A mixed methods scoping review of gender and life stage as risk factors of injury-related mortality in the Western Cape, South Africa.

CHELSEY MELISSA VOEGT

VGTCHE001

Supervisor: Professor Victoria Gibbon

Co-supervisor: Dr Elizabeth Dinkele

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Name:	**Chelsey Melissa Voegt**
Student number:	**VGTCHE001**
Signature:	Signed by candidate
Date submitted:	**15 January 2024**

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ABSTRACT

Injury-related mortality is a growing public safety concern in South Africa, especially in the Western Cape Province. Several studies have identified gender and age as risk factors of injury-related mortality, although there remains a scarcity of interstudy comparisons of these factors, and the underlying perceptions of causes linked to these. In this study, a scoping review of injury-related mortality from medicolegal death investigations in the Western Cape was conducted by screening online databases for research articles published between 2007 and 2021. Of the 11 articles, six were included in a quantitative analysis to quantify risk by gender and life stage. To assess conceptualisations of these risk factors in research, each article was evaluated using a thematic content analysis.

Men were associated with a higher mortality risk for homicide (inclusive of sharp force and firearm causes), suicide, road traffic (and transport-related) deaths, and drowning. The likelihood of homicidal deaths in males (OR = 3.95; 95% CI [3.48 – 4.49]; $p \leq 0.001$) was higher than all other causes of injury-related mortality (OR = 0.25; 95% CI [0.22 – 0.29]; $p \leq 0.001$). For all causes of injury-related mortality, early adults (20 – 34 years) and middle-aged adults (35 – 49 years) accounted for the most deaths. Homicide was the most significant cause of mortality in early adults, adolescents and middle-aged adults, while road traffic deaths were the leading cause of mortality for infants and children and adults above 49 years of age.

Qualitative results from the thematic content analysis suggest that the discourse of violence and injury in the literature differed by gender. Women were more commonly discussed with reference to vulnerability and victimhood. Contrastingly, men were portrayed with reference to culpability – regardless of whether they were victims or perpetrators of violence. Masculinity as a cause of violence, in the literature, was discussed relative to socio-economic conditions and cultural norms leading to risk-taking behaviours. Limited agency and lifestyle behaviours were described as primary causes of violence linked to life stage. Risk of injury in minors was attributed primarily to structural causes of violence, and cognitive reasoning and development linked to life stage.

Overall, these results highlight gender-linked biases in forensic death reporting. Injury-related deaths and homicides affected more males, yet males were primarily represented as perpetrators of violence. Given the drive to eradicate gender based-violence, this study emphasises the need to address structural causes of violence targeted at expressions of masculinity, social cohesion and identity in different life stages, and genders and the need for an intersectional approach to understanding medicolegal death investigations and injury-related mortality in the Western Cape and South Africa.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

ASMR – Age-Standardised Mortality Rate

CI – Confidence Interval

FACT – Forensic Anthropology Cape Town

FPS – Forensic Pathology Services

GBD – Global Burden of Disease

HIV/AIDS – Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome

IMS – Injury Mortality Survey

NIMSS – National Injury Mortality Surveillance System

OR – Odds Ratio

PRISMA-ScR – Preferred Reporting Items for Systematic Reviews and Meta-Analyses and extension for Scoping Reviews

RTC – Road Traffic Crashes

RTMC – Road Traffic Monitoring Company

SAPS – South African Police Services

SES – Socioeconomic Status

SRM – Salt River Mortuary

UNODC – United Nations Office on Drugs and Crime

WHO – World Health Organization

CHAPTER 1: INTRODUCTION

Injuries are a serious public health concern and contribute significantly to the overall number of deaths each year, with four million deaths caused by injuries in 2019 (World Health Organisation (WHO), 2021). Various types of injuries may lead to death, such as those arising from road traffic incidents, drowning, electrocution, homicide, suicide, falls and other causes of unintentional injuries. Everyone, regardless of their gender, age, socioeconomic status or geographical background, is susceptible to injury-related mortality, however, differences in the distribution, risk factors, and experiences of injury have been reported (Mathers *et al.,* 2000; Polinder *et al.,* 2007; Chalya *et al.,* 2012; Yadollahi *et al.,* 2015; Haagsma *et al.,* 2016). Globally, injury-related mortalities appear most commonly in men and young adults (15 – 29 years) (Mock, 2001; Marmot, 2005; Norman *et al.,* 2007; Wang *et al.,* 2008; Alexandrescu *et al.,* 2009; Mayosi *et al.,* 2009; Sorenson, 2011; Matzopoulos *et al.,* 2015; WHO, 2021; Bairami *et al.,* 2023; Roomaney *et al.,* 2023).

In South Africa, the all-case age standardised mortality rate in 2012 was 1,232 per 100 000 population (Pillay van Wyk et al., 2016). Of these deaths, the main causes-of-death were non-communicable disease (57.8%), followed by communicable diseases (29.8%) and finally injuries (12.4%) (Statistics SA, 2021). Injuries do not contribute a large proportion of the annual deaths, however, the rates by cause-of-death contribute to the higher ranking. This distribution is vastly different to the global pattern where most deaths were due to non-communicable (74%) and communicable diseases (14%) whilst injuries have a small contribution (7.4%) (Roser, 2021). A large proportion of these are unnatural deaths, of which injury-related mortality is the main contributor (Saayman, 2020). Unnatural deaths include those due to direct or indirect influence and its resulting complications; a chemical or electrical influence; those from an act of omission or commission; deaths where neglect or negligence may be involved; deaths while under anaesthesia; and any other sudden, unexpected and unexplained deaths (Inquests Act No.58 of 1959, 1960; Western Cape Government, 2014). In countries like South Africa, intentional injuries consistently exceeded unintentional injuries as a cause-of-death, and unsurprisingly these were associated with a high frequency of interpersonal violence and road injuries (Norman *et al.,* 2010; Matzopoulos *et al.,* 2015; Schuurman *et al.,* 2015; Msemburi *et al.,* 2016; Zaidi *et al.,* 2019; Marle *et al.,* 2021). Furthermore, homicide was the leading manner-of-death accounting for 42% of the unnatural deaths in 2020/21 (Roomaney *et al.,* 2023).

Studying injury-related mortality is important for several reasons. Firstly, to decrease the intangible costs incurred with the loss of life, disability, psychological trauma and grief experienced by both the family and community. Secondly, to reduce the financial burden placed on the economy and healthcare system from the financial costs incurred for medical treatment and loss of productivity in the workplace. Lastly, to reduce inequalities and promote equity, addressing and understanding the risk factors enabling injury-related mortality can be useful to provide evidence-based data to inform policymaking.

Understanding the aetiology of injury-related mortality is challenging as it is a multifactorial problem with several contributing factors, including, but not limited to, demographic, social, economic, and cultural factors. National and provincial research has been done to assess South Africa's injury-related mortality burden (Matzopoulos et al., 2015; Msemburi et al., 2016; Prinsloo et al., 2021; Roomaney et al., 2023). However, there remains a disconnect between official statistics and mortuary records leading to misinformation and inaccurate avenues for policy design and intervention. Furthermore, medicolegal reporting reflects a trend for prioritisation of popularity over comprehensive reporting, leaving critical discussions on prevention underexplored. Several studies have identified gender and life stage as risk factors of injury-related mortality. A problem relating to the scarcity of interstudy comparisons of gender and life stage as risk factors of injury-related mortality and the underlying perceptions of causes linked to these risk factors remains and thus needs to be addressed. Therefore, through this research it is aimed to assess gender and life stage as risk factors of injury-related mortality by analysing how the quantitative statistics are presented in comparison to the conceptualisation (qualitative) and reporting of injury mortality and risk in Western Cape medicolegal death investigations.

Following the introduction, the thesis is organised into five chapters. Chapter Two ('Background and literature review') begins with a review of injury-related mortality rates at a global and national level. Thereafter, gender and life stage are explored as risk factors and how data is reported and conceptualised. The chapter ends with the aims, objectives, research questions and hypotheses. Chapter Three ('Methodology') details the study design and research methods employed for each component (quantitative and qualitative) of the mixed methods study. Chapter Four ('Results') provides an overview of the findings obtained in the study and presents data from the scoping review, the gender and life stage patterns for different causes of injury-related mortality, and how researchers discuss gender and life stage and the contributing causes as risk factors of injury-related mortality. Chapter Five ('Discussion') explores the

findings in the context of the outlined research questions: i) how do gender and life stage affect the risk of injury-related mortality? ii) the conceptualisation and reporting of injury risk in research, and iii) the relation of quantitative and qualitative findings. Lastly, chapter Six ('Conclusions') re-iterates the study aims and summarises the key findings by answering the research questions before concluding with suggestions for future research.

CHAPTER 2: BACKGROUND & LITERATURE REVIEW

At the outset of this thesis, it is important to define some critical terms related to the work of interest. The term "injury" denotes harm to the body at an organic level resulting from acute exposure to external energy (electrical, chemical, thermal, radiation, or mechanical) in amounts exceeding the threshold of physiological tolerance (Krug *et al*. 2002). Injury-related incidents can be either fatal, providing statistics estimating a country's injury-related mortality, or non-fatal, offering an estimate of either the country's ongoing morbidity or absence of morbidity. In the context of this thesis, a risk factor refers to any variable that increases the susceptibility of an individual or subgroup of the population to developing a particular disease, condition, or outcome (Panter-Brick, 2014).

2.1 Injury-related mortality

Common yet preventable occurrences, injuries continue to cause death and are a burden to the population's health and safety regardless of age, gender, income, or geographical region (Krug *et al.,* 2002; James *et al.,* 2020). Globally, injury-related deaths continue to increase and claimed 4.4 million lives in 2019, constituting approximately 8% of global deaths that year (James *et al.,* 2020; WHO, 2021). In 2018, the global age-standardised mortality rate (ASMR) for injury was 57.9 per 100,000 population, reflecting a 13.7% decrease in the ASMR since 2007 (Global Burden of Disease (GBD), 2018). Of all causes of injury-related mortality, road traffic injuries accounted for the most deaths, followed by suicide and homicide (GBD, 2018; WHO, 2021).

Several researchers have observed an inverse relationship between socioeconomic status (SES) and injury mortality rates, with individuals of lower SES being most affected by injury and experiencing higher rates of both fatal and non-fatal injuries (Cubbin *et al.,* 2000; Burrows *et al.,* 2012; Denney *et al.,* 2014; Madsen *et al.,* 2022; WHO, 2022). Research on injury-related mortality and the associated patterns indicates vast differences in the distribution, determinants, and experiences of injury within and between countries (Mathers *et al.,* 2000; Mo, 2001; Polinder *et al.,* 2007; Chalya *et al.,* 2012; Yadollahi *et al.,* 2015; Haagsma *et al.,* 2016; James *et al.,* 2020; WHO, 2022). Research has demonstrated an unequal distribution of injuries and violence, with higher rates of fatal injuries observed in low-middle-income countries compared to their high-income counterparts (Peters *et al.,* 2002; Chandran *et al.,* 2010; WHO, 2022). In 2014, the World Health Organization reported that suicide, road traffic

injuries, and falls were the leading causes of injury-related deaths in high-income countries. In contrast, homicide and road traffic injuries were the leading causes of injury-related mortality in low-middle-income countries. This highlights that everyone's injury risk is not equal and that individuals of low socioeconomic status carry higher risk for injury encounter and injury-related mortality.

Several studies highlighted an unequal gender distribution for injury-related mortality and risk (Morrongiello & Dauber, 1998; Yadollahi *et al.,* 2015; WHO, 2021). Men exhibited a higher rate of being victims of all injury-related mortalities compared to women. In 2019, both genders across all age groups experienced interpersonal violence and suicide among the top ten causes-of-death (WHO, 2021). However, distinct patterns emerged when assessing common contributors to injury-related mortality between genders. For women, none of the top ten causes-of-death were injury-related, while for men, three of the top ten causes-of-death (interpersonal violence, suicide, road traffic injuries) were caused by injuries (WHO, 2021).

More specifically, injury-related mortality patterns deviate from general life stage mortality patterns, showing lower death rates in young children and the elderly and higher death rates in adolescence and early adulthood (Levitis & Martínez, 2013; Camarda *et al.*, 2022). Specifically, individuals between 15 and 29 years old bear a disproportionately large injury burden, accounting for 25% of total deaths, with three of the top five causes-of-death—road traffic injuries, homicide, and suicide—being injury-related (Lopez *et al.,* 2006; WHO, 2021; 2022). Although accidental deaths are the leading cause of injury-related mortality, differences exist within each life stage. Falls, burns, and drowning were the leading causes of injury-related mortality in children, compared to road traffic injury for adolescents (Murray, 2006). The complexity of injury-related risk associated with life stages involves multiple interactions, experiences, and factors (biological, physical, cognitive, and sociocultural) that mediate risk throughout life (Warrington & Wright, 2001; Agran *et al.*, 2003; MacInnes & Stone, 2008).

2.2. The South African context

In South Africa, injuries and trauma resulting from external forces are categorised as unnatural deaths and fall under the purview of medicolegal death investigation. The Inquests Act (Act 58 of 1959) in South Africa mandates the process of medicolegal death investigation, ensuring a thorough examination and investigation into any unnatural, sudden, unexpected, or unexplained death (Inquests Act No.58 of 1959, 1960).

Hanzlick (2003) highlighted that these investigations play a crucial role in social and criminal justice, necessitating collaborative efforts across the medical, legal, and law enforcement disciplines.

In the South African medicolegal death investigation, Forensic Pathology Services (FPS), South African Police Services (SAPS), and the Department of Justice all have a role to play in the investigative process. An inquest's magistrate is charged with the responsibility of determining the manner-of-death and assessing whether anyone should be held accountable for the demise of the individual in question. The SAPS, operating within the Department of Justice, assumes the duty of investigating the circumstances surrounding the suspected unnatural death, concurrently assuming responsibility for establishing the identification of the deceased individual (Inquests Act No.58 of 1959, 1960; Saayman, 2020). Conducting a comprehensive examination of the decedent's body, an authorised pathologist at the residing FPS facility carries out a postmortem analysis. This examination aims to probe the medical circumstances, ascertain the cause-of-death, and maintain custody of the decedent's body until the investigation concludes (Dinkele *et al.,* 2022). In most cases, the pathologist examines remains with available soft tissue, however, not all human remains are readily identifiable because of burning, decomposition, and mutilation. In these instances, the pathologist may solicit support from specialised experts such as toxicologists, histologists, and anthropologists to aid in the identification of remains (Morris, 2011; Baliso *et al.,* 2019; Smith, 2020).

During apartheid and until 2006, the Department of Justice and SAPS oversaw medicolegal investigations, including postmortem examinations (Dinkele *et al.,* 2022). Concerns were raised about the integrity and objectivity of postmortem examinations during and after apartheid due to the direct involvement of individuals employed by the SAPS, particularly in cases implicating the police (Saayman *et al.,* 2020). In response to these concerns, the National Health Act (Act No. 61 of 2003) was enacted in 2004 to establish an independent medicolegal process. This legislation empowered provincial health departments to oversee the medicolegal investigation of deaths by establishing a dedicated FPS facility (Dinkele *et al.,* 2022). By 2006, the reorganisation of the medicolegal system in South Africa was successfully implemented, resulting in the transfer of all medicolegal death investigations from the SAPS to the Department of Health (Evans *et al.,* 2018; Dinkele *et al.,* 2022).

2.2.1. Research on injury-related mortality

Various sources, including mortuary surveillance, the national injury mortality surveillance system (NIMSS), the road traffic monitoring company (RTMC), the home affairs death

registry, and police records, provide avenues for obtaining information on external causes-of-death. However, discrepancies in the prevalence of injury mortality rates have been identified and misclassification of injury-related statistics remains a national issue. A study done by Matzopoulos *et al*. (2015) found a disconnect between mortuary records and statistics in South Africa data obtained from police records and the RTMC on murder and transport incidents as causes-of-death. They noted a homicide rate 13% higher than what was reported by SAPS and observed 24% more road traffic deaths than the figures the RTMC recorded (Matzopoulos *et al*., 2015). This disconnect was mainly a result of the misclassification of the above two causes as unintentional deaths leading to the under-representation in national records (Matzopoulos *et al*., 2015; Groenewald *et al*., 2016; Prinsloo *et al*., 2017). This disconnect produced misleading and inaccurate data and may partly explain why so much research on injury-related mortality has been conducted to get a more accurate profile of injury-related mortality (Bradshaw *et al.,* 2003; Flisher *et al.,* 2006; Norman *et al.,* 2007; Mosiane, 2009; Norman *et al.,* 2010; Garrib *et al.,* 2011; Mendes *et al.,* 2011; Msemburi *et al.,* 2016; Prinsloo *et al.,* 2019; Prinsloo *et al.,* 2021). This underscores the importance of utilising mortuary data to inform policy and decision-making.

In the year 2000, injuries accounted for approximately 12% of deaths (Bradshaw *et al.,* 2003), with 77% of these occurrences observed in men. A more recent study by Msemburi *et al*. (2016) reported that injuries contributed to 10% of the annual death rate. The injury mortality surveys (IMS) in South Africa are mortuary-based studies that provide gender, age, and cause-specific incidence rates for the injury burden (Matzopoulos *et al.,* 2013; Prinsloo *et al.,* 2021; Roomaney *et al.,* 2023). The 2017 IMS reported an overall ASMR of 100.3 per 100,000 populations (Prinsloo *et al.,* 2021), reflecting an 8% decrease in the overall ASMR since the 2009 IMS, suggesting progress towards reducing the burden of injury-related mortality in South Africa. Intentional injuries consistently exceed unintentional injuries, with a 10.9% increase in the murder rate being reported for the second quarter of the 2023/24 financial year, compared to the previous year's (2022/23) second quarter crime statistics (Western Cape Government, 2023). The high unnatural mortality rate is associated with a high frequency of interpersonal violence in both deceased (Norman *et al.,* 2007; Matzopoulos *et al.,* 2015; Prinsloo *et al.,* 2021) and living individuals (Schuurman *et al.,* 2015; Zaidi *et al.,* 2019; Marle & Mash, 2021). As observed in other countries, unequal distributions and rates of injury-related mortality have been reported within South Africa, with gender and life stage identified as risk factors for injury (Norman *et al.,* 2007; Mosiane, 2009; Norman *et al.,* 2010; Garrib *et*

al., 2011; Mendes *et al.,* 2011; Msemburi *et al.,* 2016; Prinsloo *et al.,* 2019; Prinsloo *et al.,* 2021).

The Western Cape province is one of the nine provinces in South Africa with high population density in the City of Cape Town (4.8 million citizens) (Statistics South Africa, 2019; WC Government, 2023). Second to the Gauteng province, the Western Cape has the highest proportion of unnatural deaths (13.6%) with most caused by accidental injury (66.2%) (Statistics South Africa, 2019). Since 2003, the Western Cape's injury-related mortality rate has gradually decreased, but it remains high at 123.6 per 100,000 population (Pillay van Wyk, 2016; Prinsloo *et al*., 2021). The prevalence of assault-related mortality in the Western Cape is 20.5%, a number rising annually but also the leading cause of unnatural mortality in the province (Statistics South Africa, 2019; Prinsloo *et al*., 2021). This places pressure on mortuaries like the Salt River Mortuary (SRM) where pathologists regularly conduct 20 autopsies per day (Reid *et al*., 2019, 2020; WC Government, 2023).

Furthermore, firearms are the leading mechanism of homicide in the Western Cape (30.4 per 100 000 population) – a finding unique to the province (Statistics South Africa, 2019; Prinsloo *et al*., 2021; Roomaney *et al*., 2023). Between 2019 and 2020, the proportion of firearm-related homicides had increased by 6% whilst a decrease had been observed with every other mechanism of homicide (Navsaria *et al*., 2023). Reasons for the high rate of firearm-related violence have been linked to gang violence and gang-related killing in the Western Cape, poverty, organised crime and corruption, high levels of licensed and unlicensed firearm ownership, decreased effectiveness of law enforcement and drug trafficking (Krug, 2000; SAFCA, 2000; Seedat *et al*., 2009; Centre for the Study of Violence & Reconciliation, 2010; Siegel *et al*., 2013; Matzopoulos *et al*., 2018, 2023; UNODC, 2023; Western Cape Government, 2023). Furthermore, firearms were historically associated with control and violence during the apartheid era, with the literature suggesting that this contributes to the legacy of gun violence as well (Matzopoulos *et al*., 2018).

2.2.2.Injury-related mortality and gender

South African boys and men faced an elevated risk of injury and subsequent mortality compared to women, resulting in a disproportionate injury burden (Bradshaw *et al.,* 2005; Norman *et al.,* 2007; Matzopoulos, 2008; Gamb, 2011; Matzopoulos *et al.,* 2012; Matzopoulos *et al.,* 2015; Pillay van-Wyk *et al.,* 2016; Groenewald, 2017; Prinsloo *et al.,* 2019; Prinsloo *et al.,* 2021). Bradshaw and colleagues (2005) showed that the injury rate for men was three times higher than that for women, with the most significant gender disparities observed in the

Western Cape and Gauteng provinces. This trend persisted in rural and urban settings, as evidenced by a study in Mpumalanga, where, over an 8-year period, men were more likely to comprise the case record compared to women (Mosiane, 2009). A more recent study showed that nearly 80% of unnatural deaths were in males, with the highest male-to-female ratio being observed for homicide, with nearly seven male deaths for every female death (Roomaney *et al*., 2023).

Both genders are at risk of injury-related mortality by all causes, however, some injuries are more common than others. For example, road traffic injuries were the primary contributor to women and girls' unnatural deaths, while for men, deaths were predominantly attributable to interpersonal violence (Morrongiello & Dauber, 1998; Norman *et al.,* 2007; Matzopoulos *et al.,* 2012; 2015; Yadollahi *et al.,* 2015; Msemburi *et al.,* 2016; Prinsloo *et al.,* 2021; WHO, 2021;). Men were 6.5 times more likely to succumb to homicide compared to women, and this difference may imply that the experiences and risks which men are exposed to contribute to an elevated mortality risk (Prinsloo *et al.,* 2021). Homicides in men peaked at 15 – 29 years, whereas for females, it peaked later at 30 – 44 years (Norman *et al.,* 2007). When examining common mechanisms of homicide, sharp force trauma ranked highest for both genders, followed by firearm and blunt force trauma (Prinsloo *et al.,* 2021). Strikingly, strangulation as a mechanism of homicide occurred more frequently in women (Mole, 2019; Prinsloo *et al.,* 2021). While many studies on injury-related mortality have provided gender and age prevalence rates for respective injuries, the literature lacks an exploration of the underlying reasons for the observed injury-related mortality patterns in South Africa. Therefore, further in-depth research is required to understand why some causes-of-deaths are more common in specific subgroups within a population.

Also notable, South Africa has a high interpersonal violence rate (24.4 per 100 000 population) with the female homicide rate reportedly seven times the global rate (4.0 per 100 000 population), a phenomenon attributed to gender-based violence (Norman *et al.,* 2007; Abrahams *et al*., 2009). These high rates of interpersonal violence in both men and women reflect the extent of the issue of violence in South Africa (Abrahams *et al*., 2016). Intimate partner violence, the killing of an intimate partner, is the leading cause of homicide for South African women; with research showing women were more likely to be victims than men (Krug *et al*., 2002; Abrahams *et al*., 2013; Matzopoulos *et al*., 2015). Explanations for these high rates of female victims include the normalisation of violence to resolve conflict and dominance and control over women as expressions of masculinity (Jewkes *et al*., 2002; Abrahams *et al*., 2013).

These behaviours become acceptable and tolerated within society and women begin to accept men to control them (Boonzaier, 2005). Furthermore, reporting on intimate partner violence is often victim-focused with limited information being reported on the perpetrators, therefore, limited research exists on the victim-perpetrator relationship (Abrahams *et al*., 2009). Whilst women are most often reported as victims and men as perpetrators, men also experience intimate partner violence

South Africa reported an ASMR of 13.4 per 100,000 populations for suicide, with higher rates in men than women (Garrib *et al.,* 2011; Matzopoulos *et al.,* 2015; Prinsloo *et al.,* 2021). When considering gender differences, suicide rates peaked at different life stages. In women and girls, suicide rates were highest among those aged 15 – 19 years, while in men, it was for those aged 25 – 29 years (Prinsloo *et al.,* 2021). Additionally, an association between suicide and higher socioeconomic status was found, although further research is required to fully understand this association (Matzopoulos *et al.,* 2015).

Other causes of external mortality include accidental events like transport mortalities, falls, drowning, burns/fire-related injuries and surgical/medical complications. Once again, men were disproportionately affected compared to women for all causes except for fire/burn-related injuries, which showed more deaths in women (Prinsloo *et al.,* 2021). Interestingly, both men and women were at risk of falls, however, older women carried greater risk and had a higher percentage of falls compared to men because of higher fracture risk due to osteoporosis being more common in women than men (Scott & Gallagher, 1999; El-Menyar *et al*., 2014; Kakara *et al.,* 2023). Transport-related injuries include those caused by motorised or road vehicles, such as motorbikes, cars, trucks, and bicycles. In South Africa, transport-related injuries were the leading cause of accidental deaths, with an ASMR of 25.6 per 100,000 populations and ranked as the second leading cause-of-death after homicide (Prinsloo *et al.,* 2021). It has been underscored as the primary cause of external mortality for women because of the elevated homicide death rates in men (Bradshaw *et al.,* 2005; Matzopoulos *et al.,* 2015). Despite this, men are still disproportionately affected, with the 2017 IMS noting 3.4 road traffic deaths in men for every woman's death (Prinsloo *et al.,* 2021).

In a study conducted on an anthropological sample from the Western Cape, authors also found gender and age patterns regarding trauma (Baliso *et al.,* 2022). Similarly, most of the decedents were men; however, the majority were middle-to-old aged adults (54%), while young adults and juveniles comprised a small proportion of the sample (29%). Antemortem

trauma, injuries inflicted while alive, presented three times more in men than women and were four to five times more common in middle-to-old aged adults when compared with young adults. This was expected as rates of trauma increased over time. Interestingly, no gender differences were observed for perimortem trauma (injuries inflicted around the time of death). However, young adults and juveniles were three times more likely to present with perimortem trauma compared with middle-to-old adults. Explanations for these injury-related mortality differences are yet to be explored in the Western Cape context.

2.2.3. Injury-related mortality and age

When evaluating causes-of-death across age groups, interpersonal violence and road traffic injuries emerged as the leading cause for individuals aged 15 – 44 years (Prinsloo *et al.*, 2021). Unintentional falls (fatal or non-fatal) were a leading cause-of-death in older-aged adults (>65 years) and were reportedly caused by various risk factors such as chronic conditions affecting mobility and stability, alcohol consumption and disabilities (WHO, 2021; Da Costa *et al*., 2020; Kakara *et al*., 2023). Unintentional injuries played a significant role in the external causes of mortality for children, with road traffic injuries being the primary contributor to deaths in children under five years and those aged 10 – 14 years (Norman *et al.,* 2007; Garrib *et al.,* 2011; Msemburi *et al.,* 2016; Mathews & van Niekerk, 2020). South African studies have identified age as a risk factor for injuries, emphasising that injury types and susceptibility vary throughout life, with certain life stages being more susceptible to death from specific injuries than others. However, these studies have not examined the underlying causes that render age a risk factor nor explored how the risk profile for injuries evolves throughout an individual's life.

2.3. Risk factors of injury-related mortality

Several categorical classifications of risk factors exist with the two most common pertaining to the degree of change that can be brought about to reduce risk (Panter-Brick, 2014). These include modifiable (*e.g*., socioeconomic status, proximity to safe play space, etc) and non-modifiable (*e.g*. gender, age, or ancestry) risk factors. The main difference is that modifiable risk factors can be altered to reduce risk of injury compared unlike non-modifiable risk factors. Although age and ancestry cannot be altered, they still have an influence on injury as they may either carry increased risk or decreased risk (Davey, 2000). While an individual's gender can be altered, expressions of male gender may escalate the likelihood of injury as research has shown males to have greater risk of injury-related mortality and death than female gender. The same can be said for children versus young adults or the elderly.

The perception and experience of risk vary depending on a multitude of factors that exist at the individual, social (rooted in family or community), environmental, systemic, and historical levels (Davey, 2000; Panter-Brick, 2014). Figure 2.1 illustrates the complexity of injury encounters, where numerous contributing causes—demographic, social, economic, political, and cultural factors, among others—are experienced individually and concurrently. Individual risk factors, denoted by the bold arrows (namely, gender, life stage, geospatial location, and socioeconomic status), directly impact susceptibility and injury occurrence. In addition to the direct impact, these risk factors may interact with each other and can potentially modify injury susceptibility by shaping how the individual risk factors are experienced. Besides individual risk factors, systemic risk factors encompass structural violence embedded in society's broader social, economic, and political systems. These factors may also contribute to shaping the experience of individual risk factors during life.

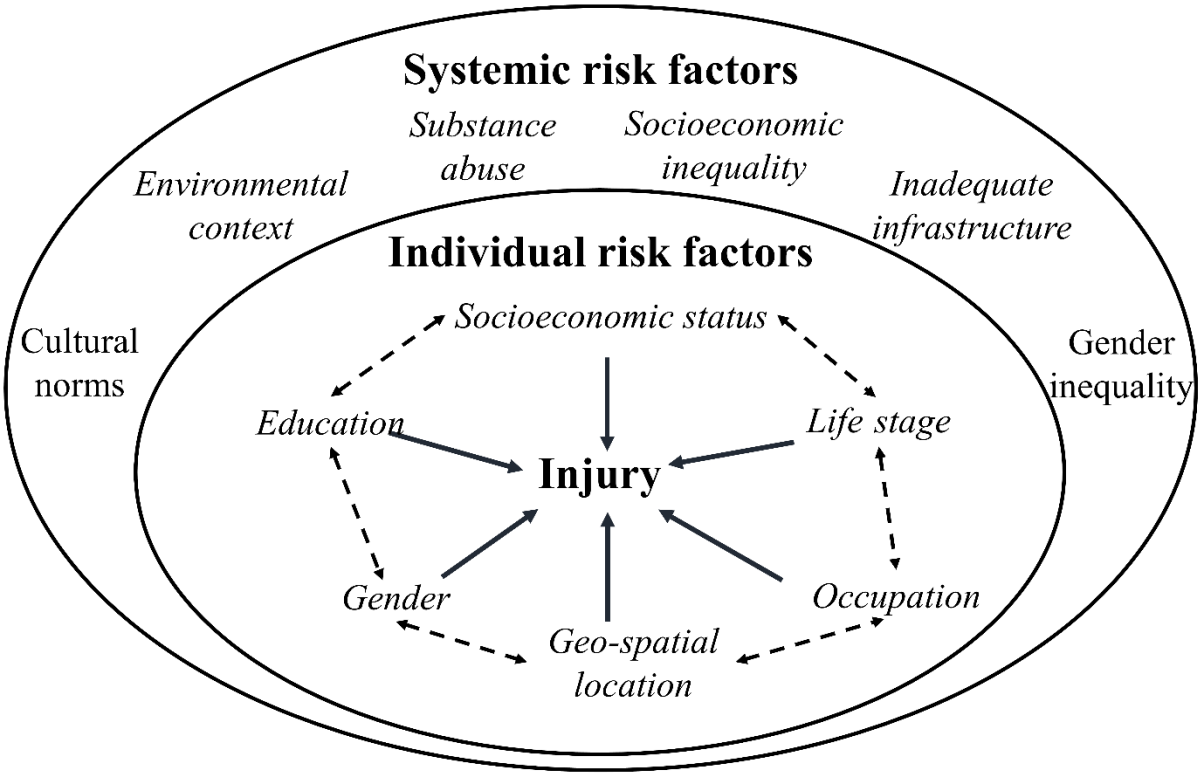

Figure 2.1. Conceptual diagram showing the complex network of individual and systemic risk factors of injury-related mortality.

2.3.1. Gender as a risk factor

Gender-specific injury patterns have been reported and continue to be shown in research with a 2017 study reporting three million injury deaths in men compared with 1.5 million deaths in women (Stillion, 1995; Morrongiello & Dauber, 1998; Yadollahi *et al.,* 2015; WHO, 2021)

Increased injury-related mortality has been associated with the male gender and at all stages of life, boys and men experienced injuries more frequently than women and girls (Baker *et al*., 1992; Morrongiello & Schwebel, 2008; Ratele, 2008). Gendered behaviours and processes of gender socialisation from a young age have been conceptualised as reasons for injury rate differences (Udry, 1998; MacInnes & Stone, 2008; Hawkes & Buse, 2013; Greig, 2016). Specifically, these socially constructed stereotypes and gender norms determine appropriate roles, behaviours and attitudes for men and women, which are inherited through generations (Greig, 2016; Wood, 2019).

A review of the literature has shown gender differences in risk-taking behaviours, and it has been suggested that these differences in risk-taking behaviours may explain the disproportionate male injury-related mortality burden (Morrongiello, 1997; Bauter *et al.,* 1998; Cherpitel *et al.,* 1998; Mawson *et al.,* 1998; Morrongiello & Rennie, 1998; Morrongiello & Matheis, 2004). A causal relationship has been established between risk-taking behaviour and being injured, where those more likely to partake in risk-taking behaviours were more likely to be injured (Turner *et al.*, 2004). One example of this relates to the higher death rate caused by unintentional falls in younger men compared to women, which has been linked to greater risk-taking behaviour and greater investment in high-risk occupations (WHO, 2021; Kakara *et al*., 2023). Risk-taking is a sexually dimorphic behaviour and is more often observed in men and boys than women and girls leading to more frequent harm and injuries in the male gender (Murray & Lopez, 1996; Udry, 1998; Davey, 2000; Ratele, 2008; Hawkes & Buse, 2013). Hillier & Morrongiello (1999) conducted a study on the risk-taking attitudes between boys and girls and found that all children could recognise varying degrees of risk, however, girls perceived risk more than boys (Hillier & Morrongiello, 1999). Interestingly, as men and women age, this pattern is reversed as elderly women are more at risk of falls than elderly men. This indicates that gender-linked factors associated with age (such as care provision, comorbidities and household expectations) also act to modify risk (Da Costa *et al*., 2020; Kakara *et al*., 2023).

Besides socialisation, Sorensen (2011) suggested that individual behaviours and lifestyle choices may also explain injury pattern differences between the genders. For example, men and boys may choose to partake in certain activities with greater risk (*e.g.*, joining a gang, excess alcohol consumption, gender segregation in occupation, *etc*) (Davey, 2000; Stergiou-Kita *et al.,* 2010). In this way, men's behaviours and choices to engage in certain activities or environments are linked to higher rates of being injured.

In South Africa, war and violence have shaped definitions of masculinity and as such, lived realities of masculinity differ (Connell, 2002; Greig, 2016). Hegemonic forms of masculinity are rooted in patriarchal notions and create environments where men are expected to behave in a certain way in response to conflict and thus encourage cultures of violence as men and boys are expected to display toughness and bravery as part of their masculinity (Morrel, 1998; Coovadia *et al.,* 2009; Shefer *et al..*, 2013; Baliso *et al..*, 2022). Masculinity can be experienced at a personal, interpersonal and structural level in society, and often, the social structures that shape masculinity are prominent. For example, how men and boys ought to express their masculinity is often dictated by society, where competing masculinities get silenced, and gender inequality and authority over women and girls are encouraged (Morrell, 1998; Wood & Jewkes, 2001; Coovadia *et al.,* 2009; Shefer *et al.,* 2013). They harm minority groups in society (women and children) and men who do not fit the conventional definition that society has of masculinity by exposing them to higher levels of injury, violence and mortality (Connell, 2002; Shefer *et al.,* 2013; Greig, 2016). These masculinities in society are not natural occurrences but result from continuous patterns of social practice and socialisation that are lived out daily (Connell, 2002; Shefer *et al.,* 2013). Furthermore, men's risk of death is not equal, as the environmental context may also influence the experience of masculinity. Therefore, considering the social context when discussing gender as a risk factor is important as it weaves together the effects of historical race, gender, and the socioeconomic divides of apartheid at both the individual and community levels.

2.3.2. Life stage as a risk factor

Variations in the primary causes of injury-related mortality across different life stages are attributed to underlying root causes and different influencing factors encountered by each life stage (Yin *et al.,* 2020). Children are most at risk of injury-related mortality because of their increased eagerness to explore their surroundings. However, as their brains are not fully developed, their ability to comprehend the dangers associated with their actions may be limited (Flavin *et al.,* 2006). Besides risk factors relating to brain development, children are dependent on adult supervision and care. When adult supervision lapses, children are negatively affected and their exposure to injury risk increases (Peden & Franklin, 2020). Lastly, the environments that children live in also create areas for risk with low socioeconomic status commonly identified as a risk factor for injury encounter in childhood due to the environmental hazards they are exposed to (McCall *et al.,* 1992; Hsieh & Pugh, 1993; Daniels & Pharoah, 2021).

In comparison, risk-taking behaviours have been used to explain the high rates of injury-related mortality in adolescents and young adults (Morrongiello & Matheis, 2007; Granié, 2010; Balocchini *et al.,* 2013; Damour, 2017; Willoughby, 2021). These risk-taking behaviours threaten adolescent health (Morrongiello & Matheis, 2007; Damour, 2017; Toska *et al.,* 2019). In addition, they also encounter various other factors that threaten their health and well-being with cognitive, biological and social influences identified as risk factors (Davey, 2000; Pickett *et al.,* 2002; Damour, 2017; Toska *et al.,* 2019). During adolescence, the important neural pathways required for critical thinking and decision-making are underdeveloped (Davey, 2000; Balocchini *et al.,* 2013; Damour, 2017; Shatkin, 2017; Camarda *et al.,* 2022). Therefore, imbalanced perspectives on risk and reward and the inability to understand the short-term dangers associated with their actions and behaviours contribute to increased injury-related mortality (Davey, 2000; Damour, 2017; Camarda *et al.,* 2022).

Besides risk-taking behaviours in adults, several other risk factors have been noted in the literature that are linked to increased risk of unintentional injuries (*e.g.,* falls) in older adults. These include increased injury encounter in older adults because of occupational risks contributing to injury-related mortality (Helmkamp *et al*., 2013). Decreased reflexes and delayed response times to potential dangers were also cited as risk factors for unintentional injuries because as people age, physical abilities linked to balance, core strength and flexibility change (Sturnieks *et al*., 2008; Ambrose *et al*., 2013). As shown, several factors have been cited in the literature, therefore, it is important to consider how these factors and their interplay contribute to greater rates of injuries across different life stages.

2.4. Conceptualisation and reporting of information

Conducting research and reporting it accurately is important for the progression of society as it can be used for educational purposes and knowledge advancement and for providing evidence-based work that can be used to inform social policy on the most appropriate means to address social issues. The way research is reported and framed is never entirely objective, as there is always an underlying bias in the interpretation and conceptualisation of results because researchers view their work from a specific perspective (Auriacombe & Schurink, 2012; Kaufman *et al*., 2020). This perspective depends on previous knowledge and is influenced by worldviews (Auriacombe & Schurink, 2012; Alele & Malau-Aduli, 2023).

Besides reporting and interpreting medicolegal research, the media also has a vital role in the dissemination of information. In the evolving media landscape, the focus often shifts towards sensational incidents that boost readership, frequently neglecting to provide insights

into potential solutions or preventive measures (Dempster *et al*., 2022). This trend reflects a prioritisation of popularity over comprehensive reporting, leaving critical discussions on prevention underexplored. News media has a particularly powerful influence in shaping worldviews, people's opinions, and biases (Singer & Endreny, 1993; Heng & Vasu, 2010; Kaufman *et al*., 2020). Death and violence are common topics reported on by the media, however, news media does not always report the true extent of crime and violence (Naylor, 2001). Moreover, over-emphasis and sensationalism of specific topics will increase readership and boost revenue (Heng & Vasu, 2010). Naylor (2001) found that 73% of the time, British newspapers portrayed men as offenders and women as victims of crime and violence. This portrayal of men and women differently is commonly referred to as gender bias and exists in news media and scientific research (Atkenson & Krebs, 2008; Upchurch, 2020). This gender bias in data reporting has harmful implications such as reinforcing biases and gender stereotypes, contributing to incorrect knowledge sharing, underscoring the true extent of violence and injuries and thus, misinforming policy and prevention strategies (Atkenson & Krebs, 2008; Leone, 2016; Willis, 2023). Therefore, studying how information is reported and conceptualised is important as it can influence society's thoughts and highlights why some issues receive more coverage than others.

2.5. Aims & objectives

This research aims to assess life stage, gender and injury-related mortality in Western Cape medicolegal death investigations.

To achieve this, the objectives of this work included:

i) Collect data on causes-of-death by age and sex using a scoping review.

ii) Identifying and describing the gender and life stage patterns of injury-related mortality that contribute to injury risk in medicolegal death investigations.

In relation to the data from the Western Cape, the research questions and hypotheses included:

i) How do gender and life stage affect the risk of injury-related mortality?
   a. If male gender is an influencing factor in injury risk, then more fatalities are expected among men compared to women.
   b. Should life stage be a determinant for injury risk, a higher frequency of deaths is expected among children and young adults

ii) How is injury risk conceptualised and reported in research?
   a. I anticipate that reporting and conceptualisations of research will mirror each other with greater focus on intentional causes of injuries.

Using the above hypotheses and research questions, the qualitative and quantitative findings will be compared to understand how researchers report and discuss gender and life stage as risk factors of injury in relation to their findings.

Understanding the elevated incidence of injury-related mortality in the absence of conflict within the country is particularly interesting (Msemburi *et al.,* 2016; Prinsloo *et al.,* 2021). The epidemiological and forensic-based literature in South Africa provides a substantial body of provincial and national data concerning the prevalence of injury-related mortality, as documented by various researchers (Peden *et al.,* 2002; Matzopoulos *et al.,* 2006; Norman *et al.,* 2007; Mosiane, 2009; Garrib *et al.,* 2011; Matzopoulos *et al.,* 2015; Prinsloo *et al.,* 2021). Insights into demographic risk factors associated with injuries encountered in a medicolegal context in South Africa have been elucidated (Bradshaw *et al.,* 2003; Norman *et al.,* 2007; Seedat *et al.,* 2009; Mendes *et al.,* 2011; Matzopoulos *et al.,* 2015; Msemburi *et al.,* 2016; Baliso *et al.,* 2020). Despite gender and age being identified as risk factors for injury in South Africa, interactions between these factors complicate the assessment of injury causation and the underlying sociocultural dynamics that contribute to the functioning of gender and age as risk factors remain inadequately understood in the South African context and are yet to be explored.

The field of bioarchaeology recognises that individuals undergo intricate life experiences shaped by diverse identities (Mant *et al.,* 2020). Intersectionality theory, developed from the work of black feminist scholars in the late 1960s and 1970s, emerged to investigate the 'multiple burdened' identities of black women residing in the United States (Crenshaw, 1989:140). This theoretical framework acknowledges that individuals possess multiple social identities, such as age, gender, race, socioeconomic status, and others (*i.e.*: work, sport, family and friend circles), which coexist and interact, creating and perpetuating social inequalities and discrimination (Crenshaw, 1989). It became a recognisable component of achieving social justice as it allowed the researchers to consider the influence of sociohistorical and structural inequalities in establishing and perpetuating power differentials in society (Bouleg, 2008; Cho *et al.,* 2013; Collins, 2015). For this reason, there has been increased utilisation of intersectionality theory within the field of bioarchaeology (Boutin, 2016; Torres-Rouff & Knudson, 2017). Therefore, this research adopts an intersectional lens, considering the influence of historical roots and patriarchy on the experience of trauma, violence, and injury in South Africa.

CHAPTER 3: METHODOLOGY

This section outlines the methods for data collection and analysis. Ethical approval for this study was granted by the University of Cape Town's Faculty of Health Sciences Human Research Ethics Committee (HREC# 430/2022) (Figure A1). A data management plan (DMP) was created to safeguard extracted data. Permission were obtained from the relevant principal investigators to access deidentified raw data.

A sequential mixed methods approach was used to explore the patterns and conceptualisation of gender and life stage as risk factors of injury-related mortality in Western Cape medicolegal death investigations (Tashakkori & Creswell, 2007; Shorten & Smith, 2017). A scoping review was conducted with a search strategy designed to identify articles from medicolegal research with data on unnatural deaths from any of the FPS facilities in the Western Cape. For articles to be included, they did not need to include data from across the entire Western Cape but it is noted that there is a likelihood that the data obtained will be skewed towards the main FPS facility servicing the City of Cape Town (Salt River Mortuary). The preferred reporting items for systematic reviews and meta-analyses – an extension for scoping review (PRISMA-ScR) guidelines were followed (*https://prisma-statement.org/Extensions/ScopingReviews)* (Tricco *et al.,* 2018). Similarities in methodologies, population and outcome measures were not done given this was not necessary for the kind of research questions posed. Once research articles were identified and screened for inclusion, quantitative data were extracted, and statistical analyses were applied to quantify risk by gender and life stage. Qualitative thematic content analysis of textual information was done to explore reporting patterns and conceptualisations of gender and life stage as risk factors for violence and injury in research. Triangulation of quantitative statistics and qualitative themes allowed data integration to identify convergences, complementarity, and discrepancies in the findings of the two data types (O'Cathain *et al.,* 2010).

3.1. Sampling and search strategy

Given the interdisciplinary nature of the research topic, four databases (PubMed, Web of Science Core Collection, Scopus and EbscoHost) were searched in September 2022 with the guidance of an experienced librarian at the University of Cape Town. Search terms included a combination of keywords relating to cause-of-death, forensics, and South Africa. The final search strategy applied to each database, accounting for the indexing terms, is presented in Table B1. Restrictions for the

publication year were applied to ensure that the data fell into the chosen study period (1 January 2007 until 31 December 2021). This study period was selected to analyse injury-related mortality after FPS was incorporated under the Department of Health.

3.1.1. Screening for inclusion

Search results and study information (Author details, article title, publication year, and journal name) and abstracts were imported into EndNote (EndNote 20 ™ v20.4.1) for screening. The PRISMA-ScR flowchart (Figure 3.1) was used for study selection. Duplicated articles were identified and removed before screening each article's content. The first stage of content screening involved assessing titles and abstracts for relevance to the objectives of this study (Table 3.1). Articles were included if they met all the inclusion criteria and excluded if they failed to meet the inclusion criteria or met the exclusion criteria for some aspects (Table 3.1). The supervisory team discussed ambiguous articles until a consensus was reached. Reference checking to identify any additional articles was conducted until no new articles were identified.

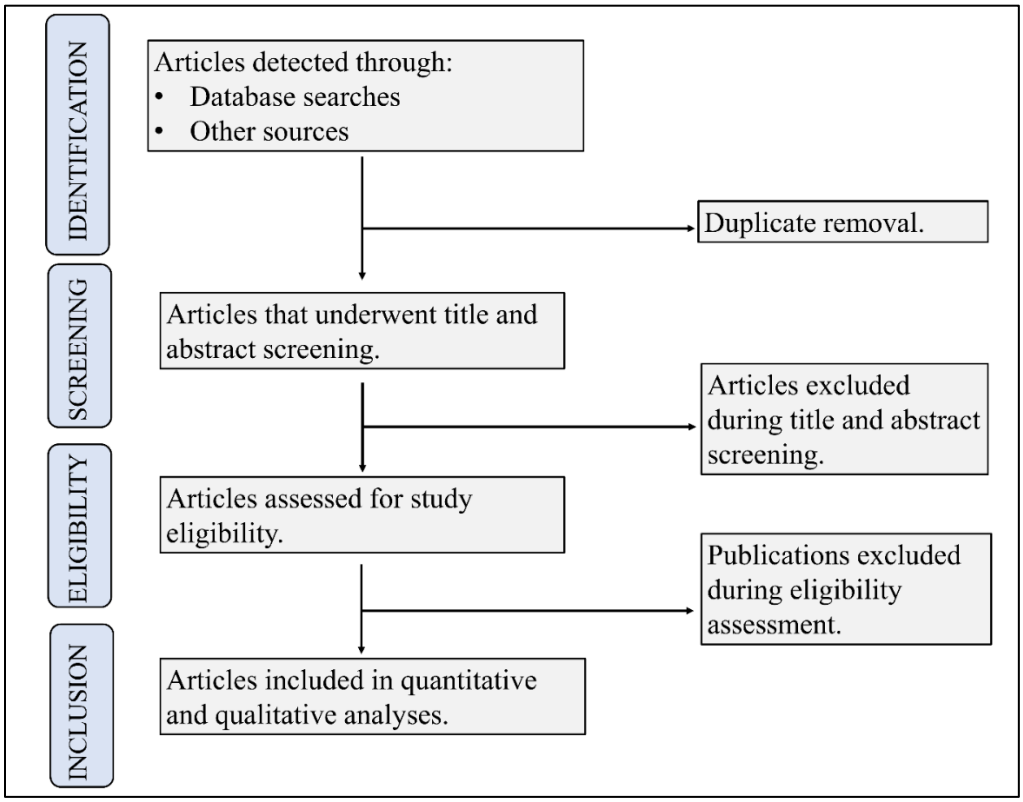

Figure 3.1. Preferred reporting items for systematic reviews and meta-analyses – an extension for scoping reviews (PRISMA-ScR) study selection process flow chart (*https://prisma-statement.org/Extensions/ScopingReviews*).

Table 3.1. The title and abstract screening inclusion criteria used to assess articles during study selection.

Title screening criteria	Abstract screening criteria
○ Article publication in English. ○ Included information on injury-related mortality (inclusive of manner-of-death, cause-of-death, mechanism of death and or method of death). ○ Contained data from any forensic mortuary located in the Western Cape province.	○ Data obtained from any FPS mortuary within the Western Cape. ○ Data on any unnatural cause-of-death (homicide, suicide, murder, road traffic incidents, drowning, etc) by age and/or gender. ○ Data from any of the years between and inclusive of 2007 till 2021.

3.1.2. Full-text eligibility assessment

The full-text eligibility assessment comprised of study quality and study suitability evaluation. Table 3.2 details the six criteria used for the quality assessment of each article. Each question was scored between zero and two, with a maximum score of 12 possible. The criteria used for study suitability assessment are listed in Table B2. Inclusions were divided into necessary primary and secondary criteria and valuable, but not compulsory, criteria. A second reviewer (LD) repeated the screening protocol to ensure inter-rater reliability in exclusion criteria. Results were compared, and reviewer discrepancies discussed. Two weeks later, the primary reviewer (CV) reviewed eligibility criteria to ensure intra-rater agreement.

Table 3.2. The six-criterion scoring tool used to assess the study quality of articles included in the full-text eligibility. Scoring: Yes = 2; No = 1; Unclear = 0 (Jones *et al*., 1995).

	Criteria	Maximum score
1	Was the study population defined?	2
2	Did the authors report the sampling strategy used?	2
3	Was there any evidence of reporting bias?	2
4	Are risk factor variables clearly defined in the study?	2
5	Were study outcomes clearly defined?	2

6	Was an error and reliability assessment completed?	2
	Total possible score	12

3.2. Data collection

To assess each cause of injury-related mortality by gender and life stage, principal investigators were contacted to arrange access to raw data. For selected articles, quantitative data relating to the pre-identified variables of interest (Table 3.3) were extracted by a single reviewer (CV) from the results section of the articles and recorded in Microsoft Excel®. General study information (authors' details, publication year, and study period), number of deaths by gender and life stage, cause-of-death or manner-of-death, and mortuary information were recorded. All data obtained in this study was derived from the research publications identified through the scoping review. The samples were from the mortuary cohort, thus, it included deaths from unnatural causes that were admitted to any FPS facility for investigation. When the gender or age was unknown, data were still recorded but excluded from analyses. The aetiologies of injury-related mortality were recorded as specified in the articles. Some recorded data were rearranged into more comparable categories for inter-study comparison. For example, Baliso *et al.* (2022) contained data on soft tissue injuries (bruising, herniation, and laceration). Given the small number of deaths observed for each, these three injuries were combined into an 'other/soft tissue' category. Qualitative data were extracted from the discussion and conclusion sections of the selected articles.

Table 3.3. Data extracted for quantitative analyses from the selected studies were identified through the scoping review.

Variables	Method of recording
Author(s)	
Year of publication	
Title of publication	
Year(s) the data in the study is from	
Sample characteristics	**Mortuary records**
	Sample size
Gender (including prevalence rates)	As specified in the data sources, it may include biological sex. Male (man); Female (woman); Undetermined (Undetermined will be used when the gender or sex of an individual was not specified and is inclusive of terminology such as unknown, undisclosed, and unspecified).
Life stage (including prevalence rates)	Since no numerical age values are recorded, I will record the age groups/ ranges reported in the resources. If no uniform age groups are observed across the studies, the supervisory team will decide on life stages and consistent age ranges. Each study's age group data can be assigned to the respective life stage it falls within so that comparative analyses can be done. **Infancy & childhood** (0 – 9 years); **Adolescence** (10 – 19 years); **Early adulthood** (20 – 34 years); **Early-to-middle adulthood** (30 – 39 years); **Middle adulthood** (35 – 49 years); **Middle-late adulthood** (40 years and older); **Late adulthood** (50 years and older).
Cause-of-death: The injuries that directly or indirectly led to the individual's death.	
Manner-of-death: The alleged circumstances surrounding how the cause-of-death arose.	Possible manner-of-death are apparent homicide, apparent suicide, apparent accident, undetermined or unknown.

3.3. Data and statistical analyses

Quantitative data were extracted in Microsoft Excel® and statistically analysed using IBM SPSS® Statistics. A *p*-value threshold of 0.05 was selected priori. Qualitative data were analysed in NVivo®.

3.3.1. Quantitative analyses

Descriptive statistics for gender and life stage were computed to assess injury-related mortality by gender and life stage in each study. Figures and tables were created using Microsoft Excel® and IBM SPSS® Statistics software. Once data collection was complete, the data were grouped into comparable categories to allow for interstudy comparisons. To assess the relationships between causes of injury-related mortality and gender or life stage, a binary meta-analysis of raw data were conducted. Odds Ratios (ORs) and their 95% confidence intervals (CIs) were calculated for each cause of injury-related mortality with population data used coming from the studies selected through the scoping review. For men's risk, relative to women's, an OR was calculated for each cause of injury-related mortality as identified in each article. The same was done for assessing early adulthood's risk of deaths relative to the other life stages. A random-effects model was applied, and results were summarised using forest plots. The effects size (ORs), summary statistics, study ID and sample size for both the control and treatment groups are presented. Where studies had sample sizes of less than 10, an overall pooled result or test for heterogeneity was not performed.

Two analyses were conducted to assess causes of injury-related mortality and life stage. First, injury-related mortality differences between youth (0 – 19 years) and adults (20 years and older) were assessed, and age ranges listed by the WHO (2016) were used. The legal South African adult age (18 years) could not be used due to the way that secondary data was recorded. Injury-related mortality differences between social life stages were also assessed using an appropriate set of life stage parameters that allowed for inter-study comparison (Table 3.3). Youth life stages (infancy, childhood, and adolescence) were created from those stipulated by the WHO (2016). Given the designation of infancy and childhood by the WHO (2016), these life stages (0 – 9 years) were grouped into one. The adolescent life stage (10 – 19 years) encompassed individuals going through puberty until early adulthood (Miller *et al.*, 2007; Stangor & Walinga, 2014; WHO, 2016). Three adult life stages were created using life stages from Buikstra & Ubelaker (1994), namely: early adulthood (20 – 34 years), middle adulthood (35 – 49 years) and late adulthood (50 years and older) (Buikstra & Ubelaker, 1994). In cases where an overlay in ages existed, and data could not be separated to fit the above life stages,

two additional life stage categories (Early-to-middle adulthood (30 – 39 years) and middle-to-late adulthood (40 years and older)) were created (Baliso *et al*., 2021). For all studies, excluding one, odds ratios (ORs) and their 95% confidence intervals (CIs) were used to assess the strength of association between early adulthood life stage (20 – 34 years) and their risk for injury-related mortality.

3.3.2. Qualitative analysis

Thematic analysis was applied to the discussion and conclusion sections of the identified articles to assess conceptualisations and reporting of gender and life stage as risk factors of injury-related mortality in research. Figure 3.2 shows the process followed for thematic content analysis. The selected articles were imported into NVivo® to begin coding (Braun & Clarke, 2006). The discussion and conclusion sections were read during the first step of thematic analysis (data familiarisation) to understand and identify data relating to the research questions (Braun & Clarke, 2012). Coding involved active reading for statements that contributed to answering the research questions and were summarised with one or two words to represent the main idea (Braun & Clarke, 2006). Upon completion of coding, codes were analysed, reviewed, and combined to begin searching for themes (Braun & Clarke, 2006). Themes were reviewed and combined with another when insufficient data supported it (Braun & Clarke, 2012). Steps two to four are very interactive and entail going back and forth between codes and themes to understand connections and extract meaning. To supplement these steps, memoing and thematic mapping was done using Miro® to visualise relationships between themes and sub-themes to develop general ideas and theories (Braun & Clark, 2006; Fielden *et al.*, 2011). The final step included naming, defining, and analysing themes and identifying appropriate extracts to illustrate each theme's elements (Braun & Clarke, 2006; 2012). Once quantitative and qualitative data were collected and analysed as separate entities, data triangulation was employed to increase the validity of the findings

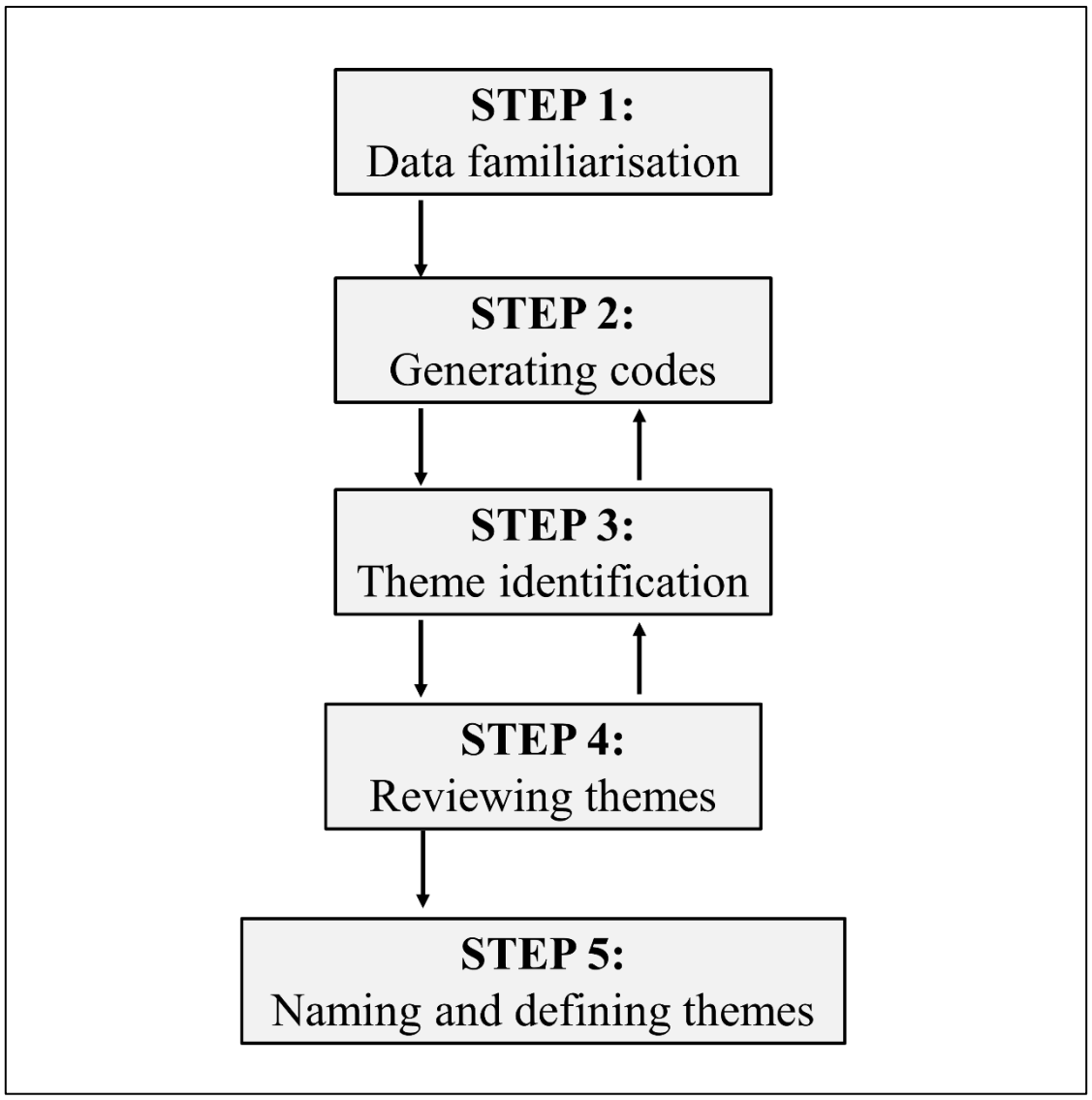

Figure 3.2. Flow of procedures used to conduct the thematic qualitative analysis. Adapted from Braun & Clarke (2006).

CHAPTER 4: RESULTS

Chapter four presents the findings from the scoping review (Table C2) and the quantitative and thematic analysis (qualitative).

4.1. Sample summary

Figure 4.1 summarises the scoping review's study selection process with 2,932 articles remaining after the removal of 2,051 duplicates from the 4,983 articles identified. Of the remaining articles, 2,721 were excluded during title screening due to a lack of South African data, no data on unnatural causes of mortality, and not being published in English. Abstract screening was performed on the remaining 211 articles, excluding 191 articles for not reporting on forensic deaths in the Western Cape province between 2007-2021. Therefore, only 20 articles remained for full-text review (Table C1). An additional five articles were identified through reference checking, but only three met the inclusion criteria, resulting in 23 articles extracted for full-text review (Table C1).

The full-text review involved study quality and suitability assessments. According to quality assessment criteria, 64% (16/25) of the studies were deemed 'high' quality (scored six or more) and 36% (9/25) were categorised as 'low' quality studies (scored below six) (Table 4.1). Studies underwent suitability assessments where they had to meet the primary and secondary suitability criteria, including the presence of gender and age statistics as listed in Table B2. Among these, 53% (8/15) lacked gender or age data that was cause-specific, and 46% (7/15) reported on jurisdictions outside of the Western Cape province (the study target region) (Figure 4.1). Therefore, a total of 11 articles underwent qualitative analysis, with only six meeting the criteria for quantitative analyses. Articles excluded from quantitative analyses reported duplicated data or contained research data outside the study period (Table C1). A summary of articles analysed quantitatively are in Table 4.2.

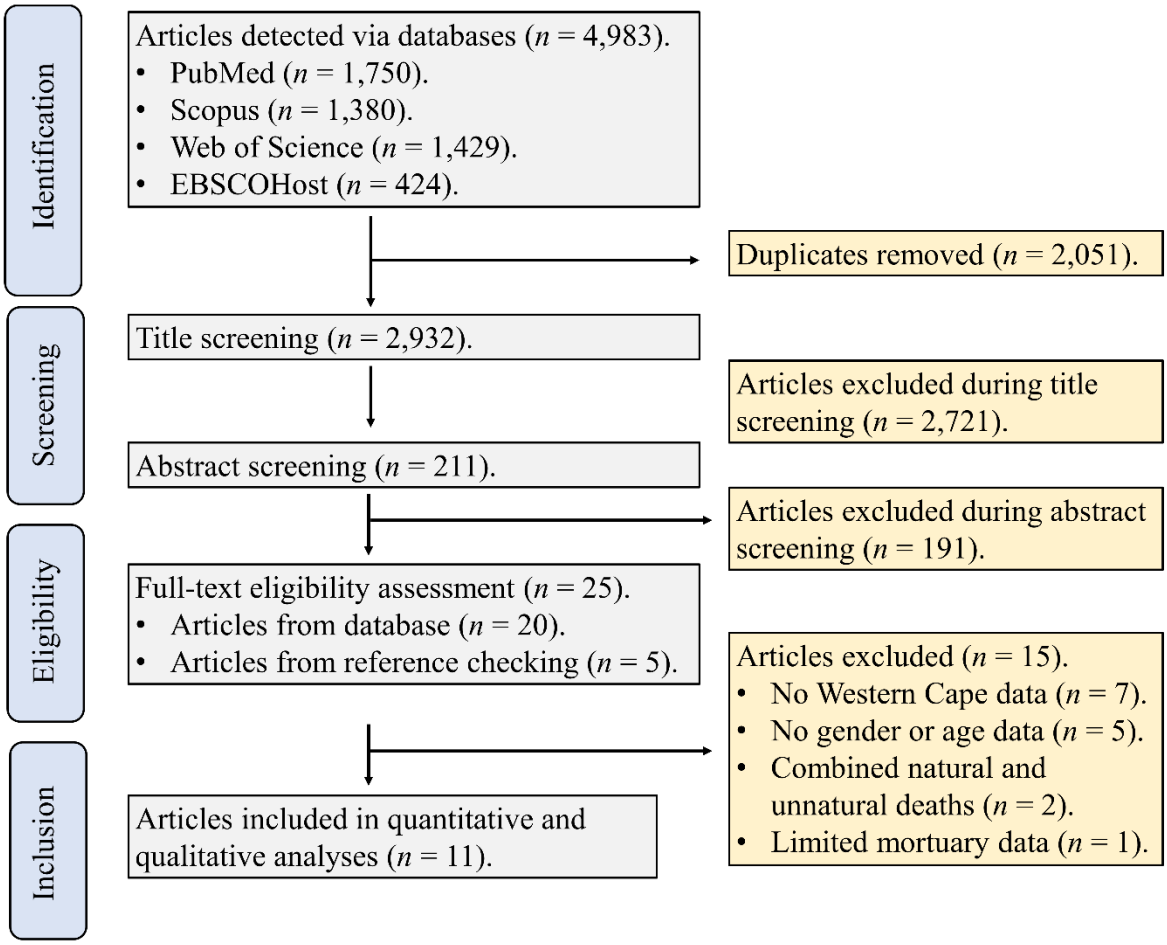

Figure 4.1. The preferred reporting items for systematic reviews and meta-analysis – an extension for scoping reviews (PRISMA-ScR) flow chart summarising the guidelines used to select articles for use in this study. It begins with outlining the number of articles identified from each database through to the articles included for data collection and extraction.

Table 4.1. Study quality assessment criteria with studies ordered by final score.

Author (year)	Study population defined	Sampling strategy reported	Reporting bias	Risk factor variables are clearly defined	Outcomes clearly defined	Error and reliability assessments completed	Total
Albertyn *et al*. (2019)*	2	2	2	2	2	1	11
Simons *et al.* (2020) *	2	2	0	2	2	1	9
Baliso *et al.* (2022) *	2	1	1	2	1	1	8
Clark *et al.* (2017) *	2	2	0	1	2	1	8
Mathews *et al.* (2013) º	2	2	0	2	2	0	8
Saunders *et al.* (2019) *	2	1	1	1	2	1	8
Auckloo & Davies (2019) *	2	2	0	1	1	1	7
Groenewald *et al.* (2017) *	1	1	1	1	2	1	7
Mole (2019) *	2	1	1	1	1	1	7
Reid *et al.* (2020) *	1	1	0	2	2	1	7
De Wet *et al.* (2014) º	2	0	2	2	0	0	6
Heathfield *et al.* (2020) º	2	0	0	0	2	2	6
Herbst *et al.* (2015) *	2	1	0	1	1	1	6
Mathews *et al.* (2019) º	1	2	1	2	0	0	6
Matzopoulos *et al.* (2015)º	2	2	0	0	0	2	6
Von Caues *et al.* (2018) *	2	0	1	1	1	1	6
Abrahams *et al.* (2016)	2	2	0	0	0	0	4
Mathews *et al.* (2016)	1	0	1	2	0	0	4
Storm *et al.* (2022)	1	0	1	1	0	0	3
Du Toit *et al.* (2018)	2	0	0	0	0	0	2
Du-Toit Prinsloo *et al*. (2013)	2	0	0	0	0	0	2
Heathfield *et al.* (2019)	2	0	0	0	0	0	2
Reid *et al.* (2016)	2	0	0	0	0	0	2
Campbell *et al.* (2013)	0	0	0	0	0	0	0
Pillay van Wyk (2017)	0	0	0	0	0	0	0

2 = well defined; 1 = uncertain or poorly defined; 0 = not defined/absent.
* Eleven articles selected for inclusion from the scoping review.
º Articles that met the minimum score for quality assessment, however, lacked having the relevant data that was required for suitability assessment.

Table 4.2. Summarised characteristics of the six studies included in the quantitative analyses showing the gender and life stage mortality distribution with studies ordered alphabetically.

Authors	**Sampling period**	**Sampling strategy***	**Sample *(n)***	**Gender** *n* (%)			**Life stage** *n* (%)						
				Male	Female	Unknown	0 – 9 years	10 – 19 years	20 – 34 years	30 – 39 years	35 – 49 years	50+ years	Unknown
Albertyn *et al.* (2019)	2014	Road traffic – autopsy records (Salt River Mortuary)	37	22 (59)	15 (41)	-	29 (78)	8 (22)	-	-	-	-	-
Baliso *et al.* (2022)	2006-2018	Skeletal trauma – Forensic anthropology Cape Town lab	69	52 (75)	17 (25)	-	3 (4)	6 (9)	26 (38)^	8 (12)	17 (25)†	9 (13)	-
Groenewald *et al.* (2017)	2010-2013	Multiple deaths – home affairs death count records.	8,272	6,679 (81)	1,593 (19)	-	454 (5)	757 (9)	3,821 (46)	-	1,806 (22)	1,429 (17)	5 (1)
Mole (2019)	2007-2016	Homicide – autopsy records (Salt River Mortuary)	10,558	9,549 (90)	884 (8)	125 (2)	90 (1)	962 (10)	4,602 (44)^	2,946 (28)	1,030 (10)	606 (6)	322 (3)
Saunders *et al.* (2019)	2010-2016	Drowning – autopsy records	1,391	833 (60)	535 (38)	23 (2)	321 (23)	217 (16)	397 (29)	-	217 (16)	219 (16)	20 (1)

		(Western Cape Government)											
Von Caues *et al.* (2018)	2008-2012	Electrocution – autopsy records (Tygerberg Mortuary)	39	32 (82)	7 (18)	-	10 (26)	1 (3)	15 (38)	-	13 (33)	-	-
n – number of deceased individuals; * - sampling data obtained from the articles used; ^ – adjusted early adulthood life stage range (20 – 29 years); † – adjusted middle adulthood life stage range (40 – 49 years); % – percentage (calculated within rows).													

4.2. Quantitative meta-analyses

Similarities in methodologies, population and outcome measures were not done given this was not necessary for the kind of research questions posed. Population data from the studies included were used. The data points (causes of injury-related mortality by gender and life stage) were extracted from each study to calculate ORs for the quantitative analyses. The review comprised of six studies with information on unnatural deaths admitted to any FPS mortuary situated in the Western Cape. Individual study sample sizes ranged from 37 deaths (Albertyn *et al.,* 2019) to 10, 558 deaths (Mole, 2019) (Table 4.2). The publication year ranged from 2017 to 2022, with injury-related mortality data reported between 2010 to 2018. Temporally, most studies (5/6) (Groenewald *et al.,* 2017; Von Caues *et al.,* 2018; Mole, 2019; Saunders *et al.,* 2019; Baliso *et al.,* 2022) included mortality data over multiple years, and only one study (Albertyn *et al.,* 2019) presented data for a single year. All studies reported gender data, and all but one study (Albertyn *et al.,* 2019) reported adult and child deaths. Albertyn *et al*. (2019) only reported on child deaths. Baliso *et al*., (2019) paper was identified as an outlier as it was a forensic anthropology study while the others were all forensic pathology studies. Despite this difference due to the value added, a conscious decision for inclusion was made in both the quantitative and qualitative analyses. Data on homicide (Groenewald *et al.,* 2017; Mole, 2019) and suicide (Groenewald *et al.,* 2017; Baliso *et al.,* 2022) as manners of injury-related mortality were reported in 33% (2/6) of the studies. Data on fire/burn injuries were available in 33% (2/6) studies (Groenewald *et al.,* 2017; Baliso *et al.,* 2022) and drowning as a cause of injury-related mortality were available in half (3/6) of the studies (Groenewald *et al.,* 2017; Saunders *et al.,* 2019; Baliso *et al.,* 2022). Road traffic deaths would be considered accidental, although the absence of reporting of whether these deaths were accidental or intentional meant these data were included in their own category. Road traffic deaths were reported in 33% (2/6) studies (Groenewald *et al.,* 2017; Albertyn *et al.,* 2019), and where the mechanism of road traffic deaths was presented, more pedestrian-related road traffic deaths (84%; 31/37) occurred than passenger-related (16%; 6/31) (Albertyn *et al.,* 2019) (Table 4.3). Other accidental causes of injury-related mortality and trauma included other transport (Groenewald *et al.,* 2017), poisoning/ingestions (Groenewald *et al.,* 2017), surgical/medical complications (Groenewald *et al.,* 2017), other unintentional injuries (although not defined as a category) (Groenewald *et al.,* 2017), electrocution (Von Caues *et al.,* 2018), threats to breathing and perimortem fracture (Baliso *et al.,* 2022).

4.2.1. Gender

In all studies, and for all causes of injury-related mortality except surgical/medical complications, more men and boys died than women and girls (Tables 4.2 and 4.3). Homicides were the leading manner of injury-related mortality in 2/6 studies (Groenewald *et al.,* 2017; Mole, 2019), during which males (91%) were significantly more affected than females (9%) (Mole, 2019) (Table 4.3). In women, homicide ranked second (n = 348) after accidental road traffic deaths (n = 471) (Groenewald *et al.,* 2017) (Table 4.3). In Mole (2019), men were nearly 11 times more likely to die from homicide than women (OR = 10.80; 95% CI [0.21 – 544.44]; p = 0.23), albeit the association between gender and homicide was not significant (Table 4.3). Whereas in Groenewald *et al.* (2017), the association between gender and homicide was statistically significant, with men being four times more likely to die from homicide (OR = 3.95; 95% CI [3.47 – 4.49]; $p \leq 0.001$) (Table 4.3). Using a random effects model, a combined effect for homicide indicated that men were four times more likely than women to die of homicide (OR = 3.95; 95% CI [3.48 – 4.45]; $p \leq 0.001$) (Groenewald *et al.,* 2017; Mole, 2019) (Figure 4.2A).

Only one study reported on mechanisms of homicide, with firearms accounting for 40% (4,254/10,558) of homicides, followed by sharp force trauma (39%; 4,142/10,558) (Table 4.3) (Mole, 2019). This is in contrast with another study where sharp and blunt force traumas were the leading causes of perimortem injury (Baliso *et al.,* 2022). Differences in the mechanism of homicide by gender were observed, with 41% (3,977/9,549) of male homicides attributed to firearms, and 34% (309/884) of female homicides attributed to sharp force trauma (Mole, 2019) (Table 4.3). For all mechanisms of homicide, there were statistically significant associations between male gender and death ($p \leq 0.001$) (Mole, 2019). Men were more likely than women to die from firearm (OR = 1.65; 95% CI [1.42 – 1.91]; $p \leq 0.001$), sharp force (OR = 1.24; 95% CI [1.08 – 1.43]; $p \leq 0.0001$) and blunt force homicide (OR = 0.78; 95% CI [0.65 – 0.94]; $p \leq 0.0001$) (Mole, 2019) (Table 4.3). Conversely, men carried lower risk for other causes of homicide (OR = 0.19; 95% CI [0.15 – 0.23]; $p \leq 0.0001$) (Mole, 2019) (Table 4.3).

Men had statistically lower odds of death compared to women for poisoning/ingestion (OR = 0.3; 95% CI [0.22 – 0.45]; $p \leq 0.001$), surgical/medical complications (OR = 0.21; 95% CI [0.16 – 0.27]; $p \leq 0.001$), fire/burn injuries (OR = 0.43, 95% CI [0.35 – 0.52]; $p \leq 0.001$), and road traffic deaths (OR = 0.60; 95% CI [0.53 – 0.68]; $p \leq 0.001$) (Groenewald *et al.,* 2017) (Table 4.3).

Men had higher odds of death for sharp force trauma (OR = 1.78; 95% CI [0.33 – 9.66]; p = 0.51) (Baliso *et al.,* 2022), fire/burn injuries (OR = 1.7; 95% CI [0.17 – 16.48]; p = 0.66), drowning (OR = 1.56; 95% CI [0.03 – 78.56]; p = 0.82) (OR = 1.02; 95% CI [0.70 – 1.45]; p = 0.90) (Groenewald *et al.,* 2017; Saunders *et al.,* 2019), other transport deaths (OR = 1.23; 95% CI [0.81 – 1.87]; p = 0.33) (Groenewald *et al.,* 2017), suicides (OR = 1.01; 95% CI [0.84 – 1.21]; p = 0.92) (Groenewald *et al.,* 2017), road traffic deaths (OR = 1.45; 95% CI [0.03 – 77.14]; p = 0.85) (Albertyn *et al.,* 2019), and pedestrian-related road traffic deaths (OR = 1.58; 95% CI [0.27 – 9.17]; p = 0.81) (Albertyn *et al.,* 2019) (Table 4.3). However, none of these findings were statistically significant. Perimortem fractures were only reported in one study, with men having statistically higher odds of injury compared to women (OR = 3.75; 95% CI [0.98 – 14.35]; $p \leq 0.05$) (Baliso *et al.,* 2022) (Table 4.3). Findings illustrated that the male gender had lower odds of blunt force trauma (OR = 0.52; 95% CI [0.12 – 2.22]; p = 0.37), firearm trauma (OR = 0.56; 95% CI [0.08 – 3.79]; p = 0.55), drowning (OR = 0.79; 95% CI [0.07 – 4.45]; p = 0.85) (Baliso *et al.,* 2022), apparent suicide by hanging (OR = 0.56; 95% CI [0.08 - 3.79]; p = 0.55) (Baliso *et al.,* 2022) and passenger-related road traffic deaths (OR = 0.63, 95% CI [0.11 – 3.66]; p = 0.61) (Albertyn *et al.,* 2019), albeit no significant association (Table 4.3) (Baliso *et al.,* 2022).

A combined effect for drowning (Figure 4.2B) illustrated that men had a nearly equal risk of death compared to women, however, it was not statistically significant (OR = 1.03; 95% CI [0.71 – 1.50]; p = 0.89) (Groenewald *et al.,* 2017; Saunders *et al.,* 2019) When assessing road traffic risk in young boys compared to young girls (0 – 12 years), different however statistically insignificant findings were observed in comparison to Groenewald *et al*., (2017) road traffic injury data. Young boys had increased risk of road traffic death compared to young girls with greater risk observed for pedestrian-related incidents compared to passenger-related road traffic incidents (Albertyn *et al.,* 2019).

Table 4.3. Gender distribution showing the association between male gender and risk of injury-related mortality for the six studies included in the quantitative analyses with studies ordered alphabetically.

			Gender *n* (%)						
Study authors	**Cause of injury-related mortality**	**Study period**	**Sample**	**Male**	**Female**	**Unknown gender**	**OR**	**95% CI**	***p*-value**
Albertyn *et al.* (2019)	Road traffic (all)	2014	37	22	15	-	1.47	0.03 - 78.06	$p = 0.85$
	Road traffic – pedestrian		31	19 (86)	12 (80)	-	1.58	0.27 - 9.17	$p = 0.61$
	Road traffic – passenger		6	3 (14)	3 (20)	-	0.63	0.11 - 3.66	$p = 0.61$
Baliso *et al.* (2022)	Blunt force	2007-2018	10	6 (11)	4 (20)	-	0.52	0.12 - 2.22	$p = 0.37$
	Sharp force		10	8 (14)	2 (10)	-	1.78	0.33 - 9.66	$p = 0.51$
	Sharp/blunt force		3	2 (4)	1 (5)	-	0.38	0.02 - 6.57	$p = 0.51$
	Firearm		5	3 (5)	2 (10)	-	0.56	0.08 - 3.79	$p = 0.55$
	Fire/burn		5	4 (7)	1 (5)	-	1.68	0.17 - 16.48	$p = 0.66$
	Threats to breathing		8	5 (9)	3 (15)	-	0.61	0.12 - 2.99	$p = 0.54$
	Drowning ^		4	2 (4)	2 (10)	-	0.79	0.07 - 9.45	$p = 0.85$
	Hanging ^		3	3 (5)	0	-	-	-	-
	Strangulation ^		1	0	1 (5)	-	-	-	-
	Perimortem fracture		25	20 (35)	4 (20)	-	3.75	0.98 - 14.35	$p \leq 0.05$*
	Soft tissue injuries		4	4 (7)	-	-	1.22	0.02 - 6.57	$p = 0.51$
Groenewald *et al.* (2017)	All causes	2010-2013	8,272	6,679	1,593	-	-	-	-
	Homicide		3,854	3,505 (52)	349 (22)	-	3.95	3.47 - 4.49	$p \leq 0.0001$*
	Suicide		868	702 (11)	166 (10)	-	1.01	0.84 - 1.21	$p = 0.92$
	Road traffic – unspecified		1,819	1,348 (20)	471 (30)	-	0.60	0.53 - 0.68	$p \leq 0.001$*
	Other transport		166	139 (2)	27 (2)	-	1.23	0.81 - 1.87	$p = 0.33$
	Drowning		180	146 (2)	34 (2)	-	1.02	0.70 - 1.45	$p = 0.90$
	Fire/burn		494	324 (5)	170 (11)	-	0.43	0.35 - 1.52	$p \leq 0.0001$*
	Poisoning/ingestion		122	70 (1)	52 (3)	-	0.31	0.22 - 0.45	$p \leq 0.001$*

	Surgical/medical complication		262	127 (2)	135 (8)	-	0.21	0.16 - 0.27	$p \leq 0.0001$*
	Other unintentional injuries		507	318 (5)	189 (12)	-	0.37	0.31 - 0.45	$p \leq 0.0001$*
Mole (2019)	Road traffic	2007-2016	3,579 (16)	-	-	-	-	-	-
	Suicide		2,012 (9)	-	-	-	-	-	-
	Procedure-related		1,286 (6)	-	-	-	-	-	-
	Sudden unexpected		5,392 (24)	-	-	-	-	-	-
	Homicide		10,558 (46)	9,549	884	95	10.80	0.21 - 544.44	$p = 0.23$
	Blunt force†		1,589 (15)	1,400 (15)	159 (18)	30	0.78	0.65 - 0.94	$p \leq 0.0001$*
	Sharp force†		4,142 (39)	3,821 (40)	309 (35)	12	1.24	1.08 - 1.43	$p \leq 0.0001$*
	Firearm†		4,254 (40)	3,977 (42)	267 (30)	10	1.65	1.42 - 1.91	$p \leq 0.001$*
	Other†		573 (5)	351 (4)	149 (17)	73	0.19	0.15 - 0.23	$p \leq 0.0001$*
Saunders *et al.* (2019)	Drowning	2010-2016	1,391	833	535	23	1.56	0.03 - 78.56	$p = 0.82$
Von Caues *et al.* (2018)	Electrocution	2008-2012	39	37	7	-	-	-	-

OR – odds ratios; CI – confidence interval; *n* – number of deceased individuals; † Mechanisms of homicide; ^ Examples of threats to breathing; * statistically significant association ($p \leq 0.05$); Female gender used as the reference group; % – percentage (calculated within columns per cause).

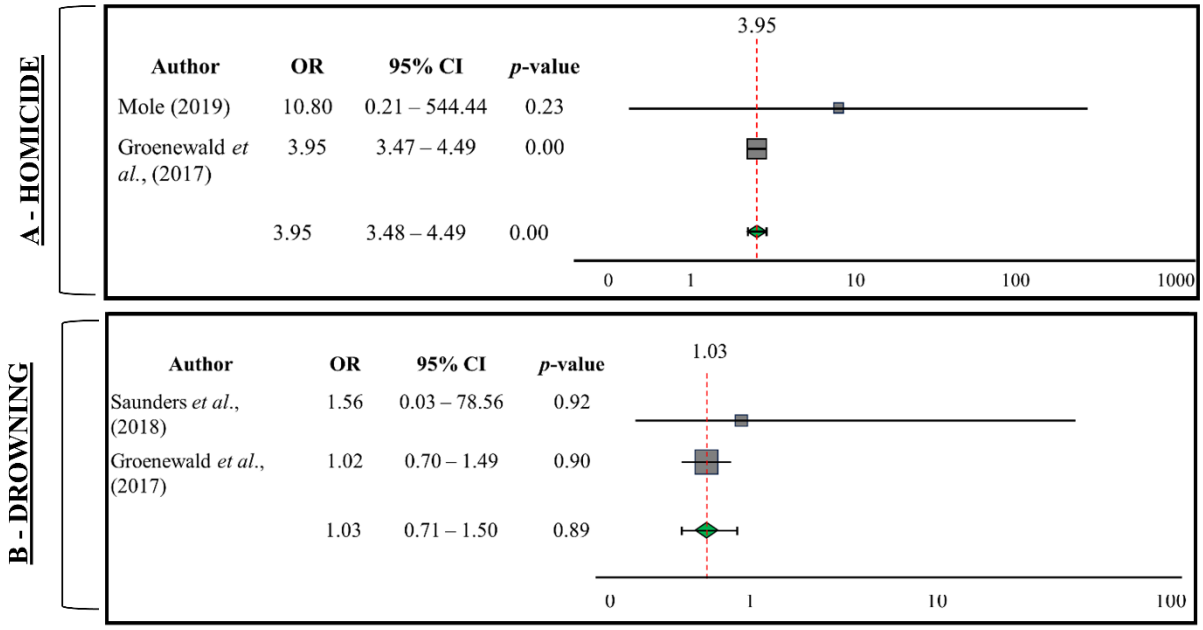

Figure 4.2. Forest plots illustrating male gender risk compared to female gender risk for two causes of injury-related mortality. Odds ratio (OR) >1 favours males having a greater risk of death, whereas an OR <1 suggests a lower risk of death. Studies displayed by first author and year of publication. Each study is represented by a square (symbolising the effect size). The horizontal line denotes the 95% confidence interval (CI). Pooled study results are shown at the bottom using a random effects model. Studies were weighted according to their sample size.

4.2.2. Life stage

Two types of life stage analyses were conducted. First, injury-related mortality differences between youths (0 – 19 years) and adults (20 years and older) were assessed. After that, analyses were done to compare injury-related mortality differences between life stages (Tables 4.4 and 4.5). Since Albertyn *et al.* (2019) only reported on deaths in the youth, this study was excluded from the adults versus youth analysis. In all studies, more adults died, and homicides were the leading manner of injury-related mortality for both adults (47%; 3,336/9,218) and the youth (43%; 518/1,221) (Groenewald *et al.,* 2017) (Table 4.4). Accounting for 33% (3,807/9,184), firearms were the leading mechanism of homicide in adults (Mole, 2019) (Table 4.4). This was contrasted with 50% (530/1,161) of homicides caused by sharp force trauma in the youth (Mole, 2019) (Table 4.4). Poisoning/ingestion accounted for the least number of deaths in the youth (1%; 12/1,211), whilst drowning accounted for the lowest number of deaths in adults (1%; 105/7,061) (Groenewald *et al.,* 2017) (Table 4.4). In Baliso *et al*. (2022), perimortem fractures were the leading trauma observed for both adults and youth (Table 4.4)

4.2.2.1. Youth

In this study, youth encompassed individuals between 0 – 19 years of age and comprised of two life stages. The first was infancy and childhood (0 – 9 years), and the second was adolescence (10 – 19 years). The results for each of these life stages are presented below.

When comparing different causes-of-death, road traffic deaths (34%; 154/454) and other unintentional injuries (20%; 90/454) were the leading causes of injury-related mortality for infants and children (Groenewald *et al.,* 2017) (Table 4.4). In both studies, infancy and childhood accounted for the second-highest number of drowning deaths (Groenewald *et al.,* 2017; Saunder *et al.,* 2018) (Table 4.4). Remarkably, infancy and childhood accounted for more road traffic (Groenewald *et al.,* 2017; Albertyn *et al.,* 2019) and electrocution deaths (Von Caues *et al.,* 2018) than in adolescence (Table 4.4). Additionally, the infancy and childhood life stage had the fewest homicides (n = 48), suicides (n = 1), other transport mortalities (n = 5) (Groenewald *et al.,* 2017) and perimortem fracture (n = 1) (Baliso *et al.,* 2022) (Table 4.4). Homicides during this life stage were predominantly from other causes (38%; 34/90) and blunt force trauma (27%; 24/90) (Mole, 2019) (Table 4.4).

Table 4.4. Life stage distribution (0 – 19 years, 20 years and older and seven life stages) of injury-related mortality for the six studies included in the quantitative analyses with studies ordered alphabetically.

Life stage *n* (%)												
Study authors	**Cause of injury-related mortality**	**Sample**	**Youth (0 – 19 years)**			**Adults (20 years and older)**						**Unknown**
			Infancy & Childhood	**Adolescence**	**Total deaths in youth**	**Early**	**Early-to-Middle**	**Middle**	**Middle-to-late**	**Late**	**Total deaths in adults**	
Albertyn *et al.* (2019)	Road traffic	37	29 (78)	8 (22)	37	-	-	-	-	-	-	-
	Road traffic – pedestrian	31	26 (89)	5 (63)	31 (84)	-	-	-	-	-	-	-
	Road traffic – passenger	6	3 (10)	3 (38)	6 (16)	-	-	-	-	-	-	-
Baliso *et al.* (2022)	Total	69	3	6	9	24	9	13	5	9	60	-
	Blunt force	10	-	1 (17)	1 (13)	6 (25)	-	-	1 (20)	2 (22)	9 (15)	-
	Sharp force	10	-	1 (17)	1 (13)	2 (8)	2 (22)	2 (15)	1 (20)	2 (22)	9 (15)	-
	Sharp/blunt force	3	-	-	-	2 (8)	1 (11)	-	-	-	3 (5)	-
	Firearm	5	-	-	-	2 (8)	-	2 (15)	1 (20)	-	5 (8)	-
	Fire/burn	5	1 (33)	-	1(13)	2 (8)	-	1 (8)		1 (11)	4 (7)	-
	Threats to breathing	8	-	1 (17)	1(13)	3 (13)	2 (22)	1 (8)	-	1 (11)	7 (12)	-
	Drowning ^	4	-	1 (17)	1(13)	1 (4)	1 (11)	-	-	1 (11)	3 (5)	-
	Hanging ^	3	-	-	-	1 (4)	1 (11)	1 (8)	-	-	3 (5)	-
	Strangulation^	1	-	-	-	1 (4)	-	-	-	-	1 (2)	-
	Perimortem fracture	24	1 (33)	3 (50)	4 (50)	5 (20)	4 (44)	6 (46)	2 (40)	3 (33)	20 (34)	-
	Other	4	1 (33)	-	-	1 (4)	-	1 (8)	-	-	3 (5)	-
Groenewald *et al.* (2017)	All causes	8272	454	757	1211	3821		1806		1429	7056	
	Homicide	10	48 (9)	470 (62)	518 (43)	2,336 (61)	-	743 (41)	-	257 (18)	3,336 (47)	-

	Suicide	868	1 (0)	67 (9)	68 (6)	385 (10)	-	247 (14)	-	167 (12)	799 (11)	1
	Road traffic – unspecified	1,819	154 (34)	128 (17)	282 (23)	672 (18)	-	499 (28)	-	366 (26)	1,538 (22)	-
	Other transport	166	5 (1)	16 (2)	21 (2)	77 (2)	-	40 (2)	-	28 (2)	145 (2)	-
	Drowning	180	48 (11)	26 (3)	74 (6)	49 (1)	-	27 (1)	-	29 (2)	105 (1)	1
	Fire/burn	494	82 (18)	26 (3)	108 (9)	191 (5)	-	112 (6)	-	82 (6)	385 (2)	1
	Poisoning/ ingestion	122	10 (2)	2 (0)	12 (1)	28 (1)	-	37 (2)	-	44 (3)	109 (2)	1
	Surgical/medical complication	262	16 (4)	6 (1)	22 (2)	15 (0)	-	33 (2)	-	191 (13)	239 (3)	1
	Other unintentional injuries	507	90 (20)	16 (2)	106 (9)	68 (2)	-	68 (4)	-	265 (19)	403 (6)	-
Mole (2019)	Homicide	10,558	90	962	1,161	4,602	2,946	1,030	-	606	9,184	322
	Blunt force †	1,589	24 (27)	12 (1)	36 (3)	642 (14)	457 (16)	171 (17)	-	119 (20)	1,389 (15)	164
	Sharp force †	4,142	10 (11)	520 (54)	530 (46)	1,839 (40)	1,161 (39)	393 (38)	-	185 (31)	3,578 (39)	34
	Firearm †	4,254	22 (24)	380 (40)	402 (35)	1,952 (42)	1,201 (41)	424 (41)	-	230 (38)	3,807 (42)	45
	Other †	573	34 (37)	50 (5)	84 (7)	169 (4)	127 (4)	42 (4)	-	72 (12)	410 (4)	79
Saunders *et al.* (2019)	Drowning	1,391	321	217	538	397	-	217	-	219	733	23
Von Caues *et al.* (2018)	Electrocution	39	10	1	11	15	-	-	13	-	28	-

n – number of deceased individuals; † Mechanisms of homicide observed in the study; ^ Examples of threats to breathing; Infancy & Childhood (0 – 9 years); Adolescence (10 – 19 years); Early adulthood (20 – 34 years); Early-to-middle adulthood (30 – 39 years); Middle adulthood (35 – 49 years); Middle-to-late adulthood (40 years and older); Late adulthood (50 years and older); % – percentage (calculated within columns for each cause).

In both studies, early adulthood (20 – 34 years) had a significantly greater risk of homicidal death ($p \leq 0.05$) compared to infants and children (Table 4.5) (Groenewald *et al.,* 2017; Mole, 2019). When assessing early adulthood's risk of death for each mechanism of homicide, they experienced a significantly greater risk of death sharp force (OR = 5.32; 95% CI [2.75 – 10.30]; $p \leq 0.001$) and firearm homicide (OR = 2.28; 95% CI [1.40 – 3.70]; $p \leq 0.001$) whilst lower risk for blunt force (OR = 0.45; 95% CI [0.28 – 0.72]; $p \leq 0.001$) and other causes of homicide (OR = 0.06; 95% CI [0.04 – 0.10]; $p \leq 0.0001$) (Mole, 2019) (Table 4.5). Early adulthood also had a significantly greater risk of suicide (OR = 50.76; 95% CI [7.11 – 362.14]; $p \leq 0.001$) compared to infants and children (Table 4.5) (Groenewald *et al.,* 2017). For all accidental causes of injury-related mortality, except deaths caused by other transport, early adulthood experienced a significantly lower risk of death compared to infancy and childhood ($p \leq 0.001$), with the lowest risk observed for deaths caused by other unintentional injuries (OR = 0.07; 95% CI [0.05 – 0.10]; $p \leq 0.0001$) and drowning (OR = 0.11; 95% CI [0.07 – 0.17]; $p \leq 0.0001$) (Groenewald *et al*., 2017) (Table 4.5). When assessing the risk of early adulthood death compared to infancy & childhood in Baliso *et al*. (2022), none of the findings were statistically significant.

Since no adult deaths were reported in Albertyn *et al*. (2019), the infancy & childhood life stage was used as the reference group. Compared to adolescence, infancy and childhood had greater odds of pedestrian-related road traffic deaths (OR = 14.44; 95% CI [2.24 – 93.22]; $p \leq 0.0001$) but lower odds for passenger-related road traffic deaths (OR = 0.07; 95% CI [0.01 – 0.45]; $p \leq 0.0001$) (Table 4.5)

Adolescence (10 – 19 years) had the lowest number of deaths for all causes of injury-related mortality except those due to homicide, suicide and other transport injuries (Groenewald *et al*. 2017) (Table 4.4). Homicides (67%; 470/757) accounted for the most deaths during adolescence, followed by road traffic fatalities (17%; 128/757) (Groenewald *et al.,* 2017) (Table 4.4). During this life stage, most homicides were from sharp force trauma (54%; 520/962) and firearms (40%; 380/962) (Table 4.4). Early adulthood experienced a lower risk of homicide compared to adolescents (OR = 0.96; 95% CI [0.82 – 1.13]; $p = 0.62$), although not statistically significant (Groenewald *et al.,* 2017) (Table 4.5). This is contrasted with a significantly greater risk of homicide in Mole's study (2019) ($p \leq 0.0001$). Compared to adolescence, early adulthood had a significantly greater risk of blunt force homicide (OR = 12.83; 95% CI [7.22 – 22.82]; $p \leq 0.0001$) and lower risk of sharp force homicide (OR = 0.57; 95% CI [0.49 – 0.65]; $p \leq 0.001$) and other causes of homicide (OR = 0.70; 95% CI [0.50 –

0.96]; $p \leq 0.05$) (Mole, 2019) (Table 4.5). Regarding other causes of injury-related mortality, early adulthood experienced a significantly lower risk of drowning compared to adolescence (OR = 0.37; 95% CI [0.23 – 0.59]; $p \leq 0.001$) (Groenewald *et al.,* 2017). Their risk of death for suicide (OR = 1.15; 95% CI [0.88 – 1.51]; $p = 0.30$), road traffic deaths (OR = 1.05; 95% CI [0.85 – 1.29]; $p = 0.65$), fire/burn injuries (OR = 1.48, 95% CI [0.97 – 2.25]; $p = 0.06$) and poisoning/ingestion (OR = 2.79; 95% CI [0.66 – 11.72]; $p = 0.16$) were greater, although not statistically significant for all (Groenewald *et al.,* 2017) (Table 4.5). There were no statistically significant differences in the risk of death between early adulthood and adolescence when assessing causes of injury-related mortality in Baliso *et al*. (2022).

4.2.2.2. Adulthood

For all causes of injury-related mortality, except those from poisoning/ingestions, surgical/medical complications and other unintentional injuries, early adulthood (20 – 34 years) accounted for the most deaths in all six studies (Table 4.4). Homicides (28%; 2,336/8,272) were the primary contributor to death in early adulthood, followed by road traffic deaths, this is similar to the middle adulthood life stage (35 – 49 years) (Groenewald *et al.,* 2017) (Table 4.4). When comparing early adulthood's risk of death for the different mechanisms of homicide to that of early-to-middle adulthood, they experienced greater odds of death, however, this was only statistically significant for other causes of homicide (OR = 6.32; 95% CI [3.83 – 10.43]; $p \leq 0.001$) (Mole, 2019) (Table 4.5). Compared to early-to-middle adulthood, early adulthood had a statistically lower risk of perimortem fracture (OR = 0.15; 95% CI [0.03 – 0.85]; $p \leq 0.05$), while the risk of death for all other findings was not statistically significant (Baliso *et al.,* 2022) (Table 4.5).

The middle-aged adults (35 – 49 years) category accounted for the second largest number of deaths for most causes of injury-related mortality, except those from drowning, other unintentional injuries, and electrocution (Table 4.4). Homicides (19%; $n = 743/8,272$) were the leading contributor to deaths in this life stage (Groenewald *et al.,* 2017), and the most perimortem fractures ($n = 7$) were also observed (Baliso *et al.,* 2022) (Table 4.4). Compared to middle adulthood, early adulthood demonstrated lower risk of death for suicide (OR = 0.71; 95% CI [0.60 – 0.84]; $p \leq 0.001$), road traffic- unspecified (OR = 0.56; 95% CI [0.49 – 0.64]; $p \leq 0.0001$), poisoning/ingestion (OR = 0.35; 95% CI [0.22 – 0.58]; $p \leq 0.001$), surgical/medical complications (OR = 0.21; 95% CI [0.11 – 0.39]; $p \leq 0.001$) and other unintentional injuries (OR = 0.46; 95% CI [0.32 – 0.64]; $p \leq 0.001$) (Groenewald *et al.,* 2017) (Table 4.5). Homicide was the only cause of injury-related mortality, where early adulthood's

risk of death was greater than middle adulthood ($p \leq 0.0001$) (Groenewald *et al.,* 2017; Mole, 2019) (Table 4.5). Compared to middle adulthood, early adulthood experienced a significantly lower risk for blunt force homicide (OR = 0.81; 95% CI [0.68 – 0.98]; $p \leq 0.05$) and a greater risk of homicide from sharp force, firearm and other causes, albeit not statistically significant (Mole, 2019) (Table 4.5). The risk of death for all other causes was not statistically significant.

Late adulthood (50 years and older) accounted for most deaths caused by surgical/medical complications (73%; 191/262), poisoning/ingestion (36%; 44/122) and other unintentional injuries (52%; 265/507) (Groenewald *et al.,* 2017) (Table 4.4). Road traffic deaths were the leading cause of injury-related mortality during this life stage (n = 366). Once again, early adulthood had a significantly greater risk of homicidal death compared to late adulthood (Groenewald *et al.,* 2017; Mole, 2019) (Table 4.5). When comparing early adulthood's risk for each mechanism of homicide, compared to the late adulthood life stage, they experienced a significantly greater risk of death for sharp force (OR = 1.51; 95% CI [1.26 – 1.82]; $p \leq 0.001$) and firearm homicides (OR = 1.20; 95% CI [1.01 – 1.43]; $p \leq 0.05$) and a lower risk for blunt force (OR = 0.66; 95% CI [0.53 – 0.82]; $p \leq 0.001$) and other causes of homicide (OR = 0.25; 95% CI [0.21 – 0.38]; $p \leq 0.001$) (Mole, 2019) (Table 4.5). Assessing early adulthood risk of death for other causes compared to late adulthood, we see they had statistically lower risk of death for all other causes of injury-related mortality except those from suicide (OR = 0.85; 95% CI [0.70 – 1.03]; p = 0.10), other transport (OR = 1.03; 95% CI [0.67 – 1.60]; p = 0.90) and fire/burn injuries (OR = 0.87; 95% CI [0.66 – 1.13; p = 0.29), which were all not significant (Groenewald *et al.,* 2017) (Table 4.5). The risk of death for all other causes of injury-related mortality was not statistically significant from Baliso *et al*. (2022).

4.2.3. Quantitative results summary

The association between two demographic factors (gender and life stage) and injury-related mortality in Western Cape medicolegal death investigations were assessed using meta-analyses. A total of 4,983 articles were screened, and six articles were analysed. Quantitative analyses revealed gender and life stage patterns. Men were over-represented for all causes of injury-related mortality. Overall, men had a greater risk of death for homicide (specifically sharp force and firearm) and perimortem injuries than women ($p \leq 0.05$) and a lower risk of death for blunt force homicide and other causes of homicide, as well as road traffic death, poisoning/ingestion, surgical/medical misadventure and fire/burn injuries ($p \leq 0.001$). Individuals in early adulthood accounted for the most deaths across all causes of injury-related mortality, with this group being most vulnerable to violent mortality (*e.g.,* homicide).

Table 4.5. Life stage distribution showing early adulthood's (20 – 34 years) risk of injury-related mortality compared to other life stages for the six studies included in the quantitative analyses, with studies ordered alphabetically.

		Life stages OR (95% CI)						
Study authors	**Cause of injury-related mortality**	**Infancy & childhood**	**Adolescence**	**Early adulthood**	**Early-to-middle adulthood**	**Middle adulthood**	**Middle-to-late adulthood**	**Late adulthood**
Albertyn *et al.* (2019)[a]	Road traffic	-	-	-	-		-	-
	Road traffic – pedestrian	-	OR = 14.44 (2.24-93.22) $p \leq 0.0001$*	-	-	-	-	-
	Road traffic – passenger	-	OR = 0.07 (0.01-0.45) $p \leq 0.0001$*	-	-	-	-	-
Baliso *et al.* (2022)	Blunt force	OR = 2.33 (0.11-51.45) $p = 0.59$	OR = 1.58 (0.15-16.31) $p = 0.70$	-	OR = 5.67 (0.29-112.36) $p = 0.26$	OR = 9.00 (0.47-173.50) $p = 0.15$	OR = 1.26 (0.12-13.59) $p = 0.85$	OR = 1.11 (0.18-6.82) $p = 0.91$
	Sharp force	OR = 0.74 (0.03-18.96) $p = 0.86$	OR = 0.43 (0.03-5.78) $p = 0.53$	-	OR = 0.26 (0.03-2.25) $p = 0.22$	OR = 0.48 (0.06-3.86) $p = 0.49$	OR = 0.35 (0.03-4.800 $p = 0.43$	OR = 0.30 (0.04-2.57) $p = 0.27$
	Sharp/blunt force	OR = 0.43 (0.01-12.73) $p = 0.62$	OR = 0.80 (0.03-21.91) $p = 0.89$	-	OR = 1.04 (0.04-28.06) $p = 0.98$	OR = 1.65 (0.06-43.44) $p = 0.76$	OR = 0.67 (0.02-18.84) $p = 0.82$	OR = 0.33 (0.02-5.97) $p = 0.46$
	Firearm	OR = 0.74 (0.03-18.96) $p = 0.86$	OR = 1.38 (0.06-32.54) $p = 0.84$		OR = 1.81 (0.08-41.62) $p = 0.71$	OR = 0.48 (0.06-3.86) $p = 0.49$	OR = 0.35 (0.03-4.80) $p = 0.43$	OR = 2.02 (0.09-46.16) $p = 0.66$
	Fire/burn injuries	OR = 0.27 (0.02-4.00) $p = 0.34$	OR = 2.02 (0.09-44.40) $p = 0.66$	-	OR = 2.64 (0.12-56.76) $p = 0.53$	OR = 1.64 (0.15-17.50) $p = 0.68$	OR = 1.71 (0.08-38.23) $p = 0.73$	OR = 2.96 (0.14-62.95) $p = 0.49$
	Threats to breathing	OR = 1.88 (0.08-42.07) $p = 0.69$	OR = 1.25 (0.12-13.24) $p = 0.85$	-	OR = 1.75 (0.17-17.69) $p = 0.64$	OR = 3.00 (0.31-28.84) $p = 0.34$	OR = 2.95 (0.14-61.96) $p = 0.49$	OR = 5.10 (0.25-1.1.93) $p = 0.29$
	Drowning^	OR = 1.09 (0.05-25.92)	OR = 0.68 (0.06-8.00)	-	OR = 2.64 (0.12-56.76)	OR = 4.20 (0.20-87.72)	OR = 1.71 (0.08-38.23)	OR = 2.96 (0.14-62.95)

		$p = 0.96$	$p = 0.76$		$p = 0.53$	$p = 0.35$	$p = 0.73$	$p = 0.49$
	Hanging^	OR = 0.43 (0.01-12.73) $p = 0.62$	OR = 0.80 (0.03-21.91) $p = 0.89$	-	OR = 0.92 (0.03-24.99) $p = 0.96$	OR = 0.50 (0.03-8.71) $p = 0.63$	OR = 0.67 (0.02-18.84) $p = 0.82$	OR = 0.33 (0.02-5.97) $p = 0.46$
	Strangulation^	OR = 0.43 (0.01-12.73) $p = 0.62$	OR = 0.80 (0.03-21.91) $p = 0.89$	-	OR = 1.04 (0.04-28.06) $p = 0.98$	OR = 1.65 (0.06-43.44) $p = 0.76$	OR = 0.67 (0.02-18.84) $p = 0.82$	OR = 1.16 (0.04-31.14) $p = 0.93$
	Perimortem fracture	OR = 0.50 (0.04-6.68) $p = 0.60$	OR = 0.25 (0.04-1.63) $p = 0.15$	-	OR = 0.15 (0.03-0.85) $p \leq 0.05$*	OR = 0.29 (0.07-1.26) $p = 0.10$	OR = 0.38 (0.05-2.88) $p = 0.35$	OR = 0.50 (0.09-2.73) $p = 0.42$
	Other	OR = 0.74 (0.03-18.96) $p = 0.86$	OR = 1.38 (0.06-32.54) $p = 0.84$	-	OR = 1.81 (0.08-41.62) $p = 0.71$	OR = 2.87 (0.13-64.35) $p = 0.51$	OR = 1.17 (0.05-28.00) $p = 0.92$	OR = 0.70 (0.06-8.75) $p = 0.78$
Groenewald *et al*. (2017)	Homicide	OR = 13.31 (9.80-18.07) $p \leq 0.0001$*	OR = 0.96 (0.82-1.13) $p = 0.62$	-	-	OR = 2.25 (2.01-2.52) $p \leq 0.0001$*	-	OR = 7.19 (6.19-8.35) $p \leq 0.0001$*
	Suicide	OR = 50.76 (7.11-62.14) $p \leq 0.001$*	OR = 1.15 (0.88-1.51) $p = 0.30$	-	-	OR = 0.71 (0.60-0.84) $p \leq 0.001$*	-	OR = 0.85 (0.70-1.03) $p = 0.10$
	Road traffic – unspecified	OR = 0.42 (0.34-0.51) $p \leq 0.001$*	OR = 1.05 (0.85-1.29) $p = 0.65$	-	-	OR = 0.56 (0.49-0.64) $p \leq 0.0001$*	-	OR = 0.62 (0.54-0.72) $p \leq 0.001$*
	Other transport	OR = 1.85 (0.74-4.59) $p = 0.186$	OR = 0.95 (0.55-1.64) $p = 0.86$	-	-	OR = 0.91 (0.62-1.34) $p = 0.63$	-	OR = 1.03 (0.67-1.60) $p = 0.90$
	Drowning	OR = 0.11 (0.07-0.17) $p \leq 0.0001$*	OR = 0.37 (0.23-0.59) $p \leq 0.001$*	-	-	OR = 0.86 (0.53-1.37) $p = 0.52$	-	OR = 0.63 (0.40-1.00) $p \leq 0.05$*
	Fire/burn	OR = 0.24 (0.18-0.32) $p \leq 0.0001$*	OR = 1.48 (0.97-2.25) $p = 0.07$	-	-	OR = 0.80 (0.63-1.01) $p = 0.06$	-	OR = 0.87 (0.66-1.13) $p = 0.29$
	Poisoning/ ingestion	OR = 0.33 (0.16-0.68) $p \leq 0.0001$*	OR = 2.79 (0.66-11.72) $p = 0.16$	-	-	OR = 0.35 (0.22-0.58) $p \leq 0.001$*	-	OR = 0.23 (0.14-0.38) $p \leq 0.001$*

	Surgical/medical complication	OR = 0.11 (0.05-0.22) $p \leq 0.001$*	OR = 0.49 (0.19-1.28) $p = 0.15$	-	-	OR = 0.21 (0.11-0.39) $p \leq 0.001$*	-	OR = 0.03 (0.02-0.04) $p \leq 0.0001$*
	Other unintentional injuries	OR = 0.07 (0.05-0.10) $p \leq 0.0001$*	OR = 0.84 (0.48-1.45) $p = 0.53$	-	-	OR = 0.46 (0.32-0.64) $p \leq 0.001$*	-	OR = 0.08 (0.06-0.10) $p \leq 0.0001$*
Mole (2019)	Homicide	OR = 50.86 (1.00-2577.18) $p \leq 0.05$*	OR = 27,605.44 (1724.77-441832.44) $p \leq 0.0001$*	-	OR = 27,611.88 (1726.29-441650.00) $p \leq 0.0001$*	OR = 27,606.07 (1724.92-441814.56) $p \leq 0.0001$*	-	OR = 27,599.82 (1723.45-441991.50) $p \leq 0.0001$*
	Blunt force†	OR = 0.45 (0.28-0.72) $p \leq 0.001$*	OR = 12.83 (7.22-22.82) $p \leq 0.0001$*	-	OR = 0.88 (0.78-1.01) $p = 0.06$	OR = 0.81 (0.68-0.98) $p \leq 0.05$*	-	OR = 0.66 (0.53-0.82) $p \leq 0.001$*
	Sharp force†	OR = 5.32 (2.75-10.30) $p \leq 0.001$*	OR = 0.57 (0.49-0.65) $p \leq 0.001$*	-	OR = 1.02 (0.93-1.12) $p = 0.63$	OR = 1.08 (0.94-1.24) $p = 0.28$	-	OR = 1.51 (1.26-1.82) $p \leq 0.001$*
	Firearm†	OR = 2.28 (1.40-3.70) $p \leq 0.001$*	OR = 1.13 (0.98-1.30) $p = 0.096$	-	OR = 1.07 (0.97-1.18) $p = 0.16$	OR = 1.05 (0.92-1.21) $p = 0.46$	-	OR = 1.20 (1.01-1.43) $p \leq 0.05$*
	Other†	OR = 0.06 (0.04-0.10) $p \leq 0.0001$*	OR = 0.70 (0.50-0.96) $P \leq 0.05$*	-	OR = 6.32 (3.83-10.43) $p \leq 0.001$*	OR = 0.90 (0.64-1.27) $p = 0.54$	-	OR = 0.28 (0.21-0.38) $p \leq 0.0001$*
Saunders *et al.* (2019)	Drowning	-	-	-	-		-	-
Von Caues *et al.* (2018)	Electrocution	-	-	-	-	-	-	-

OR – odds ratios; CI – confidence interval; *n* – number of deceased individuals; † Mechanisms of homicide observed in the study; ^ Examples of threats to breathing; Infancy & Childhood (0 – 9 years); Adolescence (10 – 19 years); Early adulthood (20 – 34 years); Early-to-middle adulthood (30 – 39 years); Middle adulthood (35 – 49 years); Middle-to-late adulthood (40 years and older); Late adulthood (50 years and older); * Statistically significant association ($p \leq 0.05$); Early adulthood life stage (20 – 34 years) was used as the reference group. [a] The reference group (to assess risk compared to adolescents in Albertyn *et al*. (2019)) was the infancy and childhood life stage due to the absence of adult deaths.

4.3. Qualitative thematic content analysis

Thematic analysis was completed using the discussion and conclusion sections from all 11 articles identified through the scoping review to understand how researchers report, discuss and conceptualise injury risk in research. It is worth noting that all articles where thematic analysis were applied, were quantitative studies. Therefore, the ways researchers discussed and conceptualised their findings were related to obtained statistical findings and not based on tested hypotheses or causative work relating to why men have a greater risk or the influence of external risk factors on causation and risk. Mortality data from three FPS mortuaries were available, with 83% (8/11) of articles containing data from Salt River Mortuary, one containing data from Tygerberg Mortuary, and 18% (2/11) not specifying where the data were from. A total of 361 codes were identified in text, with examples listed in Table D1. A word cloud was generated to visualise the frequency of words used by researchers in their reporting and conceptualisation of injury risk (Figure 4.3). Codes were assessed and grouped into comparable categories, and thematic mapping assisted with visualisation (Figure 4.4).

4.3.1. Identified themes

Four articles were published in 2019, two were published in 2017 and 2020, and one was published each year in 2015, 2018 and 2022 (Table C2). Examination of the 11 articles revealed that 82% (9/11) had a single institutional affiliation, and 18% (2/11) had two or more institutional affiliations. Investigating institutional affiliation further, 73% (8/11) were affiliated with the University of Cape Town, 18% (2/11) with the University of Stellenbosch and the South African Medical Research Council, and 9% (1/11) with the University of Pretoria, and the Western Cape Government (Table C2). Out of the 11 articles, 55% (6/11) were published in an international journal and 45% (5/11) in a South African journal, with the South African Medical Journal being the most popular (80%; 4/5) (Table C2).

In total, 18 initial themes were identified, and these were associated with behaviours, risk-taking, masculinity, socioeconomic barriers, substance abuse, social influences, peer pressure, and challenges with supervision (Table D2). These were refined, and four overarching themes emerged: i) vulnerability and victimhood in injury risk, ii) exploring culpability in injuries and violence, iii) masculinity, gender norms and the experience of injuries and violence in men and iv) socioeconomic status and environmental risks in injury patterns. Irrespective of publication year, institutional affiliation, or journal type, no differences in the conceptualisation of gender and life stage as risk factors were observed. The data presented were obtained from published manuscripts, thus, no ethical concerns to identify the authors exist.

Figure 4.3. A word frequency cloud generated from thematic content analysis applied to the discussion and conclusion sections of the 11 articles. It shows the most common words that researchers used in their discussion and reporting on injury risk. The size of each word corresponds to the frequency of its use and was created using NVivo®.

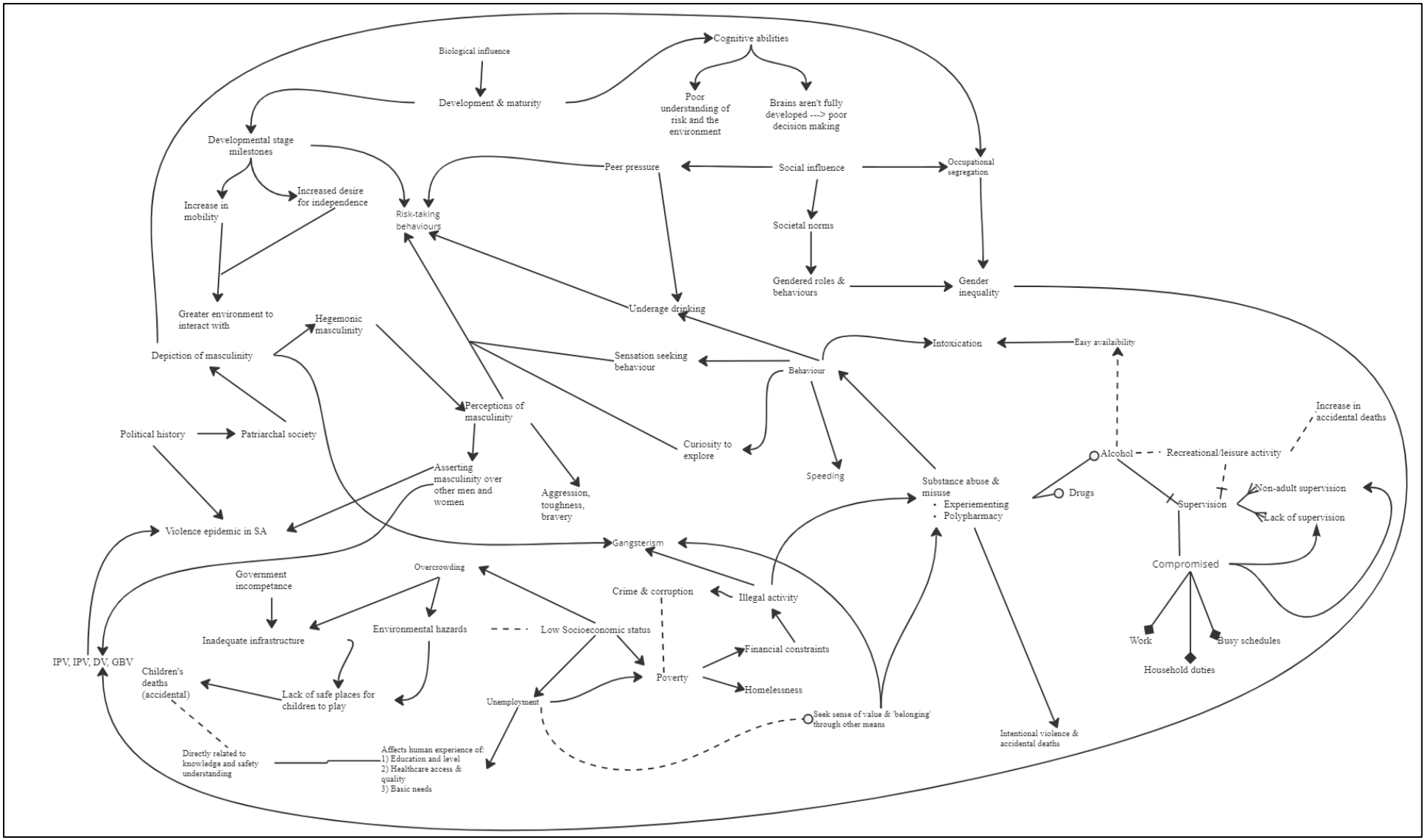

Figure 4.4. Thematic map showing the relationships and connections between refined codes. It was created using Miro®, and visualisation assisted with theme identification.

4.3.1.1. Vulnerability and victimhood in injury risk

- *"Children characteristically enjoy exploring risky activities with friends, but their concept of risk remains underdeveloped"* (Simons *et al.,* 2020:613).
- *"Drivers need to reduce speed when children are around"* (Albertyn *et al.,* 2019: 121).
- *"Lack of caregiver supervision at the time of an RTC incident"* (Albertyn *et al.,* 2019:121).
- *"In adolescence, increased autonomy, risk-taking behaviour and peer approval and acceptance are defining characteristics that result in the heightened vulnerability to injury"* (Simons *et al.,* 2020:613).
- *"In South Africa, despite significant legislative and policy gains around gender equality, women and girls remain subject to harmful gender attitudes, roles and social norms that undermine the social value and possibly the care offered to girl children"* (Simons *et al.,* 2020:613).
- *"More than half of all female homicide victims in South Africa are killed by an intimate partner"* (Clark *et al.,* 2017:5).

Researchers discussed risk in children, adolescents and women relative to their status as victims of violence and injury. The words chosen by researchers in their conceptualisation of risk ("*concept of risk remains underdeveloped*", "*lack of caregiver supervision*", & "*heightened vulnerability*") suggest victimhood and vulnerability. These words suggest an increased state of susceptibility to injury and vulnerability to harm during childhood and adolescence because of i) their low perception of danger and a lack of maturity in assessing and managing risks, ii) the inadequate monitoring of children by caregivers, iii) negligent adult behaviours (*e.g.,* speeding) and iv) interactions between specific characteristics exhibited during this life stage (*e.g., "risk-taking behaviour*", the newfound "*autonomy*", and *"peer pressures*"). Violence against women and girls was reported by researchers relative to societal expectations/norms (*e.g., "harmful gender attitudes, roles and social norms")* that perpetuate discrimination and negatively affect women and girls by diminishing their worth and value in society (*e.g., "undermine the social value")* making them vulnerable to becoming victims of violence. Their deaths were only discussed in one paper and reported relative to the prevalence of intimate partner violence and the threat it poses to South African women.

4.3.1.2. Exploring culpability in injuries and violence

- *"South African men of working age behave in a manner that puts them at greater risk of violent injury than South African women, as well as men from other countries"* (Clark *et al.,* 2017:3).
- *"School-aged boys engaged in more risk-taking activities than girls; and were more likely to rate injury risk as lower and frequently engaged in optimism bias, a belief of being less vulnerable to injury"* (Simons *et al.,* 2020:613).
- *"Highest levels of intoxication (were observed) in the 20-29 years age category, with severe intoxication occurring more frequently than mild intoxication"* (Clark *et al.,* 2017:3).
- *"Men were 20 times more likely than women to have a blood alcohol level above the legal driving limit at the time of drowning"* (Saunders *et al.,* 2018:533).
- *"Older children need to be more aware of their surroundings and take lesser risks on the road"* (Albertyn *et al.,* 2019:122).

Culpability as a reason for injury encounters in males, young adults, and adolescents was identified as a theme. The language used by researchers conceptualised men and boys as perpetrators of injury and violence. For example, researchers discussed culpability in men and boys relative to their low perception of injury risk (*i.e., rate injury risk as lower)* and behavioural differences (*e.g., behave in a manner that puts them at greater risk of violent injury)*. Researchers report that there are certain behaviours or actions that men engage in, specifically *"risk-taking activities"*, that expose them to a higher risk of experiencing violent injury compared to South African women. Researchers conceptualise these high mortality rates in men and early adults aged "*20 – 29 years"* relative to frequent alcohol abuse. Specifically, "*severe intoxication occurring more frequently*" and "*blood alcohol above the legal driving limit*" suggest that men and young adults choose to consume excess amounts of alcohol, and these choices contribute to death. In adolescence, researchers report injury encounters relative to their actions and behaviours. "*More aware of their surroundings*" suggests they are not attentive or conscious of the dangers, which leads to injury. "*Take lesser risks*" suggests irresponsible, reckless driving behaviours, and researchers think adolescents must engage in fewer risk-taking behaviours while driving.

4.3.1.3. Masculinity, gender norms and the experience of injuries and violence in men

- *"In a South African context, three factors are important in the ideology of masculinity: toughness, control and sexuality. A perceived idea of what it means to be a man results in displays of 'toughness' or 'bravery'; thus, disagreements are often resolved by arguments and subsequent fighting rather than by peaceful means"* (Clark *et al.,* 2017:3).
- *"Gender roles within society, leading to men being more likely than women to interact aggressively, especially with strangers away from their homes"* (Clark *et al.,* 2017:5).
- *"Men and boys are more likely than their female counterparts to be encouraged to participate in activities with inherent risk, including those with physical contact and adventure"* (Baliso *et al.,* 2022:804).
- *"Trauma being three times more prevalent among men and boys may relate to socio-cultural gender-based roles and patriarchal notions of masculinity"* (Baliso *et al.,* 2022:804).
- *"Violence is endemic among young men and boys in South Africa"* (Baliso *et al.,* 2022:804).

Masculine traits, gender roles and gendered behaviours were discussed as drivers of violence and injury encounters in males, irrespective of age (*e.g.,* man or boy). Traits traditionally viewed and recognised as masculine (*e.g.,* "*toughness, control, bravery, interact aggressively*") were discussed as driving forces of violence underpinning physical confrontation and fights between men. Violence was reported as a systemic norm (*e.g.,* "*violence is endemic")* that is deeply ingrained in South African men rather than an exception with societal expectations around gender-based roles and behaviours (*e.g.,* "*encouraged to participate in activities with inherent risk")* being discussed as contributors to injury and risk encounter by researchers.

4.3.1.4. Socioeconomic status and environmental risks in injury patterns

- *"Poor socio-economic status is correlated with high rates of homicide…with elevated levels of homicide in poor socioeconomic areas"* (Clark *et al.,* 2017:5).
- *"Bodies coming from high-murder rate areas have been attributed to the low socio-economic standing of most of the population, gang violence, drug trades or high population densities"* (Baliso *et al.,* 2022:803).

- *"High levels of inequality, poverty, poor infrastructure and ineffective service delivery are likely to contribute to the high rates of observed injury mortality"* (Saunders *et al.,* 2018:532).
- *"High levels of male unemployment and gender inequality within a community may be predictive factors for homicide and assault"* (Clark *et al.,* 2017:3).
- *"Adequate supervision is compromised by structural inequalities, such as poverty, unemployment, and difficult working conditions compromise adequate supervision. South African caregivers who lack the financial means to afford quality daycare services often left their children alone at home, or in the care of inexperienced adults or older children, while they sought employment or engaged in other activities"* (Saunders *et al.,* 2018:533).
- *"Socioeconomic factors such as poor road infrastructure and lack of safe play spaces near the child's home increased the likelihood of death by RTC injury"* (Albertyn *et al.,* 2019:120).

Researchers reported that individuals with low socioeconomic status were more susceptible to violence (*e.g., high rates of homicide*) and injury due to the existence of a combination of low socioeconomic risk factors (*e.g., "poverty", "gender dynamics", "ineffective service delivery", "unemployment",* and *"gang violence"*) that increased risk of violent behaviours and the likelihood of experiencing violent crimes. Researchers also reported reasons for injury risk in children relative to structural inequalities (*e.g., "poverty", "unemployment",* and *"caregiver*"), constrained decision-making attitudes of caregivers because of financial instability (*e.g.,* "*lack the financial means"*) and environmental factors (*e.g., "poor road infrastructure and lack of safe play spaces"*) that affect children's safety and well-being.

CHAPTER 5: DISCUSSION

A mixed methods study was conducted with quantitative and qualitative data analyses to identify the gender and life stage patterns in injury-related mortality and characterise the underlying causes associated with these risk factors in Western Cape medicolegal death investigations. This section discusses the results under three research questions: i) How do gender and life stage affect the risk of injury-related mortality? ii) How is injury risk conceptualised and reported in research? and iii) How do quantitative and qualitative results correlate with each other in the literature?

Postmortem data was selected to explore injury-related mortality as this is a valuable indicator of health and offers insight into the health of living communities, highlighting potential problems and risks that specific communities may face. In this research, challenges in data analyses were encountered due to varying sample sizes of each paper with small sample sizes being reported in most articles as well as inconsistencies between selected studies and the reporting of results, especially surrounding life stage classifications/ranges. The sample size variability across the included studies can be attributed to several factors such as: i) different sampling periods (*e.g.*, single year versus multi-year study), ii) unequal distribution of deaths for different causes (*e.g.*, expect a greater number of homicides than road traffic incidents), iii) differences in the sample population within each study (*e.g.*, forensic pathology deaths versus forensic anthropology deaths). Studies with a small sample focused on a single cause of injury-related mortality or assessed deaths in a single year whilst studies with a larger sample focused on multiple causes of injury-related mortality and deaths over multiple years

Only six of the identified 11 articles met the inclusion criteria for quantitative analyses. This limitation was attributed to a lack of standardised data reporting and recording across the studies. Of the six studies included, five were forensic pathology studies (Groenewald *et al.*, 2017; Von Caues *et al.*, 2018; Albertyn *et al.*, 2019; Mole, 2019; Saunders *et al.*, 2019), which analysed causes-of-death on soft tissue remains and one was a forensic anthropology study (Baliso *et al.*, 2022), which presented injuries observed on skeletonised remains. The forensic anthropology study was not representative of all decedents that passed through FPS facilities, as the individuals analysed would have been dead for an extended period before discovery and were referred to the Forensic Anthropology Cape Town (FACT) laboratory. Consequently, the forensic anthropology study was identified as an outlier, posing challenges in inter-study comparisons.

Differences in the causes of injury-related mortality between the forensic anthropology and forensic pathology studies were observed. The forensic anthropology study identified sharp and blunt force trauma as leading causes of perimortem injuries, whereas firearm-related injuries were most predominant in the forensic pathology studies. This finding agrees with traumatic injuries observed in other forensic anthropology contexts in South Africa (L'Abbé *et al.,* 2019; Steyn *et al.,* 2023). This variation in trauma between the two medicolegal death investigations may be influenced by the context wherein these crimes occur. It is possible that individuals subject to forensic anthropology death investigations may have ended up in such circumstances randomly and remained missing for a significant period before discovery. The higher rates of blunt and sharp force trauma may suggest the use of ordinary objects to commit crimes, as indicated by previous research (Bohnert *et al*., 2006). In addition, the low incidence of firearm trauma may support this hypothesis, as deaths due to firearms are more challenging to conceal because of the attention that firearms attract due to the noise. Furthermore, given the utility of the forensic anthropologist in understanding fracture patterns on bones, it seems unclear how many of these individuals were found skeletonised or underwent postmortem processing (maceration) for further analysis as this was not reported on or discussed in Baliso *et al*. (2022).

Although data comparison between the two types of medicolegal death investigations was challenging, similarities were also observed. In both types of medicolegal death investigations, male deaths outnumbered female deaths, however, men's risk of death was lower in the forensic anthropology study than in the forensic pathology studies. This suggests that irrespective of the type of death investigation, men are still victims of violence and injury. Another similarity was that fewer deaths were observed in the infancy and childhood life stage for all studies. This uniform observation may indicate children's vulnerability in society, emphasising the significant investment in their protection. Furthermore, the low number of infant and child deaths in the forensic anthropology study may also be attributed to challenges associated with scene recovery or scavenging due to the small size of juvenile bones and incomplete fusion at the epiphysis. The quantitative analyses of Baliso *et al.* (2022) data produced many findings that were not statistically significant. Therefore, it is not possible to say whether men's risk and early adulthood risk of death is an accurate measure of not being statistically significant or whether it was due to a random chance event.

5.1. How does gender and life stage affect the risk of injury-related mortality?

This study aimed to test the following hypotheses: Hypothesis 1 posited that male gender is an influencing factor for injury risk, thus more fatalities and greater risk for death are expected among men compared to women. Hypothesis 2 suggested that a higher frequency of deaths is expected among children and young adults should life stage be a determinant for injury risk. Quantitative analyses showed both gender and life stage to be demographic risk factors for injury-related mortality.

5.1.1. Gender

An alarming prevalence of injury-related mortality emerged from the quantitative analyses. Specifically, men and boys were more often victims of violence and injuries than women or girls. This pattern persisted across all studies, irrespective of publication year or institutional affiliation. These findings align with prior national and international research indicating higher injury-related mortality rates for males than females (Baker *et al*., 1992; Tardiff *et al.,* 1995; Kumar *et al.,* 2005; Mohanty *et al.,* 2005; Norman *et al.,* 2007; Morrongiello & Schwebel, 2008; Pretorius & van Niekerk, 2009; Seedat *et al.,* 2009; Sorensen, 2011; Abrahams *et al.,* 2013; Cocks & Saayman, 2013; Dhaffala *et al.,* 2013; Matzopoulos *et al.,* 2015; Matzopoulos *et al.,* 2018; Prinsloo *et al.,* 2021; Rogers *et al.,* 2022). This elevated mortality rate in males is not exclusive to injury-related incidents but extends to deaths caused by illness and disease as well (Sorensen, 2011). Various explanations exist, with prior research linking this to a combination of biological, physiological, social, and behavioural factors such as differences in sex hormones between men and women, brain structure and maturity differences and social influences on occupational segregation and gendered behaviours (Veevers & Gee, 1986; Bauter *et al.,* 1998; Udry, 1998; Blair, 2007; Sorenson, 2011; Maiolo & Reid, 2020).

This study identified gender-specific disparities in the primary causes of injury-related mortality and variations in the risk of death between men and women. Groenewald *et al*. (2017) compared the leading causes contributing to mortality rates in men and women. Homicide emerged as the predominant cause of male mortality, whereas road traffic injuries were the leading cause of injury-related mortality in women. These gender-linked differences in cause-of-death are consistent with other studies (Morrongiello & Dauber, 1998; Yadollahi *et al.,* 2015; WHO, 2021). Behavioural differences and risk-associated activities linked to masculinity (*e.g.*, physical confrontation), have been proposed as explanations underpinning the elevated homicide rates in men (Morrongiello, 1997; Bauter *et al.,* 1998; Udry, 1998; Hillier & Morrongiello, 1999; Norman *et al.,* 2007). In contrast, literature does not attribute women's

deaths in motor vehicle accidents to their own behaviours or risk-taking but rather to factors outside of their control such as vehicle ergonomics, biased safety device designs, gender inequality, and stereotypes (Bose *et al.,* 2011; Mulroy, 2019; Felton, 2023; Mann, 2023).

Results from the quantitative analyses also indicate that men faced higher odds of violent death, such as homicide, compared to less violent causes like suicides or accidents. By employing a random effects model on data from Groenewald *et al*. (2017) and Mole (2019), it was determined that men were four times more likely than women to succumb to homicide ($OR = 3.95$; $p \leq 0.01$). Notably, the risk of homicidal death for men was lower than previously observed (7:1) (Matzopoulos *et al.,* 2023), possibly attributed to the small study sample and the provincial focus compared to the national focus in that study.

Mole (2019) completed a comprehensive analysis of homicide. Men had a greater risk of homicide due to firearms and sharp forces while exhibiting a lower risk for blunt force and other causes. Firearms, constituting 42% of male homicides, emerged as the leading cause, whereas sharp force trauma accounted for the majority of female homicides (35%). These distinctive gender-based variations in the mechanisms of homicide align with findings from other South African studies (Mathews *et al.,* 2009; Pretorius & van Niekerk, 2009; Cocks & Saayman, 2013; Matzopoulos *et al.,* 2023). Despite the introduction of the national Firearms Control Act, firearms continue to account for a significant proportion of deaths, highlighting the ongoing issue of firearm-related violence in the Western Cape (Firearms Control Act No.60 of 2000, 2001; Matzopoulos *et al.,* 2018). The high rate of firearm fatalities in men have been linked to gang violence and gang-related killing in the Western Cape, poverty, organised crime and corruption, high levels of licensed and unlicensed firearm ownership, decreased effectiveness of law enforcement and drug trafficking (Krug, 2000; SAFCA, 2000; Seedat *et al.,* 2009; Centre for the Study of Violence & Reconciliation, 2010; Siegel *et al.,* 2013; Matzopoulos *et al.,* 2018; Matzopoulos *et al.,* 2023; UNODC, 2023; Western Cape Government, 2023). The legacy of political gun violence in South Africa, where firearms were historically associated with control and violence during the apartheid era, has also been noted as a social factor contributing to the high rates of violence (Matzopoulos *et al.,* 2018). Furthermore, the literature suggests that firearms were more commonly linked to the killing of strangers, while sharp force weapons were associated with domestic and intimate partner violence (Centre for the Study of Violence & Reconciliation, 2010; Gonnella, 2021). This is consistent with research findings from this study, where women were more commonly killed by sharp force weapons and aids in explaining the observed gender-based differences in homicide mechanisms.

Analysing risk differences for accidental causes of injury-related mortality, men exhibited statistically lower risk for road traffic deaths, poisoning/ingestion, surgical/medical complications, and fire/burn injuries (Groenewald *et al.,* 2017). This finding may be attributed to lower risk-taking behaviours associated with these specific causes of injury-related mortality. For all other causes assessed, no statistically significant findings were produced, making it challenging to conclude whether an association exists or if the findings were due to chance. For causes of injury-related mortality such as homicide, surgical/medical complications, other unintentional injuries, poisoning/ingestion, fire/burns, road traffic – unspecified and perimortem fractures, findings do support the hypothesis that gender is an influencing factor or that an association between gender and certain causes of injury-related mortality exists.

5.1.2. Life stage

The research revealed that individuals across all life stages experienced injuries and violence, with a higher death rate observed among adults (20 years and older) compared to the youth (0 – 19 years). Social determinants such as substance abuse, poverty, socioeconomic inequality, and weaknesses in the criminal justice system were suggested reasons underpinning the high death rate in adults (WHO, 2021). Firearms were the leading cause of homicides in adults compared to sharp force trauma in the youth, a finding previously noted by Grayaa *et al*. (2021). Reasons underpinning the high rates of firearm deaths in adults include the easy availability of firearms, coupled with the occurrence of these deaths in contexts involving gang confrontations and criminal activities—areas where adults are more commonly engaged than the youth (Seedat *et al.,* 2009; Pretorius & van Niekerk, 2016; Matzopoulos *et al.,* 2023). Conversely, the heightened incidence of sharp force homicides in the youth may be suggestive of the circumstances surrounding their deaths, where perpetrators use ordinary objects that are easily available (*i.e*., knives, scissors, forks, and broken glass) as weapons (Bohnert *et al*., 2006).

Upon further analysis, the results demonstrated a prevalence of deaths in early adulthood (20 – 34 years). This trend was evident for most causes of injury-related mortality, except for deaths attributed to surgical/medical complications, poisoning/ingestion, and other unintentional injuries, where late adulthood experienced the most deaths (Groenewald *et al.*, 2017). Early adulthood carried a significantly higher risk of homicidal death compared to infancy & childhood, middle adulthood, and late adulthood while exhibiting a lower risk compared to adolescence—although this difference was statistically insignificant (Groenewald *et al.,* 2017). Furthermore, those in early adulthood demonstrated a statistically lower risk of

accidental deaths compared to infancy and childhood, middle adulthood, and late adulthood (Groenewald *et al.,* 2017). This pattern of early adulthood mortality is not unique to South Africa but instead aligns with the global pattern of premature mortality in this age group (Veevers & Gee, 1986; Lopez *et al.,* 2006; Remund *et al.,* 2021; Rogers *et al.,* 2022; WHO, 2021; 2022). This pattern deviates from the typical U-shaped mortality curve, where deaths in early adulthood are expected to be low (Remund *et al.,* 2021; Camarda *et al.,* 2022). Numerous reasons have been suggested for this, including increased display of risk-taking behaviours, substance abuse, occupational stressors, mental health issues, and the influence of biological factors during this stage of development (Kent, 2010; Viner, 2011; Remund *et al.,* 2021; Camarda *et al.,* 2022; Centre for Disease Control (CDC), 2022).

All causes of injury-related mortality were common across all life stages, but the primary causes of death varied for each stage. Homicide emerged as the primary cause of injury-related mortality in adolescence (10 – 19 years), early adulthood, and middle adulthood (35 – 49 years) (Groenewald *et al.,* 2017). Previous research has identified interpersonal violence and road traffic deaths as the leading causes-of-death among those aged 15 to 44 years (Msemburi *et al.,* 2016; WHO, 2023). In contrast, accidental causes-of-death were the leading cause of mortality in infancy and childhood and late adulthood (Groenewald *et al.,* 2017; Mole, 2019), a finding consistent with other studies (Murray, 2006; Viner *et al.,* 2011; Pretorius & van Niekerk, 2014; Msemburi *et al.,* 2016; Mostert, 2023; Yang *et al.,* 2023). Specifically, road traffic fatalities were the primary contributor to deaths in infancy and childhood and late adulthood in this study (Groenewald *et al.,* 2017). While the low number of homicides may contribute to this pattern, high rates of road traffic deaths in infants and children have been attributed to the underutilisation of seatbelts and other restraints, along with changing restraint requirements as children age (Matzopoulos *et al.,* n.d.; Sherwood *et al.,* 2003). In late adulthood, the high rates of road traffic injuries have been suggested to result from musculoskeletal challenges, high rates of bone fractures due to osteoporosis, and slow reaction times (Azami-Aghdash *et al.,* 2018). Notably, falls have been consistently reported in the literature as a significant cause of injury-related mortality in late adulthood (Pretorius & van Niekerk, 2014; Mostert, 2023; Yang *et al.,* 2023), however, this finding was not observed in this study, potentially due to its exclusion as a separate category and its possible grouping under 'other unintentional' causes of mortality.

This study also observed an age-dependent pattern in the leading mechanism of road traffic deaths (*i.e.*, pedestrian or passenger). Pedestrian-related deaths (84%) were the most common mechanism of road traffic deaths with infants and children more involved than

adolescents. Additionally, those in infancy and childhood exhibited greater odds of pedestrian-related road traffic fatalities and lower odds of passenger-related fatalities compared to adolescents (Albertyn *et al.,* 2019). This observation aligns with prior research that reported pedestrian-related road traffic deaths to be more common in younger children (1 – 14 years), whereas passenger-related deaths were more common in older children (10 – 19 years) (Harris *et al.,* 2004; Sarkin *et al.,* 2006; Pretorius & van Niekerk, 2009). Pedestrian-related deaths contribute significantly (42%) to South Africa's total road traffic deaths (Santam, 2024); therefore, this increased proportion of pedestrian-related deaths is not new. The high rates of accidental road traffic deaths in younger children are perhaps attributed to their natural curiosity to explore and interact with their environment, a lack of education about road safety, the limited cognitive ability to comprehend the dangers associated with their actions or in their environments, and the inability to accurately judge the speed and distance of vehicles as well as limited ability to perceive road and traffic hazards (Davey, 2000; Sarkin *et al.,* 2006; Balocchini *et al.,* 2013; Matzopoulos *et al.,* n.d.; Mathews & van Niekerk, 2020; Camarda *et al.,* 2022; Papa *et al*., 2023). Reasons for more passenger-related deaths in older children may be due to them often riding in vehicles with inexperienced drivers or possibly that drivers are engaged in risky behaviours putting their lives and other's at risk (Allen & Brown, 2008).

Apart from road traffic crashes the infancy and childhood life stage had the second largest number of drowning mortalities (Groenewald *et al.,* 2017; Saunders *et al.,* 2018). This finding contrasts with the observed pattern for other causes of injury-related mortality in this study, where middle adulthood was the life stage with the second-highest number of deaths. This contrasts with results from a global study showing drowning as the leading cause-of-death in children (1 – 4 years) (Franklin *et al*., 2020). Reasons for the high number of drownings in infants and children have been attributed to i) compromised adult supervision in the home or surrounding large bodies of water because of socialising or miscommunication between caregivers and ii) the inquisitive nature of children to explore their surroundings (Saunders *et al.,* 2018; Peden & Franklin, 2020; Maharaj, 2022; WHO, 2023).

5.2. How is injury risk conceptualised and reported in research?

No temporal differences in the conceptualisation of injury-related mortality by gender or life stage were observed when comparing authors institutional affiliation, the journal it was published in, or the publication year. Findings from the qualitative thematic analysis showed that researchers described and conceptualised the causes of violence and injury differently for men and women. Examination of the language used showed a tendency to report and discuss men's injury risk relative to culpability, depicting men as perpetrators of violence rather than

victims. Masculine traits and the social behaviours associated with gender were frequently cited as causes-of-injury perpetuation and violence among men and women in South Africa. Researchers commonly attributed high rates of injuries in males relative to risk-taking and behaviours, which have been operationalised as masculine traits. It seems possible that the reporting of injury risk in men may be linked to patriarchal notions of masculinity that reinforce gender roles dictating appropriate behaviours in opposite-sex relationships (Pence & Paymar, 1993; Morrell, 1998; Wood & Jewkes, 2001; Shefer *et al.,* 2013; Thobejane & Luthada, 2019). In South Africa, people of colour experienced continuous violence during Apartheid, resulting in the normalisation of brutality and systemic violence (Coovadia *et al.,* 2009; Graaff & Heinecken, 2017; Mshweshwe, 2020). Those who were powerless used violence as a means to express their masculinity, therefore this association between violence and masculinity led to the socialisation of aggression and encouragement of male control as an acceptable and honourable means of displaying masculinity which continued many generations (Ember & Ember, 1994; Norman *et al.,* 2007; Wood *et al.,* 2008; Coovadia *et al.,* 2009; Seedat *et al.,* 2009; Machisa, 2010; Morrell *et al.,* 2012; Matzopoulos *et al.,* 2013; Shefer *et al.,* 2013; Fleming *et al.,* 2015; Viitanen & Colvin, 2015; Durham, 2020; Chou *et al.,* 2022). Through this research, it is evident that because of the ways in which male injury and mortality was discussed, men were commonly presented as perpetrators because these masculine traits were recognised as driving factors behind injury creation. What researchers failed to recognise is the web of vulnerability men find themselves I because they are actually victims of unhealthy notions of masculinity and masculine traits. This perspective perpetuates the extent of violence against men and fails to highlight the underlying roots of masculinity embedded in the country's patriarchal political history.

In contrast, women were predominantly portrayed and conceptualised in medicolegal death research as victims of injury-related mortality, with injury risk described relative to vulnerability. Through this work, thematic analysis showed that women were frequently depicted as victims of gender inequality and intimate partner violence. This finding aligns with the literature supporting the finding that women are more likely reported as victims of intimate partner violence than men. Reasons for this are because society tends to condone men's use of physical violence and displays of aggression, while women are socially expected to be non-violent (Seedat *et al.,* 2014; Fleming *et al.,* 2015; Thobejane & Luthanda, 2019; Lima-Chantre *et al.,* 2022).

As with gender, researchers discussed injury and risk differently by age, conceptualising young adults' injury in terms of culpability and children's injury in terms of

vulnerability. When discussing injury risk, children were portrayed as victims with risk for injury described in relation to developmental stage challenges. Thematic analysis highlighted that children were considered particularly vulnerable to injury due to i) vulnerability related to their developmental stage and dependence on caregivers and ii) their inability to assess risk and manage hazards associated with risk-taking activities accurately. Specifically, their deaths were linked to their low perception of danger and the inability to comprehend risk and its consequences, attributed to cognitive immaturity in this early developmental stage. This finding aligns with previous research indicating that children are more at risk of victimisation than adults (Lewit & Baker, 1996).

In contrast, researchers discussed injury risk in young adults relative to culpability. Similar to men, young adults were deemed responsible for their deaths because of their behaviours and choices. Alcohol misuse and intoxication were described as risk factors contributing to injury-related mortality in this life stage. This observation is supported by literature that suggests a correlation between high rates of intentional mortality and alcohol intoxication during early adulthood (Veevers & Gee, 1986; Spoth *et al.,* 2022; Matzopoulos *et al.,* 2023).

Interestingly, injury risk in adolescence was discussed relative to both culpability and vulnerability. Adolescents were portrayed as victims owing to the confounding influence of several factors outside of their control. Their limited agency and poor judgement of risk because of different reasoning and decision-making processes associated with their developmental stage were cited as reasons making them susceptible to injury. Previous studies have shown that a complex interaction between cognitive, physical, psychosocial, and environmental factors contributes to heightened vulnerability to injury during adolescence (Johnson & Jones, 2011). Reasons for this occur because the pre-frontal cortex, responsible for decision-making, risk assessment, and planning, only matures at the age of 25, therefore, adolescents' independence, coupled with their curiosity to explore their surroundings, and engage in risk-taking behaviours make them vulnerable to injury (Arain *et al.,* 2013; Barlow, 2020).

In addition to delineating disparities in the profiles of victims and perpetrators, socioeconomic and environmental factors contributing to injury-related mortality were also commonly discussed by researchers. Previous research has established a social gradient in illness and life expectancy, wherein individuals of low socioeconomic status were more likely to experience premature mortality due to the disproportionate exposure to inequalities and disparities that may perpetuate risk and constrain individual agency (McCall *et al.,* 1992; Hsieh

& Pugh, 1993; Groenewald *et al.,* 2010; Sartorius & Sartorius, 2010; Marmot, 2015; CDC, 2016; Govender, 2017; Probst *et al.,* 2018; UNODC, 2019; Dong *et al.,* 2020; Armstead *et al.,* 2021; Matzopoulos *et al.,* 2023). This was observed in the qualitative analysis where researchers reported individuals of low socioeconomic status were more susceptible to elevated levels of violence (*e.g.,* homicide) and injury. Various socioeconomic factors, such as poverty, unemployment, resource deprivation, and economic inequality, which are exacerbated in low socioeconomic environments, were conceptualised as contributors to increased injury risk and violent crimes. Additionally, children residing in low socioeconomic areas had an increased injury risk. Firstly, physical barriers and hazards in the environment (*e.g.,* a lack of safe places to play and poor road infrastructure) were associated with an elevated risk of injury in children as well as caregivers' abilities being constrained by socioeconomic challenges which in turn rendered children susceptible to injury.

5.3. How do qualitative and quantitative results correlate with each other in publications?

Applying a mixed methods approach allowed us to not only identify repeated patterns of injury-related mortality in Western Cape medicolegal death investigations but also enabled us to provide a greater understanding of what causes and risk factors contribute high rates of unnatural mortality - an aspect relatively unexplored in quantitative studies. The combined approach revealed distinct insights into the research questions, complementing each component. The qualitative data provided a comprehensive, contextual understanding that enriched the statistical trends and associations produced by the quantitative component.

This study found that gender influences both injury risk and causes of injury-related mortality, thereby qualifying as a risk factor. Moreover, significant disparities between victim profiles in the quantitative and qualitative were identified. The quantitative data provided insight into the impact of violence and injury on both men and women, with men facing a disproportionately higher risk. Conversely, qualitative findings revealed that researchers conceptualised the causes of violence and injury risk differently for men and women, depicting females as victims while highlighting a disparity in the portrayal of men's role in injury incidents.

By merging the quantitative and qualitative methods, discrepancies in data reporting were noted, and gender-linked biases in medicolegal death reporting were identified. Although men and boys were identified as victims of injury-related mortality through the quantitative analysis, the qualitative analysis showed that researchers often portrayed men as perpetrators

of injuries and violence when discussing injury risk in men. This observation is not intended as a criticism of medicolegal research, but serves to highlight biases, bringing attention to the mismatch between mortuary death records and the portrayal of victims and perpetrators in the literature. The disconnect between the quantitative and qualitative findings has harmful implications, as it: i) understates the true extent of violence and injuries experienced by men, thereby misinforming public policy and obscuring the reality of men's risk of death; ii) perpetuates gender inequality and injustices by endorsing and reinforcing gender stereotypes; and iii) contributes to the propagation of incorrect biases (Leone, 2016; Willis, 2023).

This pattern of reporting is not only confined to medicolegal research but has been observed in news reporting as well. Deaths and violence are common media topics. Gender frequently shapes decision-making in crime news reporting, influencing the representation of victims and perpetrators (Leone, 2016). Women are often more likely reported as victims, even though the percentage of women dying is significantly lower than that of men. This is attributed to the greater cultural stigma attached to femicide, given the gendered nature of violence and the portrayal of men as individuals valuing aggression and dominance (Schildkraut & Dawley, 2012; De Wet, 2016; Leone, 2016). The parallelism in reporting and discussing deaths in medicolegal research may indicate a strong influence of news media reporting and social norms in scientific writing.

Moreover, the integration of quantitative and qualitative results underscored the intricate nature of injury-related mortality, emphasising that neither gender nor life stage alone serves as the exclusive risk factor. These factors coexist in a network of structural issues therefore, researchers must consider each factor as one that is connected within a network where political backgrounds, socioeconomic influences, and environments simultaneously shape and contribute to risk. More specifically, structural issues that relate to medicolegal reporting were also identified in this study. These included norms in publication standards and death reporting with a predominant focus on reporting and discussing deaths in women when the statistics show more men to be affected as well as the lack of standards for life stage comparison in medicolegal death reporting.

Qualitative work revealed specific structural root causes and variables that can be used to guide policy design and prevention measures, highlighting the value of a mixed methods approach to studying injury-related mortality by uncovering insights not easily identified through quantitative data alone. For example, policy makers can design policies and interventions that focus on addressing economic (*e.g.,* poverty) and social factors (*e.g.,* gender discrimination and stereotyping, and gender status) identified through this study.

5.4. Study limitations

Potential discrepancies in the data received and how this may have impacted data collection and reporting, given that secondary data was used with potential secondary biases in postmortem data, are recognised. Higher exposure rates may lead to certain groups being disproportionately affected by injuries. However, information about exposure rate data by gender and life stage was not available for this study, thus the limitation is acknowledged. Given that the inclusion criteria developed for this study were limited, relevant studies may have been excluded, and findings may not necessarily be generalisable to any population. Sample size variations and the lack of similarity in life stage ranges between studies made life stage categorisation and inter-study quantitative comparison challenging, impacting the reliability of the data. Furthermore, the generalisability of the results were constrained by limitations relating to data collection, access to records and time constraints. This prevented an in-depth analysis of all causes of injury-related mortality observed at Salt River Mortuary (SRM) over the chosen study period. Therefore, it is acknowledged that these findings are based on a small proportion of deaths assessed in Western Cape mortuaries. Additionally, most studies only presented data on a single cause-of-death, and this limited the ability to compare findings across studies and constrained the scope and depth of understanding mortality patterns between the genders and across life stages. The study's scoping review design and research questions meant that methodologies, populations and outcome measures were not compared or described in this study, which is a noted limitation. The inductive approach to coding employed in thematic content analysis introduces the potential for bias and subjectivity, particularly during the initial research stages, as codes could be influenced by preconceived notions from research questions posed and data obtained through the scoping review. Lastly, it is important to note that this study does not and cannot make assumptions about these articles' readership, comprehension, and perception. Instead, it provides an overview of what was published (and what was not), laying the groundwork for more informed discussions on policy and preventing injury-related mortality.

CHAPTER 6: CONCLUSIONS

Through this research the value of coalescence for quantitative and qualitative research in a scoping review with a mixed methods approach is illustrated. This combined approach to studying injury-related mortality by gender and age in Western Cape medicolegal death investigations allowed for patterns and themes to be identified which are not always evident in quantitative studies (the research approach commonly used in injury research).

Due to the lack of standardised approaches in research on medicolegal reporting and postmortem investigations, few studies met the inclusion criteria, making quantitative analyses challenging. In response to the first research question on how gender or life stage were affects the risk of injury-related mortality, this study underscored the critical role of gender and life stage in injury-related deaths in Western Cape medicolegal death investigations. Violence emerged as the predominant cause of injury-related mortality among adults, surpassing accidents in youth. Notably, males and individuals in the early adulthood life stage faced a higher risk of death, with a pronounced vulnerability to homicidal deaths. Therefore, to reduce the extent of injury-related mortality, interventions must be directed towards lessening the extent of homicide and its contribution to injuries within the Western Cape province.

The language used by researchers showed distinct portrayals of risk for men and women, with men identified as perpetrators and women characterised as victims in medicolegal death investigation research. The thematic analysis further highlighted the gendered nature of violence, implicating masculinity and gender norms as root causes for perpetration and victimisation in both genders. Regarding the life stages, injury risk in infants, hildren and adolescents were often reported in terms of vulnerability and victimisation, whilst risk in adults was framed in terms of culpability. Consequently, effective interventions should be formulated to target adult behaviours as they were implicated in their own deaths and the deaths of others.

Comparison of the qualitative and quantitative findings identified discrepancies between the reporting and discussion of victims and perpetrators highlighting a gender-linked bias in perpetrator and victim representations in medicolegal death investigation research. Discrepancies revealed the gendered nature of violence. Fewer women died compared to men, however, researchers and news reporters disproportionately highlighted women as victims. It is imperative to address this disparity in research reporting, as the current presentation of the

data obscures the true magnitude of violence experienced by men, misguiding policymaking efforts that necessitate targeted interventions to reduce injury-related mortality rates.

The study's contribution extends beyond mere statistical insights, delving into the nuanced understanding of injury's structural roots, social influences and the interconnectedness of factors, contributing to injury-related mortality and the disparities. In addition, it highlights the potential biases in research reporting that shape narratives surrounding injury-related mortality. It provides a foundation for future investigations to understand injury-related mortality and highlights the necessity of cross-disciplinary collaboration to identify individual, systemic and institutional level risk factors when conducting injury-related research. Recognising the importance of identifying root causes in society and in medicolegal reporting, the study advocates for targeted interventions tailored to address gender and life stage-specific risks in the Western Cape and country, challenging the efficacy of broad-level policies.

Recommendations for future research

Through this research, many questions have emerged that have provided avenues for future research. The need for a national study incorporating data from multiple mortuaries is emphasised to assess broader patterns of injury-related mortality and temporal differences in risk conceptualisation from different institutional backgrounds. This research has shown that men and boys have a greater risk than women and girls, still, uncertainties surrounding gender-risk differences across life stages warrant further exploration, urging future research to delve into more recent and comprehensive mortuary data. Recognising the bias in the current research, due to the focus and overrepresentation of violent deaths, this study advocates for future research with a heightened focus on accidental and unintentional causes-of-death, aiming for a more profound understanding of the associated gender and life stage patterns. An important aspect, not explored in this work, is research that focuses on assessing the link between mortality and exposure rates to injury risk. Future investigations should also explore demographic patterns of perimortem injury in forensic anthropology death investigations across the country.

In analysing life stages, the study acknowledges challenges in combining infant and child categories and the difficulties related to inter-study comparison because of a lack of standardised life stage ranges. It suggests that future research employ smaller, more discrete age ranges to assess injury-related mortality more accurately but also advocates for the creation of standard life stage ranges in the discipline of medicolegal death investigations for easy and

more accurate comparison. The emergence of numerous avenues for future research underscores the issue's complexity and allows for ongoing exploration and refinement of the understanding of injury-related mortality. From a qualitative component, reporting biases were identified and a suggestion is that researchers and journals screen for gender-linked bias prior to publishing work.

Everything considered, this research demonstrated the strong impact of structural issues like gender stereotypes that can influence perception but also the research done. Therefore, as forensic scientists, pathologists and medicolegal death investigative practitioners, the research produced must be free from the influence of worldviews, news media or gender biases, and should be presented objectively as it has the potential to inform evidence-based policy and improve the lives of citizens.

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APPENDICES

APPENDIX A: Ethical approval and amendment permissions

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room 45 E-52-E-Floor- Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6492
Email: hrec-submissions@uct.ac.za
Website: https://health.uct.ac.za/home/human-research-ethics

21 September 2022

HREC REF: 430/2022

A/Prof V Gibbon
Division of Biological Anthropology
Human Biology-FHS
Email: victoria.gibbon@uct.ac.za
Student: VGTCHE001@myuct.ac.za

Dear A/Prof Gibbon

PROJECT TITLE: GENDER AND LIFE STAGE AS RISK FACTORS OF INJURIES IN SOUTH AFRICAN MEDICOLEGAL DEATH INVESTIGATIONS-
(MASTERS CANDIDATE-MS CHELSEY VOEGT)

Thank you for your response letter, addressing the issues raised by the Faculty of Health Sciences Human Research Ethics Committee (HREC).

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

Approval is granted for one year until the 30 September 2023.

Please submit a progress form, using the standardised Annual Report Form (FHS016) if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

The HREC acknowledge that the student: Ms Chelsey Voegt will also be involved in this study.

Please quote the HREC REF 430/2022 in all your correspondence.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval, where necessary, before the research may occur.

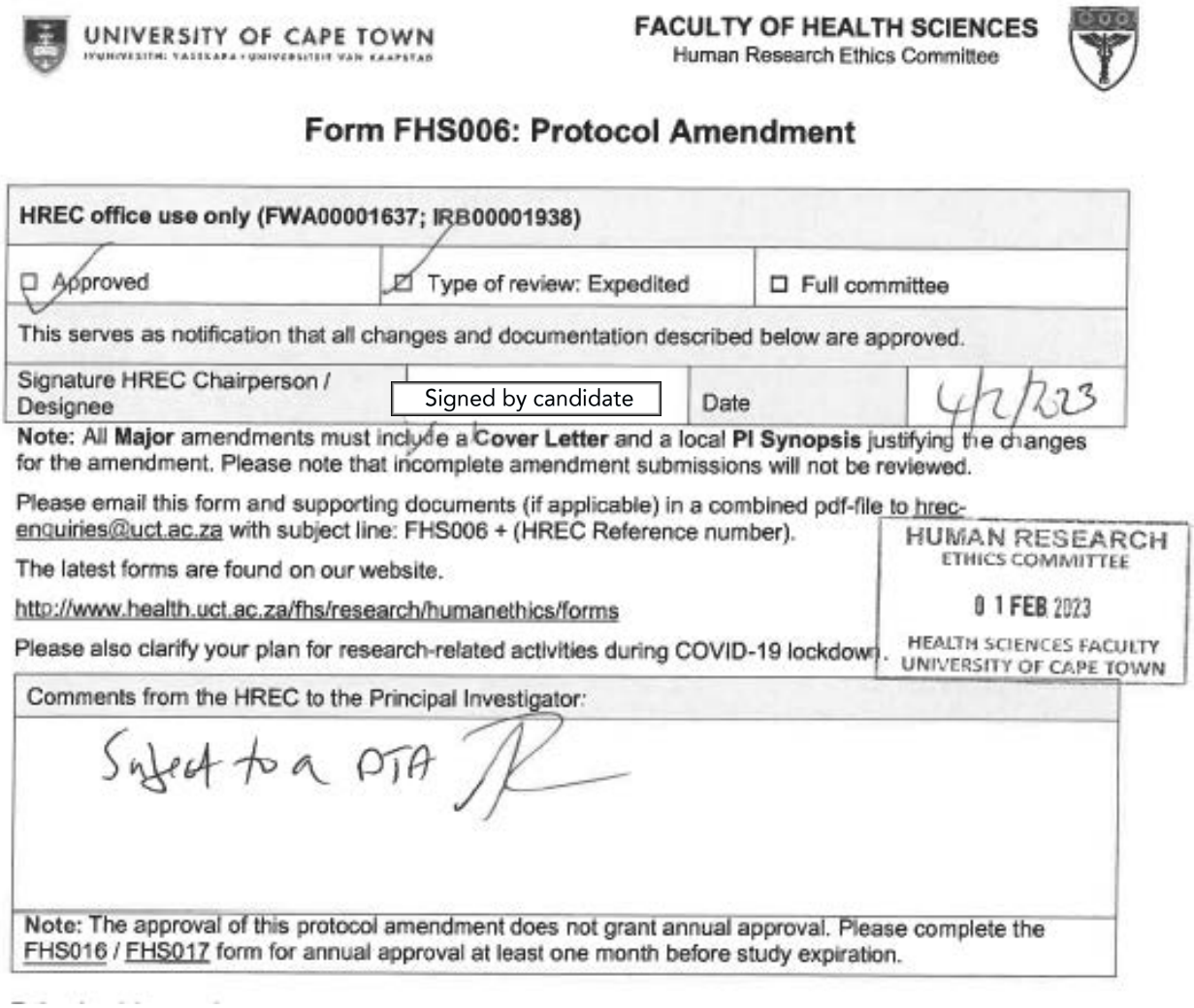
Yours sincerely

Signed by candidate

PROFESSOR M BLOCKMAN
CHAIRPERSON, FACULTY OF HEALTH SCIENCES HUMAN RESEARCH ETHICS COMMITTEE
Federal Wide Assurance Number: FWA00001637. Institutional Review Board (IRB) number: IRB00001938 NHREC-registration number: REC-210208-007

HREC/ref 430.2022

Figure A1. Ethical approval from the University of Cape Town Human Research Ethics Committee for this study (2022).



UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

FACULTY OF HEALTH SCIENCES
Human Research Ethics Committee

Form FHS006: Protocol Amendment

HREC office use only (FWA00001637; IRB00001938)		
☐ Approved	☑ Type of review: Expedited	☐ Full committee
This serves as notification that all changes and documentation described below are approved.		
Signature HREC Chairperson / Designee	Signed by candidate	Date 4/2/23

Note: All **Major** amendments must include a **Cover Letter** and a local **PI Synopsis** justifying the changes for the amendment. Please note that incomplete amendment submissions will not be reviewed.

Please email this form and supporting documents (if applicable) in a combined pdf-file to hrec-enquiries@uct.ac.za with subject line: FHS006 + (HREC Reference number).

The latest forms are found on our website.

http://www.health.uct.ac.za/fhs/research/humanethics/forms

Please also clarify your plan for research-related activities during COVID-19 lockdown.

HUMAN RESEARCH ETHICS COMMITTEE
01 FEB 2023
HEALTH SCIENCES FACULTY
UNIVERSITY OF CAPE TOWN

Comments from the HREC to the Principal Investigator:
Subject to a DTA
Note: The approval of this protocol amendment does not grant annual approval. Please complete the FHS016 / FHS017 form for annual approval at least one month before study expiration.

Figure A2. Ethical approval amendments from the University of Cape Town Human Research Ethics Committee for this study (2023).

APPENDIX B: Database search strategy and eligibility criteria

Table B1. The four databases detailing their specific search strategy, the filters applied, and the number of articles identified after conducting each search.

Database	Search date	Search strategy	Additional restrictions applied	Results
PubMed	09/09/2022	((("Cause of Death" [Mesh]) OR "cause of death" OR "Forensic Anthropology" [Mesh]) OR "Forensic Medicine" [Mesh] OR forensic) AND ("South Africa" [Mesh] OR "south africa")	Limit years from 2007 to 2022	1750
SCOPUS	09/09/2022	("cause of death" OR forensic) AND ("South Africa")	Limit years from 2007 to 2022	1380
Web of Science	10/09/2022	("cause of death" OR forensic) AND ("South Africa")	Limit years from 2007 to 2022	1429
EbscoHost	10/09/2022	("cause of death" OR forensic) AND ("South Africa")	Limit years from 2007 to 2022 Language: English Geography: South Africa	424

Table B2. The primary, secondary and valuable but not necessary inclusions for eligibility assessment.

Primary inclusions	Secondary inclusions	Valuable
Data from a Western Cape mortuary over	Cause-of-death by gender or age	Manner-of-death by gender or age
Data between 2007-2021 period.	Gender prevalence rates/data	Location data of death
Unnatural cause-of-death only	-	-

APPENDIX C: Scoping review results

Table C1. List of studies excluded during full-text review with reasons for exclusion.

Article	Title	Inclusion or exclusion	Reason for exclusion
Campbell *et al.* (2013)	Firearm injuries to children in Cape Town, South Africa: Impact of the 2004 Firearms Control Act.	Excluded during full-text eligibility.	Small injury section with no prevalence rates but gives frequency for a method of death.
Du Toit-Prinsloo *et al.* (2013)	Toward a standardised investigation protocol in sudden unexpected deaths in infancy in South Africa: a multicenter study of medico-legal investigation procedures and outcomes.	Excluded at full-text eligibility.	Info from Tygerberg but no info on specific causes of external death. Number of unnatural deaths in infant & sex distribution.
Mathews *et al.* (2013)	The epidemiology of child homicides in South Africa.	Excluded at full-text eligibility.	Reason for exclusion: National study, no Western Cape (WC) specific rates/data by gender or age.
De Wet *et al.* (2014)	Adolescent mortality in South Africa: An analysis of unnatural causes of deaths by sex, 2000-2009.	Excluded at full-text eligibility.	Reason for exclusion: Data coming from death notification forms instead of WC mortuary specifically, but it meets all other incl/excl, primary and secondary.
Matzopoulos *et al.* (2015)	Injury-related mortality in South Africa: a retrospective descriptive study of postmortem investigations.	Excluded at full-text eligibility.	Reason for exclusion: National study, no WC-specific rates/data by gender or age.
Abrahams *et al.* (2016)	Gender Differences in Homicide of Neonates, Infants, and Children Under five years in South Africa: Results from the Cross-Sectional 2009 National Child Homicide Study.	Excluded at full-text eligibility.	Reason for exclusion: National study, no WC-specific rates/data by gender or age.
Mathews *et al.* (2016)	The South African child death review pilot: A multiagency approach to strengthen healthcare and protection for children.	Excluded at full-text eligibility.	Reason for exclusion: Combine two mortuary data for prevalence rates.
Reid *et al.* (2016)	Where do children die, and what are the causes? Under-5 deaths in the Metro West geographical service area of the Western Cape, South Africa, 2011.	Excluded at full-text eligibility.	Not very detailed information.
Pillay van Wyk (2017)	Rapidly changing mortality profiles in South Africa in its nine provinces.	Excluded at full-text eligibility.	Reason for exclusion: Guest editorial as opposed to journal articles; National report with no WC-specific rates/data by gender or age.

Du Toit *et al.* (2018)	Investigation into abandoned neonates admitted to Salt River Forensic Pathology Mortuary, Cape Town.	Excluded at full-text eligibility.	COD types but no gender & age prevalence rates.
Mathews *et al.* (2019)	Homicide pattern among adolescents: A national epidemiological study of child homicide in South Africa.	Excluded at full-text eligibility.	Reason for exclusion: National study, no WC-specific rates/data by gender or age.
Heathfield *et al.* (2019)	Massively parallel sequencing in sudden unexpected death in infants: A case report in South Africa.	Excluded at full-text eligibility.	Reason for exclusion: Next-generation sequencing.
Heathfield *et al.* (2020)	A 5-year retrospective analysis of infant death at Salt River Mortuary, Cape Town.	Excluded at full-text eligibility.	Reason for exclusion: Only met primary inclusion criteria.
Storm *et al.* (2022)	Infant injuries treated at Red Cross War Memorial Children's Hospital, Cape Town, South Africa.	Excluded at full-text eligibility.	Reason for exclusion: Small mortuary data section.
Herbst *et al.* (2015)	A 10-year review of fatal community assault cases at a regional forensic pathology facility in Cape Town, South Africa.	Excluded after contact with primary authors.	Data recording challenge: The Raw dataset included data from outside study periods of interest, which could not be separated.
Clark *et al.* (2017)	Patterns of blunt force homicide in the West Metropole of the City of Cape Town, SA.	Excluded after contact with primary authors.	Duplicated datasets and study periods.
Auckloo & Davies (2019)	Post-mortem toxicology in violent fatalities in Cape Town, South Africa: A preliminary investigation.	Excluded after contact with primary authors.	Duplicated datasets and study periods.
Reid *et al.* (2020)	Bodies without names: A retrospective review of unidentified decedents at Salt River Mortuary, Cape Town, South Africa, 2010 – 2017.	Excluded after contact with primary authors.	Data recording challenge: Combined natural and unnatural death data and could not be separated.
Simons *et al.* (2020)	Childhood vulnerability to drowning in the Western Cape, South Africa: Risk differences across age and sex.	Excluded after contact with primary authors.	Duplicated datasets and study periods.

Table C2. 11 articles selected during the scoping review with information on the authors, year of publication, institutional affiliation and publication journal. Selected articles are ordered alphabetically.

First author	Year of publication	Institutional affiliation of authors	Journal
Albertyn *et al*.	2019	University of Cape Town	International Journal of Injury Control and Safety Promotion
Auckloo & Davies	2019	University of Cape Town	Journal of Forensic and Legal Medicine
Baliso *et al.*	2022	University of Cape Town	International Journal of Legal Medicine
Clark *et al.*	2017	University of Cape Town	South African Journal of Science
Groenewald *et al.*	2017	South African Medical Research Council; Western Cape government	South African Medical Journal
Herbst *et al.*	2015	University of Stellenbosch	South African Medical Journal
Mole	2019	University of Cape Town	Australian Journal of Forensic Sciences
Reid *et al.*	2020	University of Cape Town	South African Medical Journal
Saunders *et al.*	2019	University of Cape Town	Injury Prevention
Simons *et al.*	2020	South African Medical Research Council; University of Pretoria; University of Cape Town	Child Care Health Development
Von Caues *et al.*	2018	University of Stellenbosch	South African Medical Journal

APPENDIX D: Qualitative thematic content analysis

Table D1. Summary of codes identified in the 11 articles included in the qualitative analysis. Codes are listed in rows along with the number of articles the code was identified in and the number of quotations.

Code	# mentions in articles	# quotations	Continuation		
Abuse	1	1	**Code**	**# mentions in articles**	**# quotations**
Adolescence carries increased vulnerability	2	3	Lack of initiatives to protect children	1	1
Aggression	3	4	Lack of injuries	1	2
Alcohol use and abuse	2	10	Lack of knowledge	4	5
Behaviour leads to danger	3	5	Lack of record-keeping	3	5
Caregiver dependence	3	4	Laws do exist	1	1
Challenges to supervision	3	9	Low-level primary education	1	1
Children are vulnerable	4	7	Male deaths	9	14
Cognitive development	2	5	Masculinity	3	6
Complexity of interaction network	1	2	Men's behaviours	1	2
Crime and corruption	6	11	More research required	3	6
Development milestones	3	5	Night time deaths	1	1
Domestic violence	1	3	No gender difference in injury	2	2
Driving behaviour	1	7	Occupational deaths	1	2
Drinking	2	4	Older adults and death	1	1
Drug abuse	2	21	Peer influence	1	4
Environment influence	4	4	Perceptions of injury susceptibility	2	2
Easy accessibility	1	2	Perimortem trauma	1	1
Environmental hazards	1	3	Policing	3	6
Equal sex representation	1	1	Political economy influences how deaths are carried out	1	1
Excess male mortality	1	1	Poverty	4	9

Experimenting	1	1	pre-teens children	1	1
Familiar environments	1	1	Preventable deaths	1	2
Female mortality	2	2	Recording or data inconsistencies	4	9
Financial constraints	3	5	Recreation and free time	3	7
Firearm violence	3	9	Risk-taking behaviour and risk-taking	5	14
Fixing electrical equipment	1	1	Seasonal variability	2	4
Gangsterism	4	8	Gender as a risk factor	5	10
Gang hotspots	1	1	Socially accepted gender behaviour	5	13
Gender roles	4	5	Society's influence on risk	4	4
Gender equality	1	1	Socioeconomic status	4	7
Gender exposure	1	2	Structural factors	1	3
Gender inequality	2	3	Substance abuse	3	7
Government backlogs	1	2	Supervision as a risk factor	3	10
Illegal electrical wiring	1	2	Urban data bias	2	2
Illegal selling	2	2	Under-resourced	3	5
Importance of prevention	1	1	Undocumented citizens	2	3
Increase in injury with age	1	1	Unemployment	3	4
Increase in male mortality	1	1	Unidentified individuals	1	6
Increase knowledge of safety	1	5	Unskilled	2	3
Income inequality	3	3	Unsupervised	3	6
Independence	2	7	Unwitnessed deaths	1	1
Informal settlements	2	3	Urban data bias	2	2
Infrastructure	3	4	Victim of violence	2	3
Initiatives aren’t directed to the most needed areas	2	3	Violence epidemic	4	10
Interventions are multifaceted	1	1	Vulnerability	1	2
Institutional issues	6	26	Weapons	2	4
Intoxication	3	9	Xenophobia	1	1

Intimate partner violence	2	4	Young adults	5	5
Lack of familial connection	1	1			

Table D2. Initial themes and sub-themes were created through data analysis with appropriate quotations from the publications.

Theme & Description	Sub-themes	Extract
BEHAVIOUR The behaviours people exhibit/and the choices they make put their lives and those around them at risk.	1. Reckless relating to driving: How behaviours like this lead to preventable injuries and deaths.	"Older children need to be more aware of their surroundings and take lesser risks on the road." "Shift in societal norms is needed by changing driver behaviour". "Teach children the rules of the road and drivers to reduce speed when children are around."
	2. Adolescent risk-taking and exploration: As you age, you have an increased sense of independence and a desire to interact and learn from the environment, however, the brain has yet to mature at the same rate. Thus, dangers must be better understood as the consequences of their actions.	"The attainment of early developmental milestones such as independent mobility and the increasing capacity for exploratory behaviour increases this risk." "Trauma more prevalent in juveniles and young adults may speak to increased risk-taking behaviour for individuals in this age cohort." "Adolescents tend to take more risks than any other age group because they are much more susceptible than any other age cohort to peer pressure, are more oriented to the present than the future and less able to regulate their emotional states." "During this developmental stage, children enjoy exploring risky activities with friends."
	3. Masculine behaviours result from dominant forms and definitions of masculinity in South Africa. Definitions of masculinity are harmful to men as they feel the need to live up to and prove their masculinity, but also to women and children who are receiving their actions.	"South African men of working age behave in a manner that puts them at greater risk of violent injury than South African women, as well as men from other countries." • *Risk-taking and sensation-seeking:* "Evidence suggests that males are more likely to engage in risk-taking behaviour such as darting or running into oncoming traffic or playing or walking on the road with such behaviour contributing to increased risk." "impulsive and sensation-seeking behaviours of young males." • *Gang involvement:* "high levels of gang violence in which men are usually more heavily involved than women." *Conflict resolving & asserting masculinity:* "A perceived idea of what it means to be a man results in displays of

		'toughness' or 'bravery'; thus, disagreements are often resolved by arguments and subsequent fighting rather than by peaceful means." "Gender roles within society, leading to men being more likely than women to interact aggressively, especially with strangers away from their homes."
CAREGIVING & SUPERVISION Caregivers have a role and responsibility to play in protecting children and avoiding, to the best of their ability, unnecessary injuries being inflicted. However, this is not always possible because individual decisions/choices often result from underlying systemic violence or actions at play.	1. Caregiver dependence: Children are vulnerable because of their underdeveloped brains; thus, they cannot understand and comprehend the risks and consequences of their actions. Depend on adults for protection and guidance on how to avoid harm.	"Teaching children at a young age about road safety and the rules of the road also has the potential to limit risky pedestrian behaviour as children become older." "Caregivers need to develop an understanding of their role in keeping children off the road and creating safer spaces to play." "Early childhood is characterised by growing independence and an expanding social environment while relying on caregivers for protection and provision."
	2. Lack of supervision: When supervision is absent (for whatever reason), usually, a greater risk of injury or death will occur; therefore, a lack of supervision has been linked as a risk factor for injury/death in the infancy and childhood age group.	"Lack of caregiver supervision at the time of an RTC incident" "Lack of adequate adult supervision as a major risk factor for drowning in this age group." "Children are at an increased risk if left alone."
	3. Distractions & challenges to supervision: Parents and caregivers understand the role and responsibilities of supervising children. Due to several demands, this responsibility is compromised, and accidents occur unintentionally because caregivers do not mean for these things to happen. These are factors at play that complicate the lives of caregivers.	"Structural inequalities, such as poverty, unemployment, and difficult working conditions, compromise adequate supervision. Previous research has indicated that South African caregivers who lack the financial means to afford quality daycare services often left leaver children alone at home, or in the care of inexperienced adults or older children, while they sought employment or engaged in other activities." "Caregivers are likely to be preoccupied with caring for multiple children and performing household chores." "Every day domestic demands and distractions, unexpected events and preoccupations often constrain supervision and protection against injury."

CRIME, CORRUPTION & ILLEGAL ACTIVITY		
DEVELOPMENT & INDEPENDENCE Developmental milestones are a normal part of human development and are crucial for personal growth and autonomy. With this comes an increase in independence, mobility, and cognitive development, with the latter lagging behind the former. At the same time, there is an important role that context has to play, or the environment plays in causing injury because of how people may interact with/experience their environment.	1. Brain maturity and cognition: Maturity of the brain is a slow, gradual process that other factors can influence. Know sensation-seeking behaviours outweigh their ability to make calculated, well-thought-out decisions and risks; thus, injuries and deaths occur because of the imbalance between them as they do not mature at the same rate.	"The developmental stage of a child drives their cognitive ability, influencing their reasoning and decision-making abilities to decide when to avoid oncoming traffic." "During this developmental stage, children characteristically enjoy exploring risky activities with friends, but their concept of risk remains underdeveloped." "Young males are more likely to take risks and potentially overestimate their swimming skills, thereby exposing themselves to dangerous situations." "They begin to walk, run and jump, allowing them to gain access to hazards, but with still developing cognitive appraisal abilities and hazard awareness."
	2. Mobility & independence: Growing older and maturing is a developmental milestone. Become more independent and mobile as you interact with the environment and are exposed to more dangerous risks.	"Early childhood is characterised by growing independence and an expanding social environment while still relying on caregivers for protection and provision." "The attainment of early developmental milestones such as independent mobility and the increasing capacity for exploratory behaviour increases this risk." "As children reach the ages of 4 to 6 years, their awareness, interest and understanding of the environment develop even further, but usually with a greater degree of freedom of individual movement and consequently even greater exposure to water bodies."
	3. Context & injury: The vital role of context in adding to risk and exposure.	"Childhood is characterised by growing independence and an expanding social." "As children reach the ages of 4 to 6 years, their awareness, interest and understanding of the environment develop even further, but usually with a greater degree of freedom of individual movement and consequently even greater exposure to water bodies."
INSTITUTIONAL ISSUES IN FORENSICS		
LAW & ORDER		

MASCULINITY This was alluded to in the sub-theme of behaviour relating to masculine behaviours. The definitions of masculinity in South Africa result from the country's patriarchal history. Being a man includes acts of bravery and toughness, an Idea that you need to exert or show your masculinity to feel accepted. It harms men who need to portray this and live up to prove their masculinity, but also women and children who are on the receiving end and are viewed as vulnerable and of lesser status.	1. Violence endemic to men: Due to masculinity and the definitions of what it means to be a man, lots of violence occurs between men who are both the victims and perpetrators.	Violence is endemic among young men and boys in South Africa."
	2. Gender inequality & GBV: Because of the definitions of masculinity, one gender is more esteemed than another. This results in differential treatment of the genders and, as a result, leads to GBV.	"trauma being three times more prevalent among men and boys may relate to socio-cultural gender-based roles and patriarchal notions of masculinity. In the domestic sector, acceptable activities for men and boys inherently have more physical risk and contact, including but not limited to heights, machinery and electricity, and which can be more physically demanding." "In a South African context, three factors are important in the ideology of masculinity: toughness, control and sexuality." "high levels of male unemployment and gender inequality within a community may be predictive factors for homicide and assault." "In South Africa, despite significant legislative and policy gains around gender equality, women and girls remain subject to harmful gender attitudes, roles and social norms that undermine the social value and possibly the care offered to girl children." "killed by an intimate partner (that is, a current or former boyfriend/ husband/same-sex partner or rejected lover) indoors."
RECREATIONAL ACTIVITY & LEISURE		
SEASONAL VARIABILITY		

SOCIAL INFLUENCES The big and expected theme that came through as it was previously shown in the literature. Ideas of how decisions, actions, and things we say and do are influenced by the people we surround ourselves with and interact with. Whether consciously or unconsciously, we pick up on actions and things by others and get involved in them. This affects men and women (boys/girls) throughout life.	1. Peer influence and pressure: Mainly linked to the adolescent life stage and risk-taking behaviours involving themselves. They are significantly influenced and opinionated in the life stage, where they value the perceptions and opinions of peers highly but are naïve and portray sensation-seeking behaviours.	"The higher likelihood of drowning amongst older boys (7–12 years) occurs during a period when children attempt to master multiple skills, seek to succeed in their activities and become increasingly competitive with peers." "Several studies have proposed that adolescents tend to take more risks compared with any other age group because they are much more susceptible than any other age cohort to peer pressure, are more oriented to the present than the future and are less able to regulate their emotional states." "peer approval and acceptance are defining characteristics that result in heightened vulnerability."
	2. Gender socialisation: Men and women are treated differently in South African society from a young age. This occurs due to gender socialisation and the patriarchal history the society is built on. Inclusive of how we talk, behave, act, career, etc. Occurs in all spheres of our life and developmental stages.	"In the domestic sector, acceptable activities for men and boys inherently have more physical risk and contact, including but not limited to heights, machinery and electricity, and which can be more physically demanding." "In the spheres of play, men and boys are more likely than their female counterparts to be encouraged to participate in activities with inherent risk, including those with physical contact and adventure." "difference in the interaction of socio-biological factors and gender roles within society." "Injury vulnerability in South African boys has been associated with differing temperament, impulsivity, higher activity levels and less restraint of exploratory behaviour by parents." "The significantly higher activity levels of boys when compared with girls and the typically greater social independence afforded to boys may account for the greater likelihood of boys drowning during the school-age stage." "An explanation for this may be drawn from interactions between temperament and socialisation factors, which have been expressed through the greater impulsive and sensation-seeking behaviours of young males, in interaction with greater aquatic exposure that is typically socially afforded to males."

SOCIOECONOMIC BARRIERS	Social	"Societal structures are the largest determinants of risk exposure and preparedness for decision making." "Investigating cultural factors as well as behaviours and activities contributing to drowning risk."
	Economic	"high levels of inequality, poverty, poor infrastructure and ineffective service delivery are likely to contribute to the high rates of observed injury mortality."
	Environmental	Inadequate infrastructure: "socioeconomic factors such as poor road infrastructure and lack of safe play spaces near to the child's home increased the likelihood of death by RTC injury." "The relationship between electrocution-related mortality and crime cannot be ignored. Stealing electricity and copper cables from major utility providers t1hreatens not only the safety of the alleged thief, but an entire community." "Budg*et al*locations for this purpose are not prioritized in many resource-limited countries."
	Socioeconomic	"Poor socio-economic status is correlated with high rates of homicide. The current study concurs with the finding of elevated levels of homicide in poor socioeconomic areas." "as families with few resources experience significant challenges in accessing and complying with the required medical care." "extreme income inequality." "Inequality and poverty negatively affect both exposure to injury as well as outcome following injury." "lack the financial means to afford quality day care services often left their children alone at home, or in the care of inexperienced adults or older children, while they sought employment or engaged in other activities." "the high levels of gang violence in which men are usually more heavily involved than women, again as a consequence of poverty."

		"high levels of male unemployment and gender inequality within a community may be predictive factors for homicide and assault."
SUBSTANCE ABUSE A massive problem in South Africa is the misuse and abuse of substances (alcohol or drugs) for recreational purposes and lifestyle. It is a substantial public health burden and has been shown to have behavioural effects and influence the brain and thoughts. It is easily accessible in South Africa. The idea of polypharmacy is linked to violent deaths. It is not always a harmful activity (alcohol intake) and has been linked to recreational activity in men; however, when abused, it becomes dangerous – intoxication.		"increased risk to being a victim of violence and thus fatal injury has been reported with alcohol use, drug use, or both." "licit and illicit drugs are prevalent and commonly detected in homicidal cases." "Alcohol-related injury is a major public health concern in South Africa." "Intoxication occurred within all age groups, excluding the 0–9 year age group.1 All intoxication levels were seen in both male and female victims." "men were 20 times more likely than women to have a blood alcohol level above the legal driving limit at the time of drowning."
VIOLENCE EPIDEMIC		