firstly, the EQ-5D-5L health profile evaluates five dimensions of well-being: mobility, self-care, usual activities, pain/discomfort, and

anxiety/depression. Each dimension is rated on a five-point scale, ranging from “no problems” to “extreme problems” or “unable to perform.” The second part of the instrument, the EuroQol Visual Analogue Scale (EQ-VAS), allowed participants to rate their overall health on a scale from 0, worst imaginable health, to 100, best imaginable health, offering a snapshot of an individual’s perceived well-being. The Variable Abstraction Format for EQ-5D-5L Data Collection is included for further reference (Appendix D).

The five-level version (5L) provides more detailed reporting than its earlier three-level version (3L), making it especially useful for capturing subtle differences in recovery (EuroQol Research Foundation, 2019). Both self-report and proxy formats were used, making them suitable for participants with a diverse range of ages and cognitive abilities.

Data collection was undertaken between April and July 2025, with telephonic interviews scheduled daily between 14h00 and 19h00. The interviewers were selected based on their abilities to communicate the three most used languages in Namibia: English, Afrikaans and Oshiwambo. This multilingual capacity ensured that participants could raise questions or concerns in a language they were most comfortable with, thereby enhancing comprehension. Informed consent (Appendix E) was obtained before participation, and for minors, parental or guardian proxy consent was secured in accordance with ethical standards.

Three trained interviewers who administered the EQ-5D-5L questionnaire underwent a structured induction programme, which included a theoretical introduction to the EQ-5D-5L instrument and standardised interview protocols. These protocols included strict adherence to scripted wording, clear guidance on participant identification, and ensuring that only one option per dimension was selected. The programme also included realistic mock interview simulations.

The instrument was administered according to age at the time of the survey, and participants aged 12-31 completed the standard version of the EQ-5D-5L, while those aged 5-11 completed the instrument via proxy interview conducted with parents or guardians.

Each participant received a numeric identifier, recorded across all data collection instruments, namely the consent form, questionnaire, and demographic data collection form, to ensure linkage during data entry. The questionnaire data were captured in Microsoft Excel, with quality control procedures implemented during the data entry process, including real-time validation and systematic double-checking to ensure consistency, completeness, and accuracy across records.

These steps supported data integrity and reproducibility, strengthening the validity of analytical outcomes.

3.5.3 Data Management

Each participant was assigned a unique numerical identifier, consistently recorded across all data collection instruments, including consent forms, questionnaires, and demographic data sheets. This facilitated accurate linkage of records while preserving anonymity.

Data entry and management were conducted using Microsoft Excel with real-time validation and systematic double-checking protocols implemented to ensure completeness and accuracy. Quality control procedures were embedded throughout the process to minimise errors and enhance reproducibility. Paper-based survey instruments were securely stored and archived according to institutional protocols of the MVA Fund.

This integrated approach ensured that data were handled ethically and efficiently, supporting the reliability of findings and reinforcing the study's commitment to transparency, confidentiality and scientific excellence.

3.5.4 Data Analysis

The analysis aimed to quantify HRQoL outcomes and identify patterns across demographic and clinical variables. The statistical analysis was conducted with the assistance of the MVA Fund in-house statistician to ensure the appropriate selection and application of analytical methods. The EQ-5D-5L questionnaire responses were manually entered into a Microsoft Excel spreadsheet and verified for accuracy. The dataset was then cleaned and coded to support statistical analysis. The analysis of the descriptive cross-sectional survey data was conducted using descriptive and frequency-based statistical approaches to assess demographic features and HRQoL within the study sample.

Once validated, the data set was imported to IBM SPSS Statistics for Windows (Version 28) for statistical analysis. The EQ-5D-5L responses were encoded into five-digit profiles, each representing severity levels across five health dimensions (Appendix D). Summary statistics were calculated for each dimension, capturing the distribution of severity levels among participants. EQ VAS scores, ranging from 0 to 100, were analysed to reflect individuals' perceptions of overall health and symptom burdens. Skewness and kurtosis coefficients were used to assess distributional properties.

Categorical variables, such as gender, marital status, region, and employment status, were summarised using frequency distributions and percentages. Continuous variables, including the EQ-VAS, measures of central tendency (mean, median, and mode), and dispersion (range, variance, IQR and SD), were reported to capture individual health perception and symptom burden.

To further quantify functional health status, the Level Frequency Score (LFS) was computed as a weighted aggregate of the five EQ-5D-5L. The LFS was calculated by summing the numeric scores across all five dimensions, yielding a range from 5, no problems, to 25, severe problems across all domains, offering a practical summary of overall impairment. A Pearson correlation was conducted to examine the relationship between LFS and EQ-VAS scores. This analysis tested the hypothesis that greater functional limitation is associated with lower self-rated health.

The distributional patterns of EQ-VAS were analysed using skewness coefficients and standard errors of skewness to determine the extent and direction of data asymmetry. Cross-tabulation analysis was used to examine gender disparities across the five EQ-5D-5L dimensions. This facilitated comparative analysis of HRQoL results and the identification of gender-specific recovery trends. Visual tools, such as frequency tables and bar charts, were used to present trends and support results.

Multiple linear regression was performed to assess predictors of self-reported health among polytrauma survivors. Independent variables included ISS, age, and person class (role in RTA). This approach aimed to evaluate whether clinical or demographic factors were significant determinants of perceived health status post-injury. Model diagnostics included R^2, adjusted R^2, p-value and collinearity statistics (VIF and tolerance) to ensure interpretability and robustness.

Visual tools such as frequency tables and bar charts were used to present key findings, enhancing interpretability and supporting conclusions. The analytical framework provided a foundation for understanding HRQoL outcomes and informing rehabilitation strategies for young trauma survivors in Namibia.

3.6 Ethical Considerations

Before data collection, ethical approval was obtained from the Namibia University of Science and Technology (NUST) Ethics Committee (Appendix F), and permission to conduct research was granted by the MVA Fund of Namibia to ensure compliance with ethical norms for research involving human subjects. All research activities adhered to institutional protocols, prioritising the protection of sensitive information and ensuring participant autonomy throughout the study.

Phase 1 of the study involved the retrospective gathering of clinical and epidemiological data from institutional databases. In line with ethical standards and institutional guidelines, individual informed consent was waived, as the data were pre-existing and collected without direct interaction with the participants. However, strict safeguards were implemented to preserve participant autonomy and confidentiality. All data were anonymised before extraction and analysis, with any personal information such as names and identification numbers removed to ensure confidentiality and non-traceability throughout the research. Access to research data was restricted to the researcher, supervisors, and statisticians. Despite its retrospective nature, the study maintained strict standards for privacy and data protection, recognising that anonymity and confidentiality were vital for safeguarding the participants' dignity and trust.

For Phase 2, participants received comprehensive information regarding the study objectives, methodology, potential risks and benefits, and data management policies. Informed consent (Appendix E) was obtained using a systematic procedure that emphasised voluntary participation and the right to withdraw at any time without consequences. To ensure confidentiality, all participant data was anonymised during the coding process using numeric participant identifiers, eliminating the retention of any personally identifiable data. The data was securely maintained in password-protected files, with access limited exclusively to authorised research personnel. All ethical procedures adhered to the Declaration of Helsinki and Namibian National Research Ethics Guidelines (Namibia University of Science and Technology, 2023; World Medical Association (WMA), 2013).

Participant selection for Phase 2 was guided by the availability of eligible polytrauma survivors and their willingness to provide informed consent. Although it was not based on random sampling, the recruitment process aimed to minimise selection bias by engaging participants across diverse settings and ensuring fair representation in the target age group. This approach, grounded in both ethical and logistical considerations, enabled the inclusion of individuals who met the study criteria and were accessible during the data collection period.

To ensure methodological soundness and ethical integrity, several safeguards were incorporated into the study design. Standardised tools, including the EQ-5D-5L questionnaire (Appendix A) and a demographic sheet, were selected for their reliability, consistency, and cultural relevance. Interviewers were trained to approach each participant with sensitivity, especially when engaging individuals who had experienced trauma. In cases involving minors or emotionally vulnerable participants, proxy interviews were used to reduce distress and uphold dignity.

Data collection followed a strict protocol; responses were manually entered and subsequently validated using Microsoft Excel and SPSS to ensure accuracy and integrity. Each participant received a numerical identifier to maintain anonymity, and all data were stored in password-protected folders accessible only to approved research personnel. These ethical measures fostered trust, accountability, and respect for each individual whose experience contributed to the research.

3.7 Methodological Limitations

This study, conducted in two phases, had unique constraints caused by several factors. Phase 1 used pre-existing records obtained from the MVA Fund's case management system (Siebel) and supplementary Google Spreadsheets. While these databases provided an organised framework for identifying eligible individuals, the quality and consistency of their entries varied. Incomplete variables, insufficient data entry, and inconsistent coding procedures required additional manual verification and quality checks. Despite improvements in electronic retrieval, system limitations can affect data integrity and completeness. These constraints may have impacted the accuracy of prevalence estimations and the comprehensiveness of the epidemiological analysis.

Phase 2 required updated contact details for eligible participants; however, some individuals had moved or changed their phone numbers over time, affecting interviews. Recruitment relied on participant availability and consent, potentially introducing selection bias. Individuals who were unreachable or opted out of participation may differ significantly from those included, potentially creating bias in the findings towards those with higher accessibility or a greater willingness to participate.

Telephone interviews were used to increase reach; however, they restricted interpersonal connection and the emotional depth typically afforded by in-person conversations. Several participants expressed hesitation to participate in the survey, citing concerns about phone-based scams and financial theft. These issues may have influenced participation rates and trust, highlighting the necessity of clear communication and ethical transparency. The use of convenience sampling and telephonic recruitment may have introduced selection bias. Participants with stable contact details and better recovery trajectories may have been more likely to be included, potentially limiting the generalisability of findings to more vulnerable populations. The study also relied on self-reported HRQoL data, which included possible recall bias, particularly among people who experienced significant anxiety. The time elapsed since the RTA and the psychological impact of rehabilitation may have affected how participants recalled and articulated their health condition. For individuals under the age of 12, proxy interviews were administered with parents or guardians.

Although valuable, these responses reflected observed behaviours rather than personal experiences, which added to their subjectivity.

The generalisation of the findings across both phases was limited by the study's eligibility criteria, which focused mainly on MVA Fund clients who reached the six-month post-injury recovery milestone. This excluded individuals with similar trauma profiles who were not enrolled in the MVA Fund, thereby limiting the applicability of findings to all RTA survivors.

The exclusion of cases due to inadequate data and the nonparticipation of nonconsenting individuals in the HRQoL survey restricted the generalisability of our findings. Excluded individuals differed substantially from those included, e.g., in rural residency, financial position, or injury severity, meaning the findings would not fully reflect the underlying burden and recovery patterns among all polytrauma survivors.

Expanding participation criteria to include non-MVA Fund trauma survivors would improve representativeness. Diversifying data collection methods, such as combining formal face-to-face assessments with telephone interviews, may enhance response quality and participant engagement. Standardising database operations and enhancing verification protocols would further improve data accuracy and consistency.

Despite strong data security measures, such as anonymisation, password-protected storage, and limited access, the electronic nature of data management involves inherent risks, such as system failures or unauthorised breaches. While the researcher mitigated these risks, it was crucial to acknowledge their significance.

Although random sampling was not feasible, methodological clarity was maintained using structured interview protocols and validated instruments. The EQ-5D-5L questionnaire provided a standard approach to capturing HRQoL, and ethical safeguards, including informed consent and confidential data handling, reinforced the integrity of participant engagement. These initiatives demonstrate attention to transparency and the ethical use of data in trauma research.

3.8 Reporting Guidelines

To ensure methodological rigour and enhance transparency, the study adhered to internationally recognised reporting guidelines, STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) (von Elm et al., 2007) and RECORD (Reporting of Studies Conducted using Observational Routinely Collected Health Data) (Benchimol et al., 2015). It is important to note that these guidelines are primarily designed for the publication of research in peer-reviewed journals

rather than thesis writing per se. However, they were adopted here as a framework to guide the structure and reporting of this thesis, with particular focus on the methods, results, and discussion sections of the respective checklists, ensuring that the presentation of the findings met high standards of clarity, completeness, and reproducibility.

By integrating the STROBE (Appendix G) and RECORD (Appendix H) standards, the study maintained methodological integrity and facilitated comparability with other observational health research. This approach also supports reproducibility and strengthens the credibility of the findings. The adoption of these standards underscored a commitment to ethical integrity and the generation of evidence that could inform future rehabilitation policies and health interventions tailored to trauma-affected populations.

3.9 Research Dissemination

Disseminating the study findings is a crucial step in translating research into meaningful action. The study recognised the public health significance of trauma and HRQoL outcomes in Namibia and aimed to inform a wide range of stakeholders, including policymakers, rehabilitation service providers, and affected communities.

A multi-layered dissemination strategy will be implemented to ensure that the findings are both accessible and relevant. Academic distribution can be achieved by submitting publications to peer-reviewed journals focused on trauma recovery, rehabilitation, and health equity. In adherence to NUST requirements, the completed thesis will be archived in the institutional repository, making it available for academic reference. Where appropriate, digital platforms will be used to improve information exchange and enhance visibility.

The results will be shared with the MVA Fund and relevant ministries at the institutional level to promote evidence-based decision-making and enhance trauma recovery efforts. This dissemination approach reflects a dedication to transparency, ethical accountability, and inclusive participation, ensuring that the perspectives and experiences reported in the study inform the development of more responsive and equitable health systems.

3.10 Summary

This chapter provided an overview of the study's methodological approach, including its rationale, study design and setting, data sampling, and collecting and analysing strategies. It also addressed ethical considerations, study limitations, the adoption of internationally recognised reporting standards, and plans for disseminating findings. The study design combined retrospective data

analysis and cross-sectional survey methods to generate relevant evidence on HRQoL among young polytrauma survivors in Namibia.

The focus was on maintaining data integrity, upholding ethical standards, and ensuring transparency through adherence to established reporting guidelines. While acknowledging limitations, the selected methodology established a foundation for the analysis and interpretation of results, ultimately aiming to inform improvements in trauma care and rehabilitation policies.

CHAPTER 4: RESULTS

4.1 Introduction

This chapter presents the findings of the retrospective review and descriptive cross-sectional survey, providing a comprehensive understanding of injury severity and self-reported HRQoL among RTA victims aged 5 to 29 years in Namibia over four years.

The retrospective review (Phase 1) involved analysing clinical records and demographic data for 150 polytrauma RTA cases that met the inclusion criteria. These records include demographic information, injury patterns, and ISS (≥15), enabling assessment of injuries and the distribution of demographic characteristics across the sample.

The survey (Phase 2) captured self-reported HRQoL data from 90 of the 150 polytrauma RTA survivors who consented to complete the EQ-5D-5L questionnaire and demographic form. Figure 2 displays the STROBE flow diagram of study participation**.** The results are organised to reflect the study's core objectives.

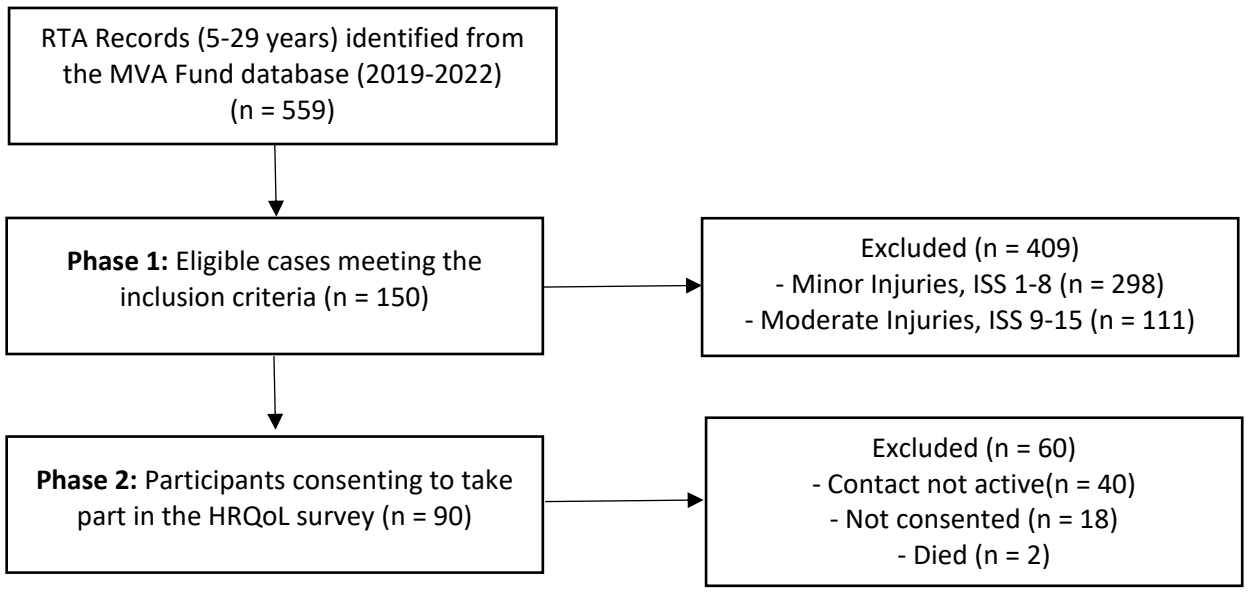

Figure 2: Strobe Flow Diagram of Study Participant (Phases 1 and 2)

4.2 Retrospective Review

4.2.1 Prevalence of Polytrauma

Between 2019 and 2022, a total of 559 RTA victims aged 5 to 29 years were identified through the MVA Fund database, all of whom had received treatment and had an established rehabilitation plan. Of these, 150 cases were classified with polytrauma, defined as an ISS of ≥15, and thus eligible for inclusion in the study (Phase 1).

Of the 150 polytrauma victims, 44 (29.3%) each were involved in an RTA in 2019 and 2020, with 38 (25.3%) in 2021 and 24 (16.0%) in 2022 **(Table 1)**. The overall prevalence of polytrauma for the four years was 26.0% (150/559, 95% CI 23.2% - 30.5%). Year-specific polytrauma prevalence was 28.2% (44/156, 95% CI 21.7% - 35.7%) for 2019; 32.6% (44/135, 95% CI 25.3% - 40.9%) for 2020; 35.8% (38/106, 95% CI 26.6% - 45.0%) for 2021, and 14.8% (24/162, 95% CI 9.4% - 20.2%) for 2022 **(Figure 3).**

4.2.2 Demographic and RTA Characteristics of Polytrauma Victims

Of the included polytrauma RTA victims, the majority were male (n=94, 62.7%), yielding a male-to-female ratio of 1.27:1 **(Table 1)**. The mean age was 22.95 years (SD ±5.99), with a median of 25 years (IQR 21-28). About 80.0% (n=121, 80.7%) of the sample were between 20 and 29 years of age, with about half in the 25–29-year age group (n=77, 51.3%) and 29.4% (n=44) in the age group 20 to 24 years. Regionally, Khomas (n=34, 22.7%) and Otjozondjupa (n=32, 21.3%) contributed the highest proportion of victims, followed by Hardap (n=16, 10.7%) and Erongo (n=15, 10.0%).

Table 1: Demographic Characteristics of Polytrauma Victims between 5 and 29 years (n=150)

Demographic Characteristics	n (%)
Gender	
Female	56 (37.3)
Male	94 (62.7)
Accident Year	
2019	44 (29.3)
2020	44 (29.3)
2021	38 (25.3)
2022	24 (16.0)
Age Group	
05-09 years	9 (6.0)
10-14 years	9 (6.0)
15-19 years	11 (7.3)
20-24 years	44 (29.4)
25-29 years	77 (51.3)
Region	
Erongo	15 (10.0)
Hardap	16 (10.7)
Karas	12 (8.0)
Kavango East	6 (4.0)
Kavango West	3 (2.0)
Khomas	34 (22.7)
Kunene	4 (2.7)

Ohangwena	2 (1.3)
Omaheke	8 (5.3)
Omusati	3 (2.0)
Oshana	7 (4.7)
Oshikoto	8 (5.3)
Otjozondjupa	32 (21.3)
Total	**150 (100)**

The monthly case count varied across the study period. In 2019, the highest number of polytrauma cases occurred in June (n=8/44, 18.2%); in 2020, in December (n=8/44, 18.2%); in 2021, in April (n=7/38, 18.4%); and in 2022, in November (n=4/24, 16.7%) **(Figure 4).**

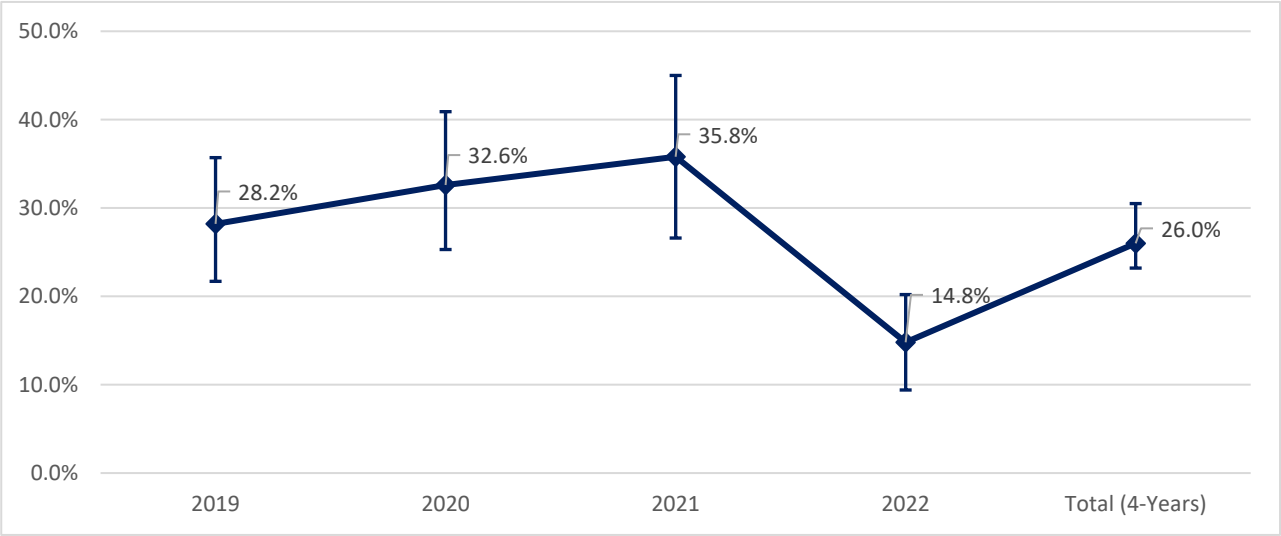

Figure 3: Year-Specific and Overall Prevalence of Polytrauma (95% CI)

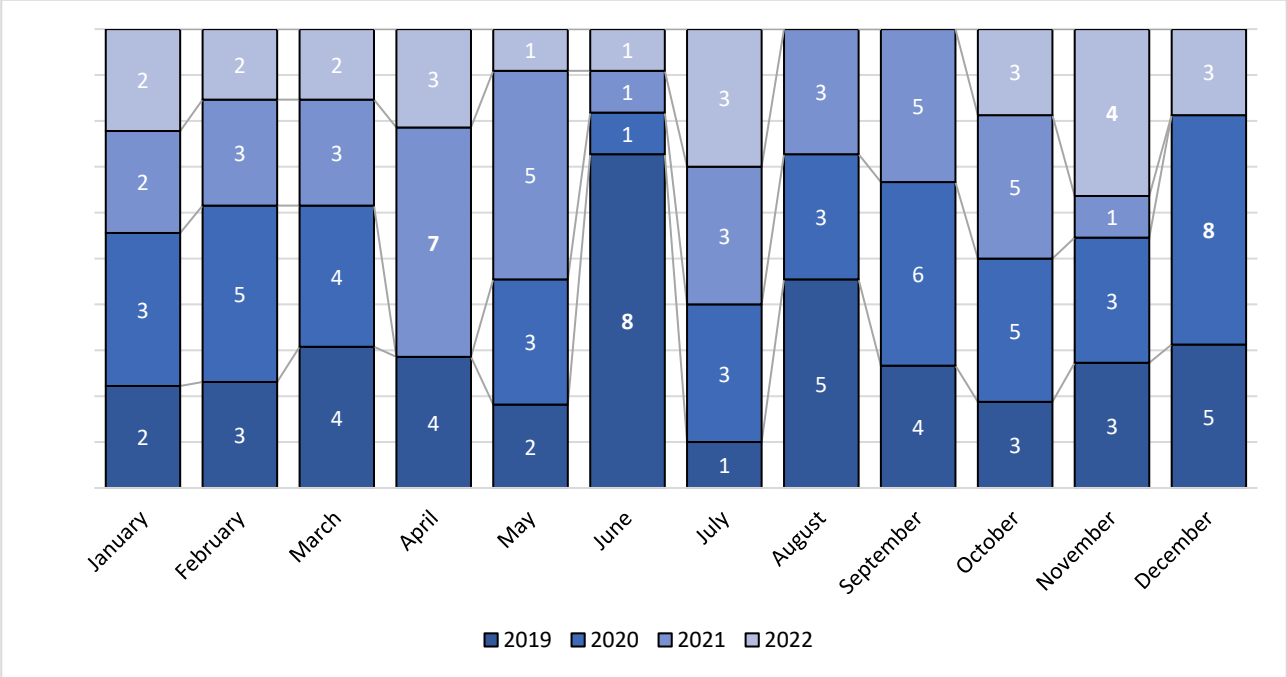

Figure 4: Distribution of Polytrauma Victims per Month of the Year

Most victims were passengers (n=98, 65.3%), followed by pedestrians (n=35, 23.3%). Rollovers were the most prevalent crash type (42.0%), followed by collisions (n=38, 25.3%) and Pedestrian Vehicle Accidents (PVA) (n=35, 23.3%). The leading cause of RTAs was categorised as "other/unspecified" (n=69, 46.0%), followed by driver-related behaviours (n=36, 24.0%), which included speeding, unlicensed driving, and reckless overtaking **(Table 2)**.

Table 2: RTA Characteristics of Polytrauma Victims between 5 and 29 years (n=150)

RTA Characteristics	n (%)
Road User Type	
Passenger	98 (65.3)
Pedestrian	35 (23.3)
Driver	14 (9.3)
Motorcyclist	2 (1.3)
Other	1 (0.7)
Crash Type	
Collisions with another vehicle	38 (25.3)
Fell/Jumped from a moving vehicle	5 (3.3)
Pedestrian Vehicle Accident (PVA)	35 (23.3)
Rollovers	63 (42.0)
With fixed objects	8 (5.3)
Other/Unknown	1 (0.7)
Mode of Transportation to Hospital	
Ambulance	113 (75.3%)
Private Vehicle	29 (19.3)
Police	7 (4.7)
Unknown	1 (0.7)
Crash Cause	
Driver-related behaviour (Unlicensed, speeding/reckless/overtaking)	36 (24.0)
Mechanical Failure	18 (12.0)
Environmental Factors (Poor roads, Weather conditions)	6 (4.0)
Pedestrian-Related	6 (4.0)
Under Investigation/Unknown	15 (10.0)
Unknown	9 (6.0)
Other/Unspecified	69 (46.0)
Total	**150 (100)**

About three-quarters of patients (n=113, 75.3%) were transported by ambulance services, while about 20.0% (n=29, 19.3%) arrived at healthcare facilities via private vehicles and 4.7% (n=7) via police. Ambulance transportation was provided by private ambulance (n=50, 33.3%), state ambulance (n=57, 38.0%) and MVA Fund (n=6, 4.0%). In the Otjozondjupa region, all 22 (14.6%)

patients were transported by ambulance, including private, state and MVA fund ambulances. Khomas showed a high utilisation of private ambulances (n=25, 16.7%) followed by MVA Fund (n=6, 4.0%), with 2 (1.3%) patients transported by private vehicle. The following regions had ≥ 50% of polytrauma RTA patients transported by private vehicle: Oshana (6/7, 85.7%), Kavango East (4/6, 66.7%), Omusati (2/3, 66.7%) and Oshikoto (4/8, 50.0%), and Kunene (2/4, 50.0%) **(Figure 5).**

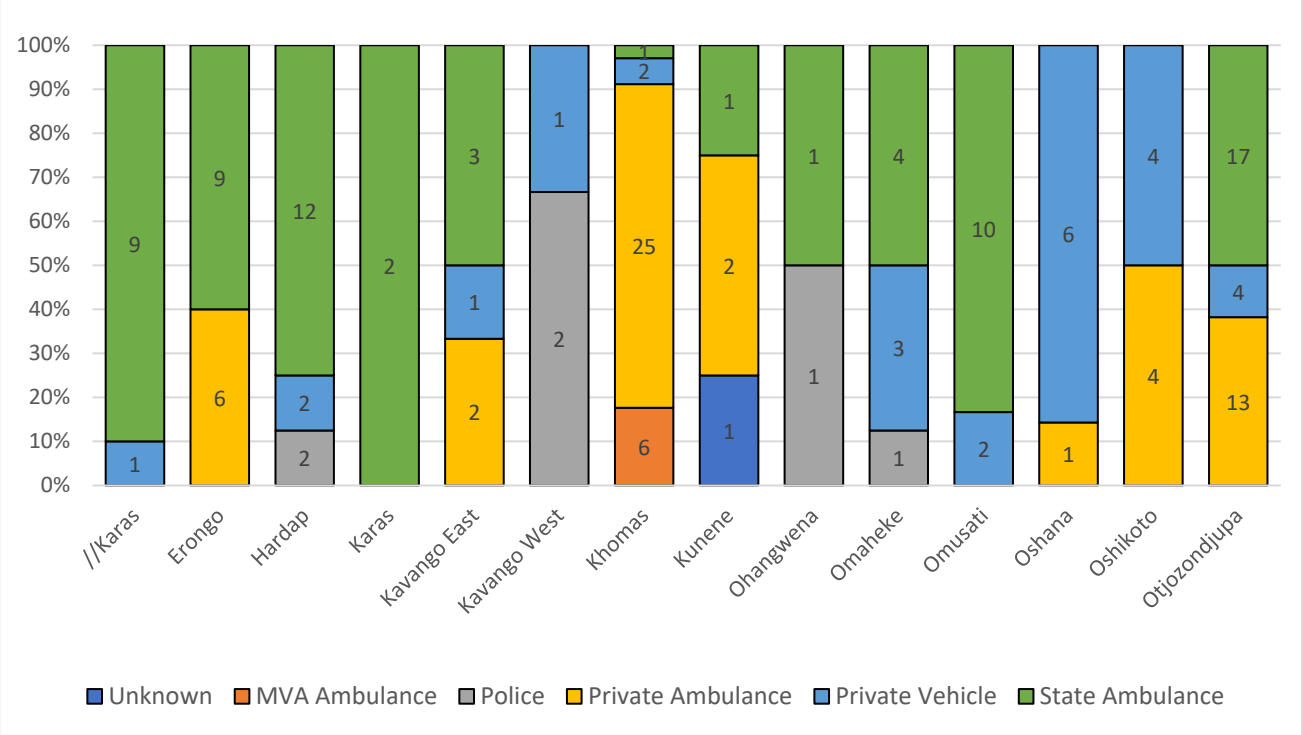

Figure 5: Mode of Transport across Regions

4.2.3 Injury Severity of Polytrauma RTA Victims

The ISS of the 150 polytrauma victims ranged between 16 and 121 **(Table 3)**. The mean ISS was 33 (SD ±22.97, 95% CI 29.3- 36.7), and the median ISS was 25 (IQR 16-36). The distribution was skewed towards lower severity scores (skewness = 1.837).

The most common ISS score was 16, representing 39.3% (n=59), followed by 25 (n=34, 22.7%) and 36 (n=23, 15.3%). These three scores collectively represented 77.3% (n=116) of the study sample. Seventy-two (48.0%) cases fell in the category, severe (ISS 25-50), while 19 (12.7%) fell in the category, critical (ISS > 50).

Table 3: Injury Severity Scores (≥15)

Injury Severity Score (ISS)	n (%)
16	59 (39.3)
25	34 (22.7)
36	23 (15.3)
49	15 (10.0)

64	6 (4.0)
81	7 (4.7)
100	4 (2.7)
121	2 (1.3)
Total	**150 (100.0)**

Footnote: *ISS of with scores categorised as follows: minor (ISS 1–8), moderate (ISS 9–15), severe (ISS 16–24), very severe (ISS 25–50), and critical (ISS >50) (Association for the Advancement of Automotive Medicine [AAAM], 2023).*

Analysis of injury patterns revealed that the most affected anatomical regions were the head/neck (n=89, 59.3%) and extremities (n=94, 62.7%). Head/neck injuries were mainly classified as moderate (n=31/89, 34.8%) and serious (n=36/89, 40.5%), while extremities were predominantly moderate (n=77/94, 81.9%) injuries, reflecting frequent musculoskeletal injuries. **Figure 6** illustrates a heat plot of the distribution of injury patterns. None of the anatomical regions sustained critical or unsurvivable injuries.

	Minor, % (n)	Moderate, % (n)	Serious, % (n)	Severe, % (n)
Head/Neck	6.7% (6)	34.8% (31)	40.5% (36)	18.0% (16)
Face	28.6% (12)	54.8% (23)	16.6% (7)	0.0% (0)
Thorax	10.9% (8)	52.1% (38)	27.4% (20)	9.6% (7)
Abdomen	0.0% (0)	48.9% (23)	38.3% (18)	12.8% (6)
Extremities	12.8% (12)	81.9% (77)	5.3% (5)	0.0% (0)
External	63.2% (12)	36.8% (7)	0.0% (0)	0.0% (0)

Footnotes: *The Abbreviated Injury Scale (AIS) classifies injuries by body region on a scale from 1 to 6: 1 = minor, 2 = moderate, 3 = serious, 4 = severe, 5 = critical, and 6 = unsurvivable. Squaring the highest AIS scores from the three most severely injured body regions and summing them yields the Injury Severity Score (ISS).*

The colour gradient represents the percentage distribution of injury severity per body region, ranging from green (0%) to red (100%), with increasing intensity indicating greater proportions within each severity category.

Figure 6: Distribution of Injury Severity by Anatomical Region (Heat plot)

4.2.4 Predictors of Injury Severity

GLMs were used to analyse ISS in the study population. The selected model predictors were gender, crash type, crash cause, road user type, and region. The analysis employed a gamma distribution with a log link function due to the skewed distribution of ISS **(Table 4)**.

The goodness-of-fit statistics indicated that the model adequately represented the data. Both the Pearson chi-square and deviance ratios were significantly below 1, indicating minimal residual variation. Parameter estimates indicated that road user type is a significant predictor of ISS (Wald $\chi^2(1) = 4.62$, $p = 0.032$), with motorcyclists and pedestrians sustaining higher ISS than passengers. Crash type likewise significantly predicted ISS (Wald$\chi^2(1) = 9.54$, $p=0.002$), with rollovers resulting in higher ISS values than normal vehicle-to-vehicle collisions. Gender and region did not predict ISS

(p>0.05). Given that regional disparities may affect trauma outcomes, future research may benefit from stratified or interaction-based analysis.

Table 4: Predictors of Injury Severity

Predictor	B	SE	Wald χ^2	Df	p	Exp(B)
Intercept	3.21	0.452	50.45	1	< 0.001	24.83
Region (Urban vs Rural)	0.087	0.123	0.5	1	0.478	1.09
Road User Type (Pedestrian)	0.312	0.145	4.62	1	0.032	1.37
Road User Type (Driver)	0.198	0.162	1.5	1	0.221	1.22
Crash Type (Rollover)	0.426	0.138	9.54	1	0.002	1.53
Crash Type (PVA)	0.289	0.151	3.67	1	0.055	1.34
Crash Cause (Driver-related)	0.174	0.129	1.81	1	0.178	1.19
Gender (Male)	0.063	0.117	0.29	1	0.591	1.07

Footnote: *Reference categories: Region = Rural, Road user Type = Passenger, Crash Type = Collision, Crash Cause = Other/Unspecified, Gender = Female. Exp(B) represents the multiplicative effect on ISS. Significant predictors (p < 0.05) are bolded in the interpretation.*

4.2.5 Multivariate Linear Regression Analysis of ISS Predictors

A multivariate linear regression analysis identified significant predictors of ISS across anatomical injury regions and selected demographic variables **(Table 5).** The overall model demonstrated statistical significance, with several anatomical regions emerging as predictors of trauma severity.

Head/neck injuries exhibited the strongest standardised effect (β=0.843) with the ISS, with a significant association (95%CI 0.72-0.96, p<0.001). Thoracic injuries (β=0.758, p<0.001) and abdominal injuries (β=0.724, p<0.001) also showed substantial standardised effects. Facial β=0.533, p<0.001), extremity (β=0.569, p<0.001), and external region injuries (β=0.270, p<0.001) demonstrated significant associations with ISS, though with comparatively lower standardised coefficients. The results indicate that head/neck, thorax, and abdomen injuries are the strongest predictors of overall ISS. Face, limbs, and external injuries also contribute, yet their influence is comparatively lower.

Table 5: Multivariate Linear Regression Analysis of ISS Predictors

Model	Unstandardized Coefficients - B	Std. Error	Standardized Coefficients - Beta	T	Sig.	95.0% CI for B		Collinearity Statistics	VIF
						Lower Bound	Upper Bound	Tolerance	
(Constant)	-38.859	1.862		-20.871	<.001	-42.54	-35.178		
Headneck	13.092	0.249	0.843	52.534	<.001	12.599	13.584	0.598	1.671
Face	13.355	0.325	0.533	41.046	<.001	12.711	13.998	0.913	1.096
Thorax	13.319	0.244	0.758	54.5	<.001	12.836	13.802	0.796	1.256
Abdomen	12.91	0.252	0.724	51.315	<.001	12.412	13.407	0.773	1.293
Extremities	13.166	0.338	0.569	38.906	<.001	12.497	13.835	0.722	1.386
External	12.713	0.612	0.27	20.782	<.001	11.503	13.922	0.912	1.096
Age	-0.02	0.048	-0.005	-0.421	0.675	-0.116	0.075	0.968	1.033
Person Class	-0.739	0.393	-0.025	-1.882	0.062	-1.516	0.037	0.878	1.139
Gender	0.866	0.614	0.018	1.411	0.16	-0.347	2.08	0.916	1.092

a Dependent Variable: ISS

Demographic variables, including gender (β=0.018, p=0.160), person classification (β= -0.025, p=0.062), and age (β= -0.005, p=0.675), did not show substantial predictive value for ISS **(Table 5)**. Collinearity diagnostics showed tolerance values between 0.598 and 0.968 and Variance Inflation Factors (VIFs) below 2, indicating acceptable levels of collinearity.

In the results, the demographic factors, gender, age and person classification did not significantly influence the ISS as indicated by their non-significant p-values. Additionally, the low VIF and high tolerance scores suggest that the predictors are independent of each other, supporting the validity and interpretability of the results.

4.3 Cross-Sectional Survey

Out of 150 polytrauma cases included in the retrospective review and eligible for participation, 90 participants (60.0%) consented and participated in the descriptive cross-sectional survey.

Of the 60 polytrauma cases included in the retrospective review that did not take part in the survey, 18 (12.0%) declined to take part in the study, while 40 cases (26.7%) were identified as “contact not active”, and two cases (1.3%) were excluded due to the participants being deceased.

4.3.1 Socio-Demographic Characteristics

The participants comprised 55 males (61.2%) and 35 females (38.8%), resulting in a male-to-female ratio of approximately 1.6:1 **(Table 6).** The 25–29 year age group (n=42, 46.6%) represented the largest segment of the sample, with 18 females (51.4% of female participants) and 24 males (43.6% of male participants). The second most represented age group among males was 30-34 years (n=16, 17.7%). The rehabilitation outcome for participants indicated that 44.2% (n=38) returned to the community, 33.4% (n=30) returned to school/studies and 24.4% (n=22) returned to work.

Overall, about one-third (n=28, 31.1%) of all participants were unemployed, with a higher proportion among females (37.1%) than males (27.3%). About one-third of respondents (n=28, 31.1%) identified as students, while full-time employment was reported by 22.9% (n=8) of females and 23.6% (n=13) of males. Casual employment was mainly reported by males (9.1%), and full-time employment showed a more balanced distribution, with 22.9% females and 23.6% males.

Marital status indicated that most respondents were single (77.1% female and 81.8% male), with a subset classified as single minors (14.3% female and 12.7% male). Educational attainment varied, with most respondents having completed high school (42.9% female; 41.8% male), while some attended college without completing a degree (14.3% female; 10.9% male).

Regional representation showed the most common region of residence was Khomas (42.9% female; 29.1% male). Otjozondjupa followed among males (16.4%), while Erongo and Hardap were more evenly represented among females **(Table 6)**.

Table 6: Sociodemographic Characteristics

Categories	Female (n, %)	Male (n, %)	Total (n, %)
Age Group			
5–9 Years	2 (5.7)	2 (3.6)	4 (4.4)
10–14 Years	2 (5.7)	3 (5.5)	5 (5.6)
15–19 Years	2 (5.7)	6 (10.9)	8 (8.9)
20–24 Years	7 (20.0)	8 (14.5)	15 (16.7)
25–29 Years	18 (51.4)	24 (43.6)	42 (46.7)
30–34 Years	4 (11.4)	12 (21.8)	16 (17.8)
Employment Status			
Casual Employment	0 (0.0)	5 (9.1)	5 (5.6)
Full-Time Employment	8 (22.9)	13 (23.6)	21 (23.3)
Part-Time Employment	1 (2.9)	2 (3.6)	3 (3.3)
Self-Employed	2 (5.7)	3 (5.5)	5 (5.6)
Student	11 (31.4)	17 (30.9)	28 (31.1)
Unemployed	13 (37.1)	15 (27.3)	28 (31.1)
Marital Status			
Divorced	1 (2.9)	1 (1.8)	2 (2.2)
Married	2 (5.7)	2 (3.6)	4 (4.4)
Single	27 (77.1)	45 (81.8)	72 (80.0)
Single (Minor)	5 (14.3)	7 (12.7)	12 (13.3)
Education Level			
Bachelor/Honours Degree	4 (11.4)	7 (12.7)	11 (12.2)
High School Graduate	11 (31.4)	19 (34.5)	30 (33.3)
Less than High School	15 (42.9)	23 (41.8)	38 (42.2)
Some College (no degree)	5 (14.3)	6 (10.9)	11 (12.2)
Region			
Erongo	6 (17.1)	6 (10.9)	12 (13.3)
Hardap	5 (14.3)	2 (3.6)	7 (7.8)
Karas	1 (2.9)	4 (7.3)	5 (5.6)
Kavango West	0 (0.0)	1 (1.8)	1 (1.1)
Khomas	15 (42.9)	16 (29.1)	31 (34.4)
Kunene	0 (0.0)	1 (1.8)	1 (1.1)
Ohangwena	2 (5.7)	1 (1.8)	3 (3.3)
Omaheke	0 (0.0)	2 (3.6)	2 (2.2)
Omusati	1 (2.9)	5 (9.1)	6 (6.7)
Oshana	1 (2.9)	4 (7.3)	5 (5.6)
Oshikoto	1 (2.9)	4 (7.3)	5 (5.6)

Otjozondjupa	3 (8.6)	9 (16.4)	12 (13.3)
Subtotal	**35 (38.8)**	**55 (61.2)**	**90 (100.0)**

4.3.2 Health Profile (EQ-5D-5L)

For the EQ-5D-5L health profile, participants reported a mean score of 1.36 (SD ± 0.88, 95% CI: 1.18–1.54) for self-care, followed by a mean mobility score of 1.83 (SD ± 1.12, 95% CI: 1.60–2.07) and mean usual activities score of 1.88 (SD ± 1.07, 95% CI: 1.66–2.10). Pain/discomfort was reported as the highest limitation with a mean of 2.43 (SD ± 1.03, 95% CI: 2.22–2.64), while anxiety/depression also showed elevated concern with a mean score of 1.91 (SD ± 1.00, 95% CI: 1.70–2.12).

In the mobility domain, 48 (53.3%) participants reported no problems, 2 (2.2%) had severe problems, and 5 (5.6%) indicated an inability to walk. In the self-care domain, 73 (81.1%) participants reported no problems, while 3 (3.3%) were unable to perform self-care tasks. For usual activities, 44 participants (48.9%) reported no limitations, while 16 (17.8%) reported moderate limitations in performing daily tasks. Pain/discomfort was widely reported, with one-third reporting experiencing slight pain (n=30, 33.3%) and 20% (n=18) reporting no pain. Thirty-nine (43.3%) participants reported no anxiety/depression, while 30 (33.3%) reported slight problems **(Table 7).**

Table 7: EQ-5D-5L Health Profile

Mobility Level	**n, %**
No problems	**48 (53.3%)**
Slight problems	21 (23.3%)
Moderate problems	14 (15.6%)
Severe problems	2 (2.2%)
Unable to walk	5 (5.6%)
Self-Care Level	
No problems	**73 (81.1%)**
Slight problems	8 (8.9%)
Moderate problems	6 (6.7%)
Severe problems	0 (0.0%)
Unable to perform self-care	3 (3.3%)
Activity Limitation Level	
No problems	**44 (48.9%)**
Slight problems	23 (25.6%)
Moderate problems	16 (17.8%)
Severe problems	4 (4.4%)
Unable to perform activities	3 (3.3%)
Pain Level	
No problems	18 (20.0%)

Slight problems	**30 (33.3%)**
Moderate problems	27 (30.0%)
Severe problems	14 (15.6%)
Extreme pain or discomfort	1 (1.1%)
Anxiety/Depression Level	
No problems	**39 (43.3%)**
Slight problems	30 (33.3%)
Moderate problems	11 (12.2%)
Severe problems	0 (0.0%)
Extremely anxious or depressed	10 (11.1%)
Total	**90 (100.0%)**

4.3.3 EQ-VAS Frequency Distribution

The EQ-VAS scores ranged from 10 to 100, with a mean of 69.9 (SD± 20.81, 95% CI 65.55 - 74.27), indicating variability among respondents. The median EQ-VAS scores were 70 (IQR 60-82.5). This indicates that 75% of participants rated their health status at or above 60. The most frequently reported score was 70 (18.9%), with the lowest score of 10 selected by three individuals (3.3%).

4.3.4 Level Frequency Score (LFS) and Self-Rated Health (EQ-VAS)

The average LFS of 9.41 (SD ±3.59, 95% CI 8.66 - 10.16). LFS is derived from the EQ-5D-5L descriptive system and represents the overall HRQoL across the five dimensions: mobility, self-care, usual activities, pain/discomfort and anxiety/depression. The score is a composite measure, where higher values (range 5 to 25) indicate greater limitations in daily functioning. LFS provides a simple and interpretable summary of HRQoL when country-specific value sets are unavailable, making it a useful tool for comparing severity across groups.

A Pearson correlation analysis demonstrated a statistically significant negative correlation between LFS and EQ-VAS (r= –0.268, 95% CI -0.449 to -0.063, p=0.011), suggesting that greater functional limitation (LFS) was associated with poorer self-rated health status (EQ-VAS).

4.3.5 Multiple Linear Regression Predicting EQ-VAS

A multivariate linear regression analysis was conducted to examine whether ISS, age, and person class predicted participants' self-rated health based on EQ-VAS scores. The output provides an estimate of how each variable contributes to changes in the EQ-VAS, while accounting for the influence of the others. It includes coefficients that quantify the direction and size of each effect, significance values that indicate whether those effects are statistically meaningful, and collinearity

statistics that confirm that predictors are not overly related, ensuring that the model is stable and interpretable.

The model explained 6.8% of the variance in EQ-VAS scores (R^2=0.068, Adjusted R^2=0.035) and was not statistically significant (F(3, 86) = 2.08, p=0.108). None of the individual predictors reached statistical significance at the conventional $\alpha = 0.05$. Person class (B= –3.51, p=0.107) and age (B= –0.57, p=0.122) showed non-significant negative associations with EQ-VAS, while ISS (B=0.14, p=0.106) showed a non-significant positive association with EQ-VAS.

4.4 Conclusion

The chapter outlined the dual methodological approach the study undertook to address the aims and objectives. It presented a detailed analysis of polytrauma resulting from RTA among Namibians aged 5 to 29.

The retrospective review of health records revealed a 26.0% prevalence of polytrauma; however, the year-specific prevalence varied. Statistical analyses, including general linear models and multivariate linear regression, explored the relationship between demographic and accident characteristics and injury severity. Key variables, such as road user type, crash type, and anatomical injury location, were used to identify potential predictors of trauma severity, considering variables.

The cross-sectional survey was conducted among polytrauma survivors who had completed a rehabilitation milestone. Participants provided demographic data and completed the EQ-5D-5L questionnaire to assess HRQoL. Multivariate linear regression analyses clinical and demographic variables that influence perceived health status.

The chapter concluded with the findings of the descriptive and inferential statistics that formed the basis for discussion in the subsequent chapter. The results will be contextualised within regional and global trauma literature, exploring implications for clinical practice and policy and highlighting opportunities for future research.

CHAPTER 5: DISCUSSION

5.1 Introduction

This chapter presents a discussion of the key findings from the retrospective review and cross-sectional survey of polytrauma among RTA victims aged 5-29 years in Namibia, with key findings summarised in Chapter 6. The results are contextualised within the broader African and global literature, highlighting implications for clinical practice, policy, and future research.

5.2 Prevalence of RTA-related Polytrauma

Polytrauma (ISS ≥ 15) among 5–29-year-old RTA victims in this study was 26.0%, underscoring the significant burden of severe injuries among young Namibians. The demographic of the polytraumatised victims consisted predominantly of males (62.7%), with the most common age group being 25-29 years. This prevalence is comparable with global estimates, where polytrauma accounts for approximately 25-27% of major trauma admissions (Hardy et al., 2024). Within SSA, reported prevalence varies between 17% and 27%, depending on the study population and trauma system maturity (Blankson, 2020; Igbokwe, 2024). Namibia's figures, therefore, sit at the upper end of regional estimates, suggesting that the country faces a trauma burden comparable to or slightly higher than other SSA settings.

Although 150 polytrauma patients over four years may appear numerically modest in a population of approximately 3 million, the polytrauma-to-population ratio demonstrates a meaningful burden when compared internationally. Given Namibia's limited trauma care resources, even relatively few cases exert disproportionate strain on emergency systems. Thus, the dataset is both representative and policy relevant.

Polytrauma incidence in Namibia has been estimated at approximately 1.25 cases per 100,000 population annually (Hardy et al., 2024), who contextualised the national case count against mid-year population estimates. Importantly, this figure reflects the restricted age group included in the dataset and should not be interpreted as a population-wide incidence. In South Africa, trauma registry data reports a higher incidence of 3-4 per 100,000 population, reflecting both greater traffic density and more robust reporting systems (Bhana et al., 2022). In Germany, where trauma registries are well established, incidence is estimated at 2-3 per 100,000, but these cases are managed within highly resourced trauma networks (Hoefer & Lefering, 2021b). Thus, while Namibia's absolute numbers appear modest, the proportional burden is comparable to

international figures, and the impact is magnified by limited emergency and rehabilitation resources (Hardy et al., 2024).

The year-specific data reveal a relatively stable prevalence, varying between 14% and 36%, with 28.2% in 2019 and 32.6% in 2020, peaking in 2021 at 35.8%, before dropping to 14.8% in 2022. This downward trend in 2022 is plausibly linked to COVID-19-related mobility restrictions, which reduced traffic volumes and RTA incidence (Transport Forum, 2022). The decline may reflect temporary external factors rather than systemic improvements in trauma care. Post-pandemic rebound effects, if present, would need to be monitored to assess whether the reduction in polytrauma prevalence is sustainable or transient.

The ISS distribution shows the burden of polytrauma with scores ranging from 16-121 and a mean of 33 (SD ±22.97). Almost half of the victims (48.0%) were classified as severe (ISS 25-50), with an additional 12.7% classified as critical (ISS > 50). The most frequent scores were 16, 25, and 36, and collectively they accounted for three-quarters of all cases. Comparable regional data confirm similar findings. A South African registry study reported a mean ISS of 36 (SD ±11) (Tuswa, 2024). The large SD (±22.97) indicates a considerable variability in injury severity in the current study, with some patients presenting with relatively lower scores, while others present with extremely high scores. This variability reflects the heterogeneity of the cohort injury profile. Clinically, this can pose challenges with the management of polytrauma and will require appropriate triaging from the RTA scene to ensure that the patients receive the correct level of care. Similarly, this may also reflect an uneven referral pathway where patients are not consistently routed for specialised trauma care. This heterogeneity is consistent in most SSA evidence, where fragmented trauma systems and variable triage can contribute to wide injury severity profiles (Alayande et al., 2022). In contrast, the South African data reveal an SD ±11, indicating a narrower spread, alluding to a more consistent spread of injury severity in that cohort.

Anatomical injuries had head/neck injuries (59.3%) and extremities (62.7%) as the most common affected areas. Studies from Ghana and Tanzania similarly reported neurotrauma and musculoskeletal injuries as dominant patterns among RTA victims (Blankson & Lartey, 2020; Massaga et al., 2023).

The observed prevalence has several implications. Firstly, it highlights the vulnerability of Namibia's youth to severe trauma, consistent with global patterns where young males are disproportionately represented in the high-severity RTA cohorts (Leijdesdorff, 2022). Secondly, the alignment with global and regional estimates suggests that Namibia's trauma burden is not inconsistent but reflects

broader LMIC challenges, including limited trauma system capacity and uneven access to emergency care (Van Breugel et al., 2020). Thirdly, the year-specific decline underscores the importance of contextual factors, such as mobility restrictions, in shaping trauma epidemiology, reinforcing the need for continuous surveillance to distinguish structural improvements from temporary fluctuations (Yasin et al., 2021).

The high baseline prevalence emphasises the urgency of strengthening Namibia's trauma data system. Reliable prevalence estimates are critical for benchmarking against regional and global standards, guiding resource allocation, and informing policy interventions. Without consistent surveillance, the ability to track progress, evaluate interventions, and advocate for investment in trauma care remains limited.

5.3 Demographic and Accident Patterns of RTA-related Polytrauma

5.3.1 Gender and Age

The predominance of the young male age group of 25–29 years among polytrauma victims reflects a well-documented global trend in RTA. Similar patterns have been reported in South Africa and Tanzania, where males account for the majority of severe RTA cases (Massaga et al., 2023; Tuswa, 2024). This demographic is characterised by high mobility, occupational exposure, particularly in commercial driving and behavioural risk factors such as alcohol consumption, speeding and poor seatbelt adherence.

Internationally, young males remain disproportionately represented in RTA statistics, although in some urbanised regions of Europe and the USA, the gender gap has begun to narrow (Kaiser, 2024). In contrast, studies from Ethiopia and Nigeria observed a gradual rise in female involvement in RTAs, linked to changing mobility patterns and workforce participation (Atalay et al., 2025). These shifts indicate that gender risk profiles are evolving, requiring adaptive interventions that address both behavioural and structural determinants of risk.

The predominance of young males highlights a critical public health concern. As members of the economically active population, severe injuries in this group carry long-term socioeconomic consequences, including reduced productivity, higher dependency ratios, and increased demands for rehabilitation services. The clustering of cases in the 25-29 age group reflects not only behavioural risk factors but also systematic shortcomings in Namibia's trauma care, where fragmented referral pathways, inequitable EMS coverage, and limited rehabilitation capacity amplify the burden of severe injuries among the economically active population. Key contributing

factors include alcohol use, speeding, poor seatbelt adherence and high-severity RTA mechanisms such as rollovers and PVAs (Febres et al., 2020; Govender et al., 2021). The implications of these findings are significant. From a health system perspective, concentrated demand for acute trauma care and rehabilitation services places additional strain on already limited resources (Whitaker et al., 2021).

Policy response must therefore prioritise behavioural change campaigns targeting young men, along with stricter enforcement of traffic laws related to alcohol use, speeding, and seatbelt compliance (WHO, 2024). At the same time, emerging female involvement in RTAs highlights the need for gender-responsive strategies that anticipate shifting risk profiles. Continuous surveillance of age- and gender-specific trends is essential to ensure that interventions remain adaptable, that resources are allocated effectively, and that the trauma care system in Namibia is strengthened.

5.3.2 Geographical Location

Geographically, the Khomas and Otjozondjupa regions recorded the highest proportion of polytrauma cases, indicating possible clustering related to urbanisation, traffic density, or regional road conditions. Windhoek, located in Khomas Region, serve as Namibia's economic and administrative hub, attracting significant commuter and commercial traffic (MVA Fund, 2022). This increases exposure to high-speed RTAs and complex traffic environments. Otjozondjupa Region, transversed by major highways linking Namibia to neighbouring countries, experiences heavy long-distance and commercial vehicle traffic, further elevating risk (Chatukuta et al., 2021). While both regions benefit from relatively better road infrastructure compared to rural areas, the high traffic volumes and mixed road user environment, including vehicles, pedestrians and cyclists, contribute to increased accident risk.

These regions also consistently report the overall highest number of RTAs annually in Namibia, according to national road safety statistics, with Khomas alone accounting for approximately 41% of all reported RTAs in 2022, followed by Otjozondjupa, Hardap, Erongo and Karas regions among the top five (MVA Fund, 2022; NRSC, 2023). This correlation reinforces the interpretation that traffic density and economic activities are major determinants of accident risk. Internationally, urbanisation, economic development and expansion of freight corridors are major determinants of RTA risk as observed in countries such as China and India (Polinder, 2015). Similar clustering is observed in South African provinces of Gauteng and KwaZulu-Natal, economic hubs with major transit corridors consistently reporting the highest RTA rate (Chichom-Mefire et al., 2018).

Both Khomas and Otjozondjupa regions contain key transit routes forming part of Namibia's vast transportation network. These corridors accommodate high volumes of heavy commercial vehicles, including trucks and long-haul freight carriers. The presence of such vehicles increases accident severity due to their size, speed and braking limitations (Tian et al., 2024). Fatigue among long-distance drivers, coupled with mixed traffic conditions, including private vehicles, pedestrians and livestock, further increases accident risk. International evidence suggests that freight corridors in LMICs are associated with higher RTA rates and more severe injuries, particularly rollovers and multi-vehicle collisions (PIARC, 2023). This pattern is evident in Namibia, where highways such as the B1 and B2 traverse these regions, linking ports and borders. Similar regional clustering has been observed in other African settings, e.g., Ghana and Kenya, where urban centres and major transport corridors are associated with higher RTA rates (Blankson & Lartey, 2020; Chatukuta et al., 2021).

5.3.3 RTA Crash and Road User Type

Rollovers emerged as the predominant crash type, accounting for over two-fifths of all trauma cases. This is notably higher than what is reported in many HICs, where rollovers account for 10-20% of severe RTAs (Eboli et al., 2020). This high proportion is notable and may be attributed to Namibia's extensive road network, high-speed travel on highways and the prevalence of long-distance journeys. In the USA, rollovers have been shown to carry a markedly higher fatality risk, particularly when occurring at high speeds. Their clinical significance is further highlighted by the strong correlation between rollovers and elevated severity scores (National Highway Traffic Safety Administration [NHTSA], 2022). Rollover RTAs typically result in multiple, severe injuries due to the violent forces involved, such as occupant ejection, multiple impacts and prolonged extrication times (Al-Salehi et al., 2024; WHO, 2023a). The regression analysis conducted in this study further confirmed that rollovers are significantly more likely to result in severe or critical injuries compared to other crash types.

PVAs accounted for nearly a quarter of cases in Namibia, a pattern that mirrors trends observed in urban areas across SSA, Asia and Latin America. Pedestrians remain highly vulnerable, with evidence showing that even low-speed impacts can result in significant trauma, particularly in the head, thorax and extremities (Peng et al., 2024). Passengers and pedestrians, who are the most affected group and represent the most vulnerable populations, echo findings from South Africa and Tanzania, where non-driver road users consistently bear the greatest burden of injury (Chichom-Mefire et al., 2018; Massaga et al., 2023). In contrast, in HICs, investments in pedestrian infrastructure and traffic calming have reduced fatalities, lowering them to less than 15% of total RTFs (Bouillon 2013).

The relationship between crash type and injury severity is explained by intertwined biomechanical and contextual mechanisms. Rollovers expose occupants to multi-directional forces, repeated impacts and potential ejection, often overwhelming protective systems such as seatbelts and airbags (Krafts et al., 2019; NHTSA,2020). Roof crush and side impact further compromise the survival space, increasing the likelihood of head/neck and thoracic trauma. In contrast, PVAs involving direct impact to unprotected bodies often strike the lower extremities first, followed by secondary head or thoracic injury upon ground contact (WHO, 2018).

These biomechanical pathways are amplified by environmental and behavioural contributors. Speeding, reckless overtaking and poor road conditions predispose vehicles to rollovers, while inadequate pedestrian infrastructure increases exposure to PVAs. Consequently, crash type is not merely a descriptive classification but a proxy for deeper systematic vulnerabilities, structural, environmental and behavioural, that shape trauma severity and reveal points for intervention (Chen et al., 2025; Dumitrascu, 2024).

The predominance of rollovers and PVAs, combined with the demographic and regional patterns observed, highlights the need for targeted interventions. Priority actions should include stricter enforcement of speed limits and fatigue management on highways, investment in pedestrian infrastructure and traffic calming in urban areas, and the strengthening of emergency response systems along transit corridors and rural areas.

5.3.4 RTA Crash Causes

The retrospective review revealed that the leading causes of RTAs were classified as “other/unspecified” (46.0%), followed by driver-related behaviour (24.0%) such as speeding, reckless overtaking and unlicensed driving. Among the defined crash cause categories, driver-related behaviour emerged as the most prominent contributor to crash type, aligning with global evidence that human error is the leading contributor to RTA, accounting for the majority of incidents worldwide (WHO, 2023a). Regional studies from Namibia and South Africa similarly highlight speeding, reckless driving, and non-compliance with licensing regulations as major determinants of crash severity and mortality (MVA Fund, 2022). The finding that nearly one-quarter of RTAs were linked to driver behaviour underscores the need for intensive enforcement of speed limits, adherence to licensing, and public awareness campaigns targeting young drivers, particularly in Khomas and Otjozondjupa regions, where RTA prevalence was highest.

Mechanical failure, though less frequent, remains a notable contributor to RTA. Its occurrence reflects persistent challenges with vehicle roadworthiness and maintenance, particularly in contexts where inspection regimes are weak or fleets are ageing. Evidence from South Africa similarly highlights the role of mechanical defects, such as faulty brakes, worn tyres and defective lighting (Road Traffic Management Corporation, 2023). Strengthening vehicle inspection systems and enforcing compliance, especially with commercial vehicles, could substantially reduce this burden and improve overall road safety outcomes.

Environmental factors and pedestrian-related causes, each accounting for 4.0% of RTAs, may be underestimated due to attribution bias toward “unspecified” categories. Nevertheless, poor road infrastructure and hazardous weather conditions are well-documented contributors to RTA risk in rural Namibia and across SSA (MVA Fund, 2022; WHO, 2023a). Although PVAs appeared relatively few in the cause-of-crash dataset, they were more prominent in crash type analysis, accounting for 23% of polytrauma cases. This resonates with global evidence that vulnerable road-users bear a disproportionate burden of injury, particularly in LMICs (WHO, 2023a). Targeted interventions such as traffic calming, protected crossings, and urban speed management are therefore critical to reducing pedestrian risk and improving safety outcomes.

The high proportion of unspecified causes (46.0%) reflects systematic gaps in RTA investigation and reporting. Globally, the WHO emphasises the need for robust, standardised RTA data systems to support evidence-based interventions and track progress towards SDG targets (WHO, 2023a). In Namibia, strengthening police-health data integration and adopting standardised cause-of-crash coding could reduce uncertainty, enhance surveillance, and improve the design of prevention strategies.

5.3.5 Mode of Transportation to Hospital

Transportation data indicated that two-thirds of patients were transported by ambulance services, including those operated by state, private providers, and the MVA Fund. The remaining patients relied on alternative transport such as police or privately owned vehicles. Although ambulances represented the dominant mode of transport, nearly one in four patients relied on non-medical or informal transport. This reliance on non-specialised transport reflects a persistent gap in Namibia’s EMS.

Regional analysis revealed notable disparities in ambulance coverage and transport modalities. Otjozondjupa region demonstrated the most comprehensive ambulance coverage, including state,

private providers and MVA Fund. The Khomas region relied heavily on private ambulance services, with minimal use of state-operated ambulances. A high reliance on private vehicles was observed in Oshana (85.7%), Kavango East (66.7%) and Omusati (66.7%) regions, indicating limited access to formal emergency services.

These findings reflect a broader regional trend across LMICs where EMS are often inadequately resourced and informal transport plays a critical role in trauma response (Chirombo, 2024; WHO, 2023a). In Nigeria and Kenya, limited ambulance availability and delayed prehospital care have been linked to increased mortality and poorer trauma outcomes (Chirombo, 2024; Nto et al., 2024). Unlike HICs, Namibia faces constraints in trauma infrastructure, including limited access to specialised trauma centres, advanced prehospital systems, and rehabilitation services (Alayande et al., 2022).

Reliance on police and private vehicles, especially in regions with limited ambulance coverage, reflects systemic gaps in EMS provision and highlights the need for coordinated transport strategies. These challenges are driven by factors including geographical isolation, underfunding of rural health systems, a shortage of trained EMS personnel, and poor integration between dispatch services and community responders (Chirombo, 2024; WHO, 2023a). In some cases, cultural norms and mistrust of formal systems may influence transport choices, with families opting for private vehicles due to perceived delays or cost concerns.

Delayed transport can exacerbate injury severity, reduce survival chances and increase long-term disability. The uneven distribution of EMS further reinforces health inequities, particularly for rural and low-income populations (Chirombo, 2024). Moreover, reliance on informal transport complicates data collection, disrupts continuity of care and hampers coordination between prehospital and hospital services.

To address these challenges, Namibia needs to expand EMS coverage in underserved regions, strengthen dispatch coordination, and raise public awareness of available emergency services. Linking transport data to health outcomes will support targeted interventions and inform policy development. Ultimately, aligning Namibia's trauma transport system with regional and global best practices requires a multisectoral approach, bringing together health, transport and community stakeholders, to ensure timely, equitable and effective care for all trauma patients.

5.4 Injury Severity and Predictors

The ISS analysis revealed that the majority of cases fell within the severe to critical range, aligning with international trauma classification thresholds (Bouillon, 2013). This high prevalence of severe injury reflects the impacts of high-energy RTA mechanisms, particularly rollovers and PVAs. Comparable trauma data from South Africa and Tanzania similarly reported high rates of polytrauma, especially involving head and extremity injuries (Massaga et al., 2023). While severe injuries are also common in HICs, survival rates are significantly improved through advanced trauma systems and timely interventions (WHO, 2023). In contrast, Namibia and other LMICs face limited trauma resources and delayed access to care, which exacerbate the consequences of severe injury.

Analysis of anatomical injury patterns revealed that the head/neck and extremities were the most frequently affected regions. These findings mirror regional studies in South Africa, Tanzania and Ghana, where neurotrauma emerges as a dominant injury pattern among RTA victims (Blankson & Lartey, 2020; Massaga et al., 2023). Head/neck injuries are particularly concerning due to their strong association with increased morbidity, long-term disability and the need for intensive care. Extremity injuries, while often survivable, contribute substantially to functional impairment and prolonged rehabilitation. These patterns reinforce regional evidence highlighting musculoskeletal trauma as a frequent outcome of RTAs (Massaga et al., 2023). Together, these findings emphasise the dual burden of neurotrauma and limb trauma and the corresponding need for both acute medical care and long-term rehabilitation services.

Regression models in this study demonstrated that road user type, especially pedestrians and motorcyclists, and crash type, notably rollovers, were significant predictors of higher ISS. Multivariate linear regression further revealed that anatomical injury location, particularly head/neck, thorax, and abdomen, was a stronger predictor of trauma severity than demographic factors. Evidence from trauma studies in Ghana and Egypt supports this finding, demonstrating that injury site is a key determinant of clinical outcome, with a strong association with ICU admission and mortality (Leijdesdorff, 2022; Okyere et al., 2020).

Gender and geographical region did not significantly predict ISS in this cohort. However, regional disparities may still influence trauma outcomes through variations in emergency response capacity, hospital proximity, and access to rehabilitation services. Comparable findings were reported at Kalafong Hospital in South Africa, where urban pedestrian injuries were associated with the most severe injuries, despite similar ISS distributions across regions (Tuswa, 2024).

Broader continental evidence highlights variability in injury patterns. For example, North African studies report a higher prevalence of thoracoabdominal trauma in high-speed RTAs, attributed to differences in road infrastructure, vehicle type, and enforcement of safety regulations (Abdelrahman, 2016). This further suggests that injury patterns are shaped not only by RTA mechanics but also by broader transport and policy environments.

Together, these findings demonstrate that injury severity in Namibia is driven primarily by high-energy RTA mechanisms and the involvement of vulnerable road users, with anatomical injury location emerging as the strongest predictor of clinical outcomes. The predominance of head/neck and extremity injuries underscores the dual burden of acute critical care needs and long-term rehabilitation needs.

Addressing these challenges requires not only improvements in prehospital and hospital trauma capacity but also broader system-level interventions, ranging from road safety enforcement to investment in rehabilitation infrastructure. Aligning Namibia's trauma response with regional and global best practices will be essential to reduce mortality, mitigate disability, and promote equitable recovery for all RTA victims.

5.5 Functional Outcomes of Polytrauma RTA Cases

5.5.1 Socio-Demographics

The cross-sectional survey revealed a male-to-female ratio (1.6:1) similar to the retrospective review. Most survivors were single (80.0%), with a subset classified as minors, which has important implications for recovery. Limited spousal or household support may exacerbate socioeconomic vulnerability, hinder reintegration into work or school, and increase reliance on formal rehabilitation and psychosocial services. This highlights the need for trauma care planning that integrates social support mechanisms alongside clinical interventions.

Rehabilitation outcomes show that 44.2% of participants reintegrate into their communities, while a smaller proportion (24.4%) managed to return to work. Unemployment was reported by 31.3% of participants, with a higher prevalence among females (37.1%) compared to males (27.3%). This highlights a possible barrier for victims to return to work, particularly given that they are in the productive years for labour market participation.

Educational attainment was generally low, with high school graduates comprising the largest group (33.3%). Only 12.2 % have completed a bachelor's or honours degree, highlighting the limited higher education attainment among survivors. The regional representation highlights that the Khomas

region accounts for the largest share of survivors (34.4%), followed by Otjozondjupa (13.3%) and Erongo (13.3%). Despite these regions being centres of high economic activities, unemployment among survivors remains high, and may signal wider economic and social factors that hinder them from securing employment post-injury.

These socio-economic vulnerabilities are critical determinants of recovery, as limited financial resources and weak social support systems often hinder access to rehabilitation and long-term care. Similar findings have been reported in trauma cohorts across South Africa, Kenya, and Tanzania, where unemployment and youth status exacerbate disability outcomes (Alayande et al., 2022).

Studies from Ghana and Nigeria further confirm that lower educational attainment and unemployment are associated with delayed recovery, reduced rehabilitation access, and increased psychological distress (Kunfah et al., 2025; Sekoni et al., 2021). Chatukuta et al. (2021) emphasise that young, economically inactive survivors often lack the financial and social resources to sustain long-term care, compounding the disability burden. These regional findings highlight the intersection of trauma recovery with broader socioeconomic inequities, underscoring the need for integrated rehabilitation strategies that address both clinical and social determinants of health.

Globally, systematic reviews of trauma outcomes have similarly shown that unemployment and low education are among the strongest predictors of long-term disability and reduced HRQoL (Lotfalla et al., 2024).

5.5.2 Functional Outcomes

The EQ-5D-5L result revealed moderate limitations across several domains, with pain/discomfort (80.0% reporting some level of pain) and anxiety/depression (56.7% reporting some problems) being the most affected. The mean EQ-VAS score was 69.9 (SD ±20.8) with wide variability, reflecting diverse recovery trajectories. Rehabilitation outcomes showed that nearly half of survivors reintegrated into their communities (44.2%), while fewer returned to school (33.0%) or work (24.4%), highlighting barriers to full socioeconomic recovery. This pattern resonates with findings from Rwanda, where survivors of RTI reported persistent functional impairments and socioeconomic challenges despite clinical recovery (Ingabire et al., 2023).

Mental health outcomes are also critical. A recent meta-analysis from SSA found that PTSD affect nearly 25% of RTA survivors, with the female gender, depression, poor social support, and substance use identified as significant risk factors (WHO Regional Office for Africa, 2023). This underscores

the need for integrated physical and mental health support in Namibia, where trauma care systems are still evolving.

Regression analysis in this study did not demonstrate significant associations between ISS, age, person class, and EQ-VAS, suggesting that unmeasured factors, such as family support, access to rehabilitation, and psychological resilience, may play a role in perceived recovery. This aligns with broader literature that critiques the overreliance on clinical metrics alone to predict outcomes (Aytenew, 2025; Lotfalla et al., 2024). For example, a Kenyan study reported higher rates of full functional recovery and lower rates of psychological morbidity among RTA survivors, attributed to stronger family support systems and Community-Based Rehabilitation initiatives (Hung et al., 2020).

Recovery outcomes were mediated by socioeconomic factors rather than injury severity alone. Educational attainment influenced reintegration, with higher education linked to better employment prospects (Mock et al., 2017). Gender disparities compound vulnerability, as women face higher unemployment and weaker social support systems (Chokotho et al. 2020). Household income determined access to rehabilitation, while psychosocial stressors such as anxiety and depression further undermine recovery (Haagma et al, 2016).

These findings confirm that trauma outcomes are shaped by the intersection of injury with socioeconomic vulnerability. Survivors embedded in supportive family and community networks demonstrate better HRQoL, while those lacking such resources face prolonged disability and dependency (Haagsma et al., 2016).

The cross-sectional survey findings highlight that socioeconomic vulnerabilities, functional limitations and psychosocial distress are central to the recovery trajectory among Namibian RTA survivors. The ISS derived from the retrospective review provides baseline information on the injury profile of individuals involved in RTA and who sustain polytrauma. However, on its own, it does not explain long-term outcomes. Future longitudinal studies may address the gap and provide more definite insight into the recovery trajectory.

5.6 Study Limitations

While methodological constrains were outlined in Chapter 3, their interpretive impact is particularly evident when considering Namibia's trauma landscape. Regional reporting gaps, especially in sparsely populated areas such as Kunene and Omaheke, may have led to underestimation of polytrauma incidence, while the concentration of data from Khomas and Otjozondjupa reflect urban

bias. EMS disparities, with rural regions relying heavily on informal transport, further complicate the comparability of outcomes and may have amplified injury severity through delayed care.

Socioeconomic recovery challenges, including high unemployment and low educational attainment among survivors, limited reintegration and shape HRQoL trajectory beyond what clinical variables alone can explain (Ballout, 2025; Yaw et al., 2025). These limitations underscore the need for cautious interpretation of findings and highlight the importance of equity-focused trauma policy that accounts for Namibia's geographic and socioeconomic heterogeneity.

5.7 Conclusion

This chapter summarised findings from both a retrospective clinical review and a cross-sectional survey of the burden, severity, and recovery outcomes of RTI among young people (5-29 years) in Namibia. The results revealed a substantial burden of severe injury among young adults, with males and urban regions most affected, mirroring patterns seen across SSA. The demographic analysis highlighted that risks are concentrated among young males, but also noted emerging trends in some regions where female victims are increasing due to the changing workforce and mobility patterns Click or tap here to enter text.Socio-demographic and functional outcomes further demonstrated the long-term consequences of trauma. Many survivors, mostly unemployed with low educational attainment or students, face significant socioeconomic vulnerabilities that hinder recovery and reintegration. Functionally, survivors reported moderate limitations in daily activities, with pain and psychological symptoms most prominent. Rehabilitation outcomes revealed that while many survivors reintegrate into their communities, fewer return to school or work, underscoring persistent barriers to socioeconomic recovery.

Integrating findings from both phases reveals that anatomical injury patterns and crash mechanisms identified in the retrospective review directly manifest as functional limitations and poorer HRQoL outcomes in the survivor survey. Regional disparities in transport and EMS coverage compound socioeconomic vulnerabilities, underscoring the systematic nature of trauma care gaps in Namibia.

The findings mirror evidence within SSA, where socioeconomic inequities, limited rehabilitation and high psychological morbidity constrain recovery. Globally, systematic reviews confirm that injury severity alone does not fully explain outcomes; social determinants such as family support, resilience and rehabilitation access are equally important. Overall, Namibian findings emphasise the need for integrated trauma care and rehabilitation strategies tailored towards vulnerable groups. Policy priorities should include strengthening trauma registries, enforcing traffic laws, enhancing

vehicle standards, expanding emergency medical services and providing social protection and vocational rehabilitation. Addressing these challenges holistically will reduce the burden of RTI, improve HRQoL, and support progress toward global road safety and SDG targets.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This study highlights the considerable burden of RTA-related polytrauma among Namibian youth and its implications for trauma care and policy. Key findings highlighted include a severe injury burden that affects one in four victims, predominantly young males with head /neck and extremity injuries most common. Crash mechanism played a decisive role, with rollovers and PVAs standing out as the strongest predictors of severe outcomes, underscoring the vulnerability of non-driver road users and risk of high-speed travel. Regional clustering in Khomas and Otjozondjupa regions reflected traffic density and the presence of a transit corridor, while inequities in EMS left rural areas dependent on informal transport, exposing systemic gaps in trauma response.

Survivors faced significant socioeconomic challenges, including high unemployment, low educational attainment, and limited social support, which hindered reintegration into school, work and broader community life. Long-term recovery was further constrained by persistent functional and psychosocial limitations with pain, anxiety/depression reported as common outcomes. Collectively, these findings reveal that injury severity and recovery trajectory are shaped not only by crash mechanics but also by structural weakness in emergency care and socioeconomic vulnerability. Consistent with these findings, other studies have shown that rehabilitation and injury outcomes are shaped by the broader social and contextual factors, particularly access to rehabilitation and socioeconomic vulnerability (Bachani et al., 2017).

The findings highlight disparities in trauma care in the prehospital phase, particularly for individuals residing outside urban centres and in need of alternative transport to reach health facilities. These disparities drive home the importance of trauma systems that prioritise anatomically guided clinical care and address the social determinants of health through regionally tailored interventions and inclusive rehabilitation strategies.

The study contributes to trauma research and policy in Namibia by integrating anatomical injury severity with patient-reported HRQoL outcomes in a young, high- risk population. Unlike existing Namibian and regional studies that focus primarily on mortality or acute clinical outcomes, this research demonstrates that long-term recovery following road traffic-related polytrauma is not adequately explained by injury severity alone. Instead, it highlights the role of socioeconomic vulnerability, emergency care access and post-injury rehabilitation context in shaping the recovery trajectory

Methodologically, the study contributes by combining routinely collected RTA data with survivors reported HRQol measures, offering a more holistic framework for assessing trauma burden in LMIC. Collectively the study advances understanding of trauma beyond survival, positioning recovery and lived experiences as central outcomes for trauma system strengthening in Namibia.

All the research objectives were achieved. Objective 1 aimed to determine the prevalence of polytrauma among RTA victims aged 5-29 years in Namibia (2019-2022). This objective was met, with prevalence established at 26.0% (150/559 cases). Year-specific variance was observed, with the highest prevalence in 2021 (35.8%) and the lowest in 2022 (14.8%).

Objective 2, aimed to review the epidemiological profile of polytrauma victims and was achieved, showing that the majority of victims were male (62.7%), with the 25-29 year age group most affected. The cohorts had high unemployment and low educational attainment, and rehabilitation outcomes revealed limited reintegration, with only 24.4% returning to employment and 44.2% engaged in community participation. The Khomas and Otjozondjupa regions recorded the highest case numbers with passengers at 65.3% and pedestrians at 23.3%. It was also noted that rollovers (42.0%) and PVAs (23.35%) were the most frequent of the crash types.

Objective 3 aimed to compare demographic and RTA characteristics to injury severity. The study findings revealed that patients' ISS scores ranged from 16 to 121. Head/neck and extremities (limbs/arms/legs) were the most frequent injuries. Prediction analysis revealed that patients involved in rollovers (crash type) and motorcyclists and pedestrians (person-type) sustained a higher ISS than passengers.

Objective 4 aimed to assess patient-reported HRQoL outcomes among polytrauma survivors. This was also achieved as RTA survivors reported moderate HRQoL, with pain/discomfort and anxiety/depression as the most common health issues raised. The EQ-VAS had an average score of 69.95 with a notable variability among participants, and correlation analysis showed that LFS were negatively associated with EQ-VAS scores.

The study tested two hypotheses. The first hypothesis, which stated that demographic factors significantly predicted injury severity, was not supported, as variables such as gender, person classification, and age did not yield significant associations with injury severity. The second, which stated that RTA variables were significant in predicting injury severity, was accepted because crash type (specific rollovers) and road user type (passengers and pedestrians) were strong predictors of higher ISS scores.

Overall, the study calls for the development of equitable trauma frameworks in Namibia that integrate clinical, social and contextual variables to improve outcomes for all survivors. This chapter's recommendations aim to guide policy, practice, and future research toward a more effective and equitable trauma care system.

6.2 Recommendations

6.2.1 Implications for Practice

Data from the retrospective review reveal a 26.0% polytrauma prevalence, with many cases recorded as unspecified or unknown RTA causes. This highlights gaps in the current documentation standard and underscores the need for more comprehensive and systemic data collection. Strengthening collaboration with police and other stakeholders will ensure that information captured reflects the actual circumstances of RTAs, improving surveillance, and enabling targeted prevention strategies.

Given that thoracic, abdominal and head/neck injuries were the strongest linked to elevated ISS and trauma outcomes, anatomical triage guides should prioritise these injury types. This aligns with international standards, such as the UK's National Major Trauma Registry and Swedish Traffic Accident Data Acquisition, where early identification during the "golden hour" is emphasised. For Namibia, this requires skilled healthcare professionals to lead trauma care in the initial response phase, supported by ongoing training adapted to local realities. The deployment of Namibia's first Lodox full-body X-ray machine at Katutura Hospital exemplifies how technology can enhance diagnostic speed and precision. Although prehospital ultrasound is not yet available in Namibia, evidence from SSA and other low-resource trauma systems highlights its potential to improve triage and hospital destination decisions (Alayande et al., 2022; Chirombo, 2024; Gudugbe et al., 2023).

Rehabilitation services must respond to the study’s finding that HRQoL was reduced with pain/discomfort and anxiety/depression most affected, and the reintegration rate was low. Transition to a community-based model, as promoted by the WHO Community-Based Rehabilitation framework, would integrate physical and psychosocial recovery and support reintegration, particularly for rural survivors with limited access to urban facilities. Community health workers and peer mentors should deliver rehabilitation and psychosocial support in local languages and within the cultural contexts.

Health communication should be simplified to accommodate survivors with low literacy, improving adherence to treatment plans. Materials must be developed in local languages and tailored to the

cultural context. Rehabilitation should be gender-sensitive, recognising the complex interplay between pain, gender and recovery outcomes, particularly among young male survivors who formed the majority of the cohort.

6.2.2 Implications for Policy

The study documented regional disparities in prehospital access, with rural survivors often relying on alternative transport to reach health facilities. Trauma registries should therefore include both anatomical and social indicators to capture these inequities. Namibia can leverage the MVA Fund case management system, integrating it with MoHSS and NRSC data to create a unified national trauma registry. The use of ICD-10 diagnostic coding, already adopted by NAMAF, should be fully implemented to ensure consistent classification and high-quality data.

Public health interventions must directly address the study's findings that passengers and pedestrians are at risk. Infrastructure upgrades such as improved pedestrian walkways, speed bumps, improved lighting, and strict enforcement of speed limits and seatbelt laws should be prioritised. Road safety campaigns must be conducted in local languages and target youth and other high-risk groups. Traditional leaders and local influencers should be engaged to promote road safety, especially in rural communities.

Emergency response systems must be strengthened to address the rural-urban disparities identified. Namibia should increase the number of ambulances and trained first responders, drawing on components from models from South Africa and Canada. From South Africa, useful component includes the South African Triage Scale (SATS) to standardise emergency centre triage and community responder training to extend basic trauma care into rural areas. From Canada, Namibia can draw from their approach of universal ambulance coverage and integrated trauma centres linked to EMS dispatch. Additionally, mobile trauma and rehabilitation units should be deployed during high-risk periods, and referral pathways must be regionally adapted to ensure timely transfer. Public-private partnership, including NGOs and private ambulance services, can supplement state capacity, especially in remote areas.

The study highlighted a low reintegration rate and a low return-to-work rate. Social protection measures are therefore vital. A partnership with the Ministry of Labour and vocational centres should provide skills development and job placement, while targeted social grants should prioritise the young, the unemployed, and rural survivors.

6.2.3 Implications for Research

Future trauma research in Namibia should move beyond descriptive epidemiology to address system-level and intervention-focused approaches that generate actionable evidence for prevention and policy. The high prevalence of polytrauma among young RTA victims underscores the need for longitudinal surveillance systems capable of monitoring post-pandemic trends and identifying key determinants such as road user behaviour, occupational exposure and the emerging involvement of females in RTAs. Research will provide a dynamic understanding of trauma burden and allow researchers to anticipate shifts in risk profiles over time. Equally important is the examination of pedestrian and passenger vulnerability, which requires systematic evaluation of road infrastructure deficits, exposure patterns and the effectiveness of safety interventions. Rural disparities in trauma care further demand mapping of EMS coverage and assessment of informal transport systems in underserved regions.

Future studies must also integrate HRQoL outcomes into trauma research, moving beyond acute survival to capture long-term recovery trajectories. This includes socioeconomic determinants such as loss of income, educational impact, and mental health status. Collectively, these priorities will generate evidence to guide prevention, strengthen emergency response and improve rehabilitation policy in Namibia. Equitable trauma frameworks should incorporate interaction terms and stratified models shaped by geography, gender and socioeconomic status.

Longitudinal research is needed to track long-term functional recovery and HRQoL, especially for those in rural and socioeconomically disadvantaged communities who face compounded challenges. Dedicated funding from national bodies such as the MVA Fund or MoHSS should be directed towards this priority, aligned with international best practice. Models from the US National Highway Traffic Safety Administration and EU Horizon 2020 initiatives emphasise the importance of sustained investment in trauma research and data systems, offering valuable guidance for Namibia's policy development.

Transparency and accountability are essential. Findings from longitudinal studies and trauma care evaluations should be published and disseminated to inform public health policy and guide improvement in road safety and emergency response systems.

Finally, the development of an integrated trauma care system requires interdisciplinary collaboration. Clinicians, public health experts and social scientists must work together to design a responsive model of care. Partnership with universities and research institutions, both local and

international, should be facilitated to provide technical support, training and opportunities for joint studies. This collaboration model will strengthen Namibia's trauma research capacity and ensure that interventions are evidence-based and contextually relevant.

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APPENDICES

Appendix A: EQ-5D-5L Questionnaire

Health Questionnaire

English version for South Africa

VERSION FOR INTERVIEWER ADMINISTRATION

Note to interviewer: although allowance should be made for the interviewer's particular style of speaking, the wording of the questionnaire instructions should be followed as closely as possible. In the case of the EQ-5D-5L descriptive system on page 2 of the questionnaire, the precise wording must be followed.

If the respondent has difficulty choosing a response or asks for clarification, the interviewer should repeat the question word for word and ask the respondent to answer in a way that most closely resembles his or her thoughts about his or her health today.

INTRODUCTION

(Note to interviewer: please read the following to the respondent.)

We are trying to find out what you think about your health. I will explain what to do as I go along, but please interrupt me if you do not understand something or if things are not clear to you. There are no right or wrong answers. We are interested only in your personal view.

First, I am going to read out some questions. Each question has a choice of five answers. Please tell me which answer best describes your health TODAY.

Do not choose more than one answer in each group of questions.

(Note to interviewer: first read all five options for each question. Then ask the respondent to choose which one applies to him/herself. Repeat the question and options if necessary. Mark the appropriate box under each heading. You may need to remind the respondent regularly that the timeframe is TODAY.)

EQ-5D DESCRIPTIVE SYSTEM

First, I would like to ask you about MOBILITY. Would you say that:

You have no problems in walking about?	Q
You have slight problems in walking about?	Q
You have moderate problems in walking about?	Q
You have severe problems in walking about?	Q
You are unable to walk about?	Q

Next, I would like to ask you about SELF-CARE. Would you say that:

You have no problems washing or dressing yourself?	Q
You have slight problems washing or dressing yourself?	Q
You have moderate problems washing or dressing yourself?	Q
You have severe problems washing or dressing yourself?	Q
You are unable to wash or dress yourself?	Q

Next, I would like to ask you about USUAL ACTIVITIES, for example, work, study, housework, family or leisure activities. Would you say that:

You have no problems doing your usual activities?	Q
You have slight problems doing your usual activities?	Q
You have moderate problems doing your usual activities?	Q
You have severe problems doing your usual activities?	Q
You are unable to do your usual activities?	Q

Next, I would like to ask you about PAIN OR DISCOMFORT. Would you say that:

You have no pain or discomfort?	Q
You have slight pain or discomfort?	Q
You have moderate pain or discomfort?	Q
You have severe pain or discomfort?	Q
You have extreme pain or discomfort?	Q

Finally, I would like to ask you about ANXIETY OR DEPRESSION. Would you say that:

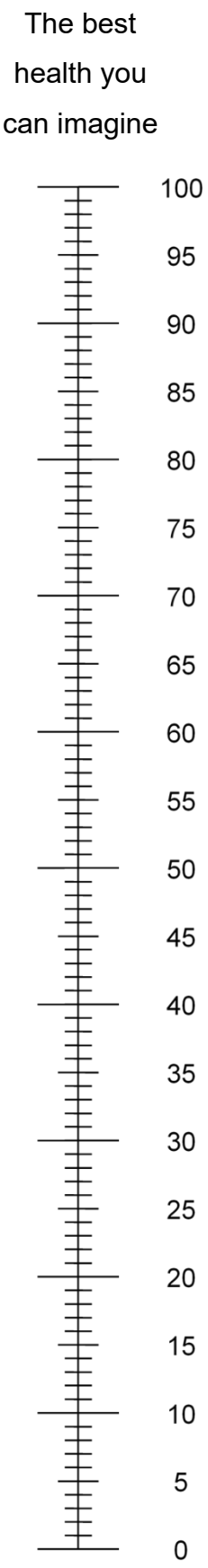
You are not anxious or depressed?	Q
You are slightly anxious or depressed?	Q
You are moderately anxious or depressed?	Q
You are severely anxious or depressed?	Q
You are extremely anxious or depressed?	Q

EQ-5D VAS

- **Now, I would like to ask you to say how good or bad your health is TODAY.**
- **I would like you to picture in your mind a vertical line that is numbered from 0 to 100.**
  (Note to interviewer: if interviewing face-to-face, please show the respondent the VAS line.)
- **100 at the top of the line means the <u>best</u> health you can imagine.**

  0 at the bottom of the line means the <u>worst</u> health you can imagine.
- **I would now like you to tell me the point on this line where you would put your health TODAY.**
  (Note to interviewer: mark the line at the point indicating the respondent's health today. Now, please write the number you marked on the line in the box below.)

THE RESPONDENT'S HEALTH TODAY = ☐



Thank you for taking the time to answer these questions.

Appendix B: Data Variable List for the Retrospective Review

Variable Name List	Description
Case Number	System Generated Unique Case Identifier and Regional Indicator
Accident Date	Day, Month, Year
Age	Years
Gender	Male /Female
Road User Type	Pedestrian, Driver, Passenger, Cyclist
Crash Detail	Region e.g., Khomas, Erongo, Hardap
Crash type	Collisions, Roll-overs, Others, With fixed objects, With animals
Primary response	Private ambulance, State ambulance, private vehicle
Injury	ISS
Triage to hospital	Primary admission facility: State hospital, Private hospital
Level of care	Primary admission type-ICU, High care, General/Surgical ward
Secondary admission	State hospital, Private hospital, Stepdown facility
Length of stay	Number of days (admission in healthcare facility)
Patient outcomes	Discharged, died, Ongoing rehabilitation, still on admission for active treatment

Appendix C: Variables for the Retrospective Review

Variable	Position	Label	Measurement Level	Column Width
Crash serial number	1	Crash serial number	Nominal	14
Region 1	2	Erongo=2, Hardap=3, Karas=1, Kavango East=4, Kavango West=5, Khomas=6, Kunene=7, Ohangwena=8, Omaheke=9, Omusati=10, Oshana=11, Oshikoto=12, Otjozondjupa=13	Scale	12
Age	3	Age	Scale	12
Gender 1	4	Male =2, Female=1	Nominal	12
Person class A	5	Driver=3, Motorcyclist=4 ,Other=5, Passenger=1, Pedestrian=2	Scale	12
Transported by 1	6	MVA Ambulance=5, Police=4, Private Ambulance=6, Private Vehicle=1.State Ambulance=3.Unknown=2	Scale	12
Place of death	7	Place of death	Nominal	7
Crash type	8	Collisions=1, Fell/Jumped from moving vehicle=2, Other/Unknown=6, Pedestrians=3, Rollovers=4.With fixed objects=5	Nominal	31
Crash cause	9	Driving without licence=1, Mechanical Failure=2, No Licence,Speeding,Intoxicate=3, Other=4, Overtaking=5, Poor Road Conditions/Design=6, Ran Across the Road=7, Reckless and Negligent Driving=8, Speeding=12, Tire burst=9, Under Investigation=10, Unknown=11, Weather Condition=13	Nominal	30
Case serial	10	Case serial	Nominal	14
Sub status	11	Sub status	Nominal	24
Rehab plan	12	Rehab plan	Nominal	1
Injury description	13	Injury description	Nominal	50
Injury severity	14	Injury severity	Nominal	22
Hospital details	15	Hospital details	Nominal	50
Headneck	16	No injury = 0, Minor=1, Moderate=2, Serious=3, Severe=4, Critical=5, Maximal (incompatible with life) =6	Scale	12

Variable	Position	Label	Measurement Level	Column Width
Face	17	No injury = 0, Minor=1, Moderate=2, Serious=3, Severe=4, Critical=5, Maximal (incompatible with life) =7	Scale	12
Thorax	18	No injury = 0, Minor=1, Moderate=2, Serious=3, Severe=4, Critical=5, Maximal (incompatible with life) =8	Scale	12
Abdomen	19	No injury = 0, Minor=1, Moderate=2, Serious=3, Severe=4, Critical=5, Maximal (incompatible with life) =9	Scale	12
Extremities	20	No injury = 0, Minor=1, Moderate=2, Serious=3, Severe=4, Critical=5, Maximal (incompatible with life) =10	Scale	12
External	21	No injury = 0, Minor=1, Moderate=2, Serious=3, Severe=4, Critical=5, Maximal (incompatible with life) =11	Scale	12
Aiscalc	23	Aiscalc	Nominal	12
ISS	24	ISS	Scale	12

Appendix D: Variable Abstraction Format for EQ-5D-5L Data Collection

Variable Name	Definition	Response Format	Source	Notes for Interpretation
Mobility Score	Level of difficulty in walking or moving around	1–5 Likert scale	EQ-5D-5L Health Profile	1 = No problems, 5 = Unable to walk; proxy responses flagged if applicable.
Selfcare_Score	Ability to wash or dress oneself	1–5 Likert scale	EQ-5D-5L Health Profile	Higher scores indicate greater dependency.
Usual_Activities_Score	Ability to perform usual activities (e.g., work, study, housework)	1–5 Likert scale	EQ-5D-5L Health Profile	Contextualised for age and employment status.
Pain_Discomfort_Score	Level of physical pain or discomfort	1–5 Likert scale	EQ-5D-5L Health Profile	Consider comorbid conditions when interpreting elevated scores.
Anxiety_Depression_Score	Level of anxiety or depression symptoms	1–5 Likert scale	EQ-5D-5L Health Profile	May require cross-checking with clinical notes if available.
Eq_Vas_Score	Self-rated overall health status	0–100 scale	EQ-VAS	0 = Worst imaginable health, 100 = Best imaginable health.
region code	Region where the RTA occurred	System-generated code	MVA Fund serial number	Used for stratified analysis and regional comparisons.

Appendix E: Consent Form

Study Title: Epidemiology and patient-reported outcomes of polytraumatised patients involved in road Traffic Accidents in Namibia

Researcher: Hertlinda Munkanda

Institution: Namibia University of Science and Technology

Contact Information:

Mobile Number: 0812596053

Email: herklie@yahoo.com

Introduction

You are invited to participate in a research study assessing the health-related quality of life of polytraumatised road traffic accident (RTA) patients in Namibia using the EQ-5D questionnaire. Before you decide to take part, it is vital to understand why the research is being done and what your participation will involve. This form provides the information necessary for you to make an informed decision. You may ask questions at any time for further clarification.

Purpose of the Study

The purpose of this study is to evaluate the health-related quality of life of individuals who have sustained multiple injuries (polytrauma) as a result of RTAs in Namibia. The EQ-5D questionnaire, a standardised tool designed to measure different aspects of daily health and well-being, will be used. Your responses will help researchers understand the impact of RTI outcomes, their impact on daily life, and potentially contribute to improved care and policy planning in the future.

Procedures

- You will be asked a series of questions about your current health status, well-being and daily functioning.
- The questionnaire will take approximately 5 to 10 minutes to complete.
- Depending on your location and preference, the interview may take place **in person** or **over the telephone**.
- If the interview is conducted by phone, the researcher will clearly explain each question and record your responses.
- No physical procedures or medical examinations are required.

Voluntary Participation

Your participation in this study is entirely voluntary. You are free to refuse to participate or to withdraw from the study at any point without facing any consequences. However, please note that once the data is analysed and published, we will no longer be able to withdraw your responses.

Confidentiality

- All information you provide will be treated with strict confidentiality.
- Your responses will be recorded, analysed and published anonymously.
- No identifying information (such as your name, contact details, or any personal identifiers) will be collected or shared with third parties.
- All data will be stored securely and only accessed by the research team.

Risks and Benefits

There are no known risks associated with participating in this study. While there are no direct benefits to you, your contribution is valuable and may help improve services to others affected by RTAs in the future.

Consent Statement

By signing this form (for in-person interviews) or giving your verbal consent (for telephone interviews), you confirm that:

- You have read (or were read) and understood the information provided about the study.
- You have had the opportunity to ask questions and receive satisfactory answers.
- You voluntarily agree to participate in the study.
- You understand that you may withdraw your participation at any time, without any consequence.
- Use this questionnaire ID as reference on any queries In-person interview:

Participant Name (Print): _____

Signature: _____

Date: _____

Verbal Consent (for telephonic interviews):

☐ Participant has provided verbal consent to proceed with the interview**.**

Interviewer Name: _____

Signature: _____

Appendix F: Ethical Clearance

NAMIBIA UNIVERSITY
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School of Health Sciences

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W: www.nust.na

FACULTY OF HEALTH, APPLIED SCIENCES AND NATURAL RESOURCES

DECISION/FEEDBACK ON RESEARCH PROPOSAL ETHICAL CLEARANCE

Dear Prof/Dr/Mr/Ms/Other(s): Hertlinda Munkanda

Student No (if applicable): 9862609

Research Topic:	Epidemiology and patient-reported outcomes of polytraumatised patients involved in road traffic accidents in Namibia
Supervisor (if applicable):	Dr Andrit Lourens
Co-supervisor(s): if applicable	Ms JC Botha
Qualification registered for (if applicable):	Masters of Health Sciences

Re: Ethical screening application No: FHNRAS:57/2023

The Research Ethics Screening Committee has reviewed your application for the above-mentioned research project. Based on the recommendation of the expert reviewer, the research as set out in the application is hereby:

(Indicate with an X)

Approved: i.e. may proceed with the project	X	
Approved provisionally: i.e. may proceed but subject to compliance with recommendation(s) listed below		
Not approved: Not to proceed with the project until compliance with recommendation(s) listed below and resubmit ethics application for consideration		
IS MINISTRY OF HEALTH & SOCIAL SERVICES (MoHSS) APPROVAL REQUIRED?	YES:	NO: X

It is important to note that as a researcher, you are expected to maintain ethical integrity of your research, strictly adhere to the ethical policy of NUST, and remain within the scope of your research proposal and supporting evidence as submitted to the REC. Should any aspect of your research change from the information as presented, which could have an impact or effect on any research participants/subjects/environment, you are to report this immediately to your supervisor or REC as applicable in writing. Failure to do so may result in withdrawal of approval. Kindly consult your supervisor or HoD if you need further clarification.

We wish you success in your research endeavour and are of the belief that it will have positive impact on your career as well as the development of NUST and the society in general.

Ethical issues that require compliance/ must be addressed		
No.	**Ethical issues**	**Comment/recommendation**
1.	Permission	Permission must be obtained from MVA Fund before data is utilised.
2.		

NB: May attach additional page as required

Full Name (reviewer) Dr Larai Aku-Akai Signature: Date: **19 October 2023**

Full Name: Dr Larai Aku-Akai Signature: Date: **19 October 2023**
Chair: Ethics Screening Committee

Appendix G Completed STROBE Checklist for Cross-Sectional Studies

Item No.	Recommendation	Page(s) in Thesis	Complete	Comments/Details
Title and Abstract				
1	Indicate the study's design with a commonly used term in the title or the abstract	Title Page, Abstract	✔	"Cross-sectional" and "retrospective review" mentioned.
2	Provide in the abstract an informative and balanced summary of what was done and what was found	Abstract	✔	Structured abstract with Introduction, Methods, Results, Conclusion.
Introduction				
3	Explain the scientific background and rationale for the investigation being reported	1.1, 1.2	✔	Background, context, and problem statement provided.
4	State specific objectives, including any prespecified hypotheses	1.4	✔	Research questions, aims, objectives, and hypothesis stated.
Methods				
5	Present key elements of study design early in the paper	3.1, 3.2	✔	Dual-method: retrospective review and cross-sectional survey.
6	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	3.3	✔	Namibia, 2019–2022, MVA Fund, HRQoL assessment in 2025.
7	Give the eligibility criteria, and the sources and methods of selection of participants	3.4	✔	Inclusion/exclusion criteria and database source described.
8	For matched studies, give matching criteria and number of exposed/unexposed	n/a	n/a	Not applicable (not a matched study).
9	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	3.4, 3.5, 3.6, Appendices	✔	Variables, outcomes, and instruments (ISS, EQ-5D-5L) defined.
10	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if more than one group	3.5, 3.6, Appendices	✔	Data sources (MVA Fund, EQ-5D-5L), variable list, and settings.
11	Describe any efforts to address potential sources of bias	3.4, 3.5, 3.9	✔	Sampling method, exclusion of incomplete records, limitations discussed.
12	Explain how the study size was arrived at	3.4	✔	All eligible cases included (total population sampling).
13	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	3.7, 4.2	✔	Age groups, ISS categories, EQ-5D-5L scoring explained.

14	Describe all statistical methods, including those used to control for confounding	3.7	✔	Descriptive, cross-tabulation, regression models described.
15	Describe any methods used to examine subgroups and interactions	4.2.4, 4.3	✔	Regression analyses, predictor variables, subgroup analysis by gender and region.
16	Explain how missing data were addressed	3.5, 3.9	✔	Excluded incomplete cases, limitations discussed.
17	If applicable, describe analytical methods taking account of sampling strategy	3.7	✔	Analytical approach appropriate for total population sampling.
18	Describe sensitivity analyses	3.9	✔	Not explicitly reported; limitations acknowledged.
Results				
19	Report numbers of individuals at each stage of study—e.g., numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	4.1, 4.3	✔	Flow of participants through phases and numbers excluded.
20	Give reasons for non-participation at each stage	4.3	✔	Opted out, not contactable, deceased.
21	Consider use of a flow diagram	4.1	✔	Added for clarity.
22	Give characteristics of study participants (e.g., demographic, clinical, social) and information on exposures and potential confounders	4.2, 4.3	✔	Demographics, injury characteristics, confounders described.
23	Indicate number of participants with missing data for each variable of interest	4.3, 3.9	✔	Missing data discussed in limitations.
24	Summarise follow-up time (e.g., average and total amount)	n/a	n/a	Not applicable (cross-sectional/retrospective).
25	Report numbers of outcome events or summary measures	4.2, 4.3	✔	Prevalence, ISS, EQ-5D-5L outcomes reported.
26	Report unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included	4.2.4, 4.3.4	✔	Regression coefficients, p-values, confidence intervals reported.
27	Report category boundaries when continuous variables were categorised	4.2, 4.3	✔	Age groups, ISS categories defined.
28	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a	n/a	Not directly relevant for this prevalence study.
29	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	4.3, 5	✔	Subgroup analyses by gender, region, and crash type.

Discussion				
30	Summarise key results with reference to study objectives	5.1, 5.4	✔	Discussion addresses all aims and objectives.
31	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	3.9, 5.5	✔	Limitations, potential biases, and generalisability discussed.
32	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	5, 6	✔	Overall interpretation cautious and contextualised.
33	Discuss the generalisability (external validity) of the study results	5.5, 6	✔	Generalisability (limitations to MVA Fund clients etc.) discussed.
Other Information				
34	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Title Page, Acknowledgements	✔	Funding and institutional support stated.
35	State ethical approval from an appropriate committee and that participants gave informed consent	3.8, Appendix D	✔	Ethical approval and consent described and appendix included.

Appendix H: RECORD Statement Checklist for Use of Routinely Collected Health Data

No.	Item	Thesis Location	Completed	Comments
1	The type of data used should be clearly described.	3.4, 3.5	✔	MVA Fund routine case management database, Google Sheets, Siebel.
2	The study population included in the analysis should be described, including how data were linked.	3.4, 3.5	✔	All eligible individuals aged 5-29, data linkage via unique case numbers.
3	The methods used to select the study population (codes or algorithms) should be detailed.	3.4, Appendices	✔	Inclusion/exclusion criteria, variable list, and ISS threshold specified.
4	Any validation studies of the codes or algorithms used to select the population should be referenced.	3.4, References	✔	ISS and EQ-5D-5L referenced as validated tools.
5	A complete list of codes and algorithms used to classify exposures, outcomes, confounders, and effect modifiers should be provided.	Appendices	✔	Full variable and coding list included.
6	Data cleaning methods should be described.	3.5, 3.6	✔	Data cleaning, exclusion of incomplete records, verification described.
7	Data linkage methods and quality evaluation should be described.	3.6	✔	Linkage by unique numeric identifiers, cross-validation by research team.
8	Ethical approval and consent procedures for use of routinely collected data should be described.	3.8, Appendix D	✔	Ethical approval and processes for consent/waiver described.
9	The limitations of using routinely collected health data should be discussed.	3.9, 5.5	✔	Data completeness, potential misclassification, generalisability.
10	Access to the data and code should be declared (if applicable).	3.6	✔	Data available only to researcher/supervisors/statistician; not public.

Appendix I: Language Editing Letter

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Faculty of Commerce, Human Sciences and Education – Department of Communication and Languages

Email: mmhene@nust.na

Tel: 61 207-2095 Cell: 0812954690

27 November 2025

TO WHOM IT MAY CONCERN.

I am writing to certify that a thesis titled***: "Epidemiology and Patient-Reported Outcomes of Polytraumatised Patients Involved in Road Traffic Accidents in Namibia"*** presented in fulfilment of the requirements for the degree of Master of Health Sciences at the Namibia University of Science and Technology (NUST) was presented to me by **Hertlinda Munkanda** student number **9862609** for **LANGUAGE EDITING**.

Neither the thesis content nor the author's intentions were altered. The content guarantees the quality of English Language in this thesis. The editor's track changes were accepted and further changes made by the author were checked and a final version of the thesis was sent to the author for submission, examination and repository.

Do not hesitate to contact me if you have any queries. Thank you.

Yours sincerely

Prof Max Mhene

(Associate Professor: Linguistics, Literature and Communication)

Appendix J: Turnitin Similarity Report

Dr Andrit Lourens

Final Thesis_H Munkanda_9862609_1 Dec 2025

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Integrity Flags

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Our system's algorithms look deeply at a document for any inconsistencies that would set it apart from a normal submission. If we notice something strange, we flag it for you to review.

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Top Sources

12% Internet sources
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The sources with the highest number of matches within the submission. Overlapping sources will not be displayed.

1	Student papers	Federation University on 2022-06-14 2%
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