A retrospective review of railway-associated deaths in the Cape Town Metro East region over a two-year period.

By

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Declaration

By submitting this thesis electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (unless to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe on any third-party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

Signature: Dr HL Okkers Date: December 2021

Abstract: English

Background: Railway travel is an integral part of the daily transport of people and cargo worldwide, and no less so in South Africa. Generally considered safer than road transport, rail travel is still associated with risk and railway-related deaths attract significant media attention. There is limited local research into the epidemiology and pathology of these deaths. An improved understanding of these cases will assist in preventative strategies to minimise fatalities.

Objectives: The aim of this study was to investigate railway-associated fatalities in the Cape Town Metro East region over two years, from 2016 to 2017. The objectives were to obtain a demographic profile of victims, characterise injury patterns, identify the temporal and geographical distribution of deaths and, where possible, the causes of death.

Methods: A retrospective descriptive review of all railway-associated fatalities admitted to the Tygerberg Forensic Pathology Laboratory between 1 January 2016 and 31 December 2017 was performed. Data were collected from autopsy reports and available contemporaneous notes for each case, including South African Police documents and hospital notes, where relevant.

Results: There were 104 cases of railway-associated deaths during the two-year period under study. Males accounted for 87 cases, while there were only 17 female victims. The mean age of all cases was 34.8 years. Most incidents occurred between the morning hours of 8 am and 10 am and in the evening from 7 pm to 10 pm, and a midweek peak of 62.5% of cases were reported as pedestrians who were struck whilst crossing the railway tracks. Khayelitsha was the suburb where the highest number of cases were recorded. Multiple blunt force injuries as the terminal cause of death accounted for 81.7% of cases. One case of electrocution and one of downing were reported. Two cases of alleged assault were recorded. Head injuries accounted for 91 cases with only five decapitations. Transection of the thorax occurred in eight cases and multiple rib fractures were also recorded. Multiple organs were disrupted and the upper limbs on the right were predominantly injured. 17 victims had blood alcohol levels above the legal limit of 0.05 g/100ml.

Conclusion: More than half of the cases died as a result of multiple traumatic injuries after crossing the railway tracks as pedestrians. This study emphasizes the importance of adequate contemporaneous documentation of the cases. The background information and scene investigation play a significant role in determining factors assisting in the determination of the cause and manner of death. Optimal security can aid in the decline of unnecessary railway incidents and death. It is recommended that the investigation of railway-associated fatalities become a priority to prevent circumstances in which these cases occur.

Opsomming: Afrikaans

Agtergrond: Spoorwegreise is ’n intergrale deel van die daaglikse vervoer van passasiers en vrag wêreldwyd, en ook grotendeels in Suid-Afrika. Oor die algemeen word dit veiliger beskou as padvervoer, inteendeel is dit nogsteeds geassosieer met ’n risiko’s. Spoorwegverwante sterftes trek groot aandag in die media. Daar is ’n beperkte plaaslike navorsing oor die epidemiologie en patologie van hierdie sterftes. ’n Deeglike begrip van hierdie gevalle sal van hulp wees met voorkomende strategieë om sterftes te minimaliseer.

Doelwit: Die hoofdoel van hierdie studie was om ondersoek in te stel in verband met spoorweg verwante sterftes in die Kaapstad- oostelike streek oor ’n tydperk van twee jaar vanaf 2016 tot 2017. Die doelwitte was om ’n demografiese profiel van slagoffers te verkry, beseringspatrone te karakteriseer, die daaglikse temporale en geografiese verspreiding van die sterftes vas te stel en waar moontlik die oorsake van die dood.

Metodes: ’n Terugskouende beskrywende oorsig van alle sterftes wat veband hou met spoorweë wat tussen 1 Januarie 2016 en 31 Desember 2017 in die Tygerberg Forensiese Patologie lykshuis opgeneem is, is uitgevoer. Data is versamel uit lykhouingsverslae en beskikbare eietydse aantekeninge vir elke geval, insluitend die Suid-Afrikaanse Polisie dokumente en hsopitaal notas, waar van toepassing.

Bevindinge: Oor die twee jaar tydperk is 104 spoorwegverwante sterfgevalle geindentifiseer. 87 van die gevalle was mans, terwyl daar net 17 vroue slagoffers was. Die gemiddelde ouderdom van alle gevalle was 34.8 jaar oud. Meeste van die voorvalle het tussen die oggendure van 8:00 tot 10:00 en saans van 19:00 tot 22:00 plaasgevind. Daar was n piek van 62.5% gevalle in die middel van die week geraporteer as voetgangers wat getref was toe hulle die trienspoor gekruis het. Khayelitsha was die voorstad waar ’n beduidende aantal gevalle aangeteken is. Verskeie stomp kragbeserings het 81.7% uitgemaak as die terminal oorsaak van dood.
Een geval van dood was deur middel van elektriese skok en n ander deur verdrinking geidentifiseer. Daar was twee beweerde aanrandings. Met betrekking tot die beseringspatrone, is 91 gevalle hoofbeserings en slegs vyf onthoofdings. Transeksie van die toraks het in ag gevalle plaasgevind en veelvuldige rib frakture is aangeteken. Verskeie

organe is ontwrig en die boonste ledemate aan die regterkant is hoofsaaklik beseer. Bloed alkohol vlakke van 17 slagoffers was bo die wettige limiet van 0.05 g/100ml.

Afleidings: ’n Groot hoeveelheid van die slagoffers het gesterf a.g.v. veelvuldige traumatiese beserings nadat hulle as voetgangers die spoorwegoorgesteek het. Hierdie studie beklemtoon die belangrikheid van doelgerigte eietydse dokumentasie van die gevalle. Die agtergrond inligting en toneelondersoek speel ’n belangrike rol in die bepaling van faktore wat help om die oorsaak en manier van dood te bepaal. Optimale veiligheid kan help met die afname van onnodige spoorwegvoorvalle en dood. Dit word aanbeveel dat die ondersoek van sterftes wat verband hou met spoorweë geprioritseer prioriteit word om gevalle soos hierdie te voorkom.

ACKNOWLEDGEMENTS:

Firstly, I would like to thank my colleagues and friends for all their guidance and encouragement.

My heartfelt thanks to my family and my husband for all the prayers and motivational chats during the testing times over the six years. You all pulled me across the finishing line.

Lastly, with the help of my supervisor, Dr E. Afonso - we successfully finally concluded this paper. Without his guidance and advice throughout, this would not have been possible.

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LIST OF ABBREVIATIONS

TFR	Transnet Freight Rail
BOC	Bombela Operating Company
GMA	Gautrain Management Agency
SAMRC	South African Medical Research Council
RSR	Railway Safety Regulator
BAC	Blood alcohol concentration
SAPS	South African Police Service
HREC	Health Research Ethics Committee
FPS	Forensic Pathology Services
CCTV	Closed-circuit television
PRASA	Passenger Rail Agency of South Africa

GLOSSARY

Train-associated fatalities: Any death that was related to a train incident such as being struck by a train, a death that may have occurred on the train, death that ensued from jumping or falling of a train or platform.

Train surfing: "The act of riding, hanging on the outside of a moving train, tram or other rail transport. It includes standing on the roof, dodging power lines, jumping on and off the train repeatedly, jumping from a bridge onto a moving train and jumping between carriages" (1).

Verge: "The strip of land that borders the railway track" (2). The section extending next to the railway line.

Bridge: "A structure that is built over a road, river or railway to allow people and vehicles to cross from one side to the other" (3).

Platform: "A long, flat, raised structure at a railway station, where commuters get on or off the train" (4).

Chapter 1: Introduction

1.1 Background

Railway services are an integral part of the daily transport of people and cargo worldwide, and no less so in South Africa. Although rail travel is regarded the safest means of public transport, it is not without risk (5). Reports of train accidents and railway fatalities have become commonplace in the media. In Cape Town, the lay press has highlighted various incidents ranging from non-fatal derailments to train-associated electrocutions and multiple-fatality train-vehicle collisions such as the much-publicised Blackheath incident in 2010, where 10 school children were killed (6, 7).

During the period from 01 January 2012 to 31 December 2015, the Tygerberg Mortuary recorded 186 cases that presented to the mortuary due to train-related transport fatalities. There was an average of 44.33 fatalities per year. Though train-related fatalities account for a small proportion of deaths, they are nevertheless important given the extent of their social and economic impact.

When bodies are brought to the mortuary, there is often no history or information regarding the circumstances of death other than that the body was found on a train or near a railway line. The pattern of injury observed at autopsy is often the only evidence available to inform or suggest the possible mechanism of injury and help to determine the possible cause of death. Overall, there is a lack of research related to railway-associated injury patterns in South Africa.

The purpose of this study was to investigate railway-associated deaths in terms of injury patterns and causes of death. This in turn, could improve the understanding of railway-associated deaths and determine possible risk factors for South Africans being involved in such an accident. The importance of reviewing these deaths in the Metropole cannot be overemphasized.

1.2 Aims and objectives

1.2.1 **The primary aim of this study was:**

To investigate railway-associated deaths in the Tygerberg region over a 2-year period.

1.2.2 **The secondary aims of this study were:**

1. To determine the case demographics in terms of age, sex and employment.
2. To categorize the injuries sustained and, if possible, distinguish between manners of death and assess the effect of train speed on associated injuries.
3. To identify the temporal and geographical distribution of deaths.
4. To categorise, where possible, the cause and manner of death.

Chapter: 2 Literature Review

2.1 Introduction

In the ever-changing world of technology and energy efficiency, trains and railway systems have evolved from humble beginnings as steam locomotives in the early 1800s to high-speed trains and complex integrated railway systems (8). This evolution has maintained railway services not only as an integral part of the daily transport of people but also as a vital part for the delivery of cargo and goods globally. The UK Underground, for example, is more than 150 years old and has 350 stations. It is said to be the oldest and largest urban network system in the world. It transports 3.5 million passengers daily and between the years 2018 and 2019 there were 311 deaths on this railway system (9).

When comparing railway systems across the globe, each country has a different approach and facilities vary in their adequacy. There are many different types of trains ranging from high-speed trains, inter-city trains, regional trains to rapid and light rail trains all of which form part of the railway network.

In South Africa, the three largest railway operators are the Passenger Rail Agency of South Africa, the Bombela Operating Company, and Transnet Freight Rail (TFR) (10).

The Passenger Rail Agency of South Africa (PRASA) is a State-Owned Enterprise that reports to the Minister of Transport of South Africa. Its primary function is to transport commuters along the railways of South Africa, with 525 million passengers annually (11). PRASA is currently undertaking a Fleet Renewal Programme which is aimed at upgrading public transport through modernisation of their trains, stations, and restructuring of signalling programme for their current infrastructure and network (11). PRASA currently still experiences multiple difficulties in maintaining continuity of services due to high levels of vandalism, cable theft and damage to essential infrastructure that often results in an interruption of its daily operations (11).

The Bombela Operating Company (BOC) is a public-private enterprise, which in conjunction with the Gautrain Management Agency (GMA) aims to provide safe, efficient and reliable transport for commuters in the Gauteng region of South Africa.

The Gautrain connects three metropolitan centres in Gauteng (namely Tshwane, Johannesburg and Ekurhuleni) and transports 100,000 passengers per day (12), (13).

PRASA and the Gautrain are responsible for the bulk of passenger rail in South Africa and reported an average passenger volume of more than 14 billion passenger-kilometres per year between 2011 and 2016 (11). Transnet Freight Rail specialises in the transport of freight across South Africa.

The South African Medical Research Council (SAMRC) 2008 report profiling fatal injuries in South Africa listed transport-related fatalities as the second most common manner of death in the country, accounting for 29.4% of unnatural deaths (14). Railway-associated deaths accounted for 3.3% (299 cases) of these.

Statistics from the Railway Safety Regulator (RSR) in South Africa report higher numbers of fatalities, with between 412 and 473 cases between 2010 and 2016 (10). Forty percent of these deaths occurred in Gauteng, with 24% each in the Western Cape and Kwazulu-Natal (10).

A report by the International Railway Safety Council indicates that railways provide a safe and sustainable form of transport. The European Railway Agency suggested that the risk of death for a train passenger within the European Union is approximately 0.16 fatalities per billion train kilometres (15). This is 33% less than the risk of death for a passenger on a bus and is 27 times higher than the risk of death for an occupant of a car (15).

Trains are the most affordable means of transport, particularly for people from lower socio-economic backgrounds. Although train-related fatalities account for such a small proportion of deaths, they are nevertheless important given the extent of their social and economic impact. Fatalities, therefore, often bear not only the emotional cost because of the loss of life, but also a financial one with the loss of household income (16,17). On a more personal level, witnesses of fatal accidents such as engine drivers or bystanders may suffer significant psychological trauma following such an event (17).

2.2 Factors affecting injury reporting

Under-reporting of non-fatal and fatal injuries in South Africa by rail operators is a systemic problem as the authorities are often unaware of almost a quarter of deaths which take place on their property and surroundings. This may stem from a lack of proper surveillance and patrol (18). Furthermore, cases where the victim initially survives an incident and may later succumb to their injuries may not be registered as a rail-associated death. This may be due to poor documentation of the incidents, and therefore may require further investigation.

2.3 Factors associated with railway deaths

Various factors have been described which contribute to the burden of rail-associated fatalities. These risk factors include overcrowding of trains, violence, risk-taking commuter behaviour (such as train surfing, hanging from trains, jumping onto a moving train, crossing railways while a train is coming towards the commuter) and excessive use of alcohol (5, 18).

In a broader South African context, the construction and development of railway lines adjacent to informal settlements have historically been shown to put socially disadvantaged groups at greater risk of injury and death as pedestrians in rail traffic incidents (19). This led to the description of the public transport system in South Africa as “one of the most palpable creatures of apartheid” (19).

2.4 Classification of railway-associated deaths

Within the literature, the classification of fatal railway injuries is not standardized and varies considerably, often without clear definitions.

Lerer and Matzopoulos (18), researching rail-associated injury and mortality in Cape Town, classified their study population as follows:

- *Falls-from-train: these were cases in which the passenger fell from the train due to train surfing, falling from the platform in front of the oncoming train or when caught between the train.*

- *Struck-by-train: included all cases of commuters and passengers crossing the train lines and being run over (train-pedestrian incidents).*
- *Suicidal acts: these were cases where suicide was suspected, attempted or completed.*
- *Violence: passengers assaulted within the property of the station or on the train, as well as the cases where individuals were thrown from the train.*
- *Other: Electrocution, unknown causes of death and deaths not related to the operation of the trains.*

They found that, in Cape Town, the most common cause of death was being struck-by-train (50% of cases) followed by suicides (18%) and violence (11%) (18).

A study from Chicago in the United States of America (20) classified types of railway-associated fatalities into three groups:

- Apparent intentional deaths (suicides), which compromised approximately half of the total number of deaths.
- Unintentional deaths occurring at crossings and stations.
- Unintentional deaths occurring elsewhere along the railroad.

It is often difficult to classify the manner of death when the exact circumstances of the incident and surrounding the death are unknown. This is especially true for cases of possible suicide where the intent is not known, resulting in their erroneous categorisation as accidents. The information required to make this definitive decision is rarely available or adequate. Sousa et al. (21) emphasized the usefulness of witnesses, when available, to assist in describing a case. In Germany, Driever, Schmidt and Madea (22) found that 56% of individuals committed suicide and 26% were accidental.

Mishara and Bardon (23) attempted to characterise differences between accidental and suicidal deaths in Canada. They identified suicides as occurring in predominantly young adults compared to children or elderly; a higher rate of drug use amongst accidents; and that suicidal cases had a greater propensity for psychiatric diagnoses. Importantly, they note that similarities between the two groups (accidents and

suicides) also exist and that local research is required to confirm the relevance of findings.

2.5 Traumatology associated with fatalities

Railway fatalities are commonly associated with significant bodily disruption. Driever, Schmidt and Madea (22) analysed the type and location of injuries associated with rail-pedestrian incidents. They observed that injury patterns in cases of pedestrians struck while upright at the time of collision did not allow for differentiation between cases of suicide and accident. In cases where the victim was lying down, decapitation was only present in cases of suicide.

Injury patterns were not only determined by the type of collision but the position of the body in relation to the track and the train's velocity on impact (22):

1. Less than 80 km/hr: Single rupture of liver/ spleen noted with no loss of body parts.
2. Between 80 km/hr – 100 km/hr: Brain expulsion, demolition of abdominal organs and opening of one or two anatomical cavities.
3. Between 100 km/hr – 160 km/hr: Dismembering of the body, amputation of limbs, abdominal organ expulsion and opening of two or three anatomical cavities.
4. More than 160 km/hr: Fragmentation of body parts.

Ghomi et al. (24) also noted that train speed plays a key factor in the severity and extent of injuries and agreed with the findings of Driever, Schmidt and Madea (22). They reported that the proportion of accidents is almost three times higher when the train speed is over 40 km/h compared to when it is lower than 40 km/h. At train speeds of more than 65 km/h, females suffer more severe injuries than males (24) .

Assessment of wounds is also important in order to identify or exclude other injuries, which may indicate violence such as stab or gunshot wounds (22). The presence of such wounds helps differentiate a homicide from an accident. Similarly, signs of vital reaction may assist in identifying attempts at covering up a homicide.

2.6 The role of alcohol and drugs

Alcohol and drugs are known contributory factors to transport-related injuries, and this is no different with railway-related fatalities. In Cape Town, more than 40% of fatalities, including those caused by violence, had positive blood alcohol concentration (BAC) (5, 18). More than half of the pedestrians and passengers had blood alcohol concentration levels above 0.05 g/100ml (5).

A study published in Portugal by Sousa et al. (21) states that 50% of the victims were under the influence of some substance. They found that alcohol, opioids, cocaine, cannabinoids, methamphetamines and amphetamines were present in the toxicological results of their cohort. They further found that alcohol was the most common substance detected in railway-associated fatalities. Silla and Louma (17) describe alcohol consumption in conjunction with other medicines and drugs as a contributing factor in fatalities in Finland.

Motor vehicle drivers under the influence of alcohol have been targeted by both law enforcement and the media. This is not the case with railway-associated fatalities. In fact, alcohol is still freely advertised at railway stations and commuters under the influence of alcohol are still allowed to access the railway services and tracks (5).

2.7 Safety considerations

2.7.1 Railway factors

Level crossings are places where roads or paths intersect railway lines and this carries an increased risk of collisions between trains and pedestrians or cars (25). Level crossings where railway-associated fatalities occur can be grouped into (26):

- Railway-controlled crossings, where the crossing is controlled by a member of staff who signals when it is safe to cross.
- Automatic crossings, where there is an automatic mechanism that sounds an alarm when a train approaches.

- Passive crossings, where there are no warning systems in place at pedestrian railway crossings. These are typically on private roads, farms or footpaths.

A study on the safety of the three types of level crossings in Great Britain and the European Union between 1946 and 2009 found that railway-controlled crossings were superior to automatic and passive crossings when reviewing accidents per year and fatalities per year. Automatic crossings were found to be associated with higher accident rates when compared to passive and railway-controlled crossings. Fatalities at passive crossings were found to be numerous but usage by road users was low (26).

2.7.2. **Human factors**

Despite implementing safety regulations and improvements, many railway-related injuries and fatalities are due to individuals behaving unsafely. This includes errors of perception and a lack of knowledge or judgement. In a study from New Zealand, Lobb (16) remarked that there may be intentional violations such as suicide, walking along tracks, socialising and thrill-seeking behaviour. In all of these behaviours, there seems to be a high association with alcohol intoxication.

2.8 Mechanical factors affecting railway-associated deaths

Evans (25) described the causes of fatal train collisions and derailments as varied and stated that usually there was an immediate cause for the collision. Contributory causes were related to management failures.

Evans described that notwithstanding the use of an automatic train protection system, accidents were the result of drivers missing a red signal, over-speeding and other human errors. This type of system is a safety measure that controls the braking system of a train by constantly monitoring the track and signalling conditions. If it deems the train to be going too fast it automatically applies brakes on the train (25).

2.9 Literature review: conclusion

To conclude, the literature indicates that there is a lack of research in railway fatality deaths, especially within South Africa. This current study, therefore, aimed to investigate railway-associated fatalities resulting from train-person collisions.

It characterised the victims, injury pattern, aetiology of cases and predisposing factors such as alcohol exposure and commuter behaviour in the context of railway-associated fatalities.

This type of analysis will help to develop preventative measures that can be applied in the South African context and aims to decrease the burden of railway-associated fatalities.

Chapter 3: Methodology

3.1 Study population

All fatalities admitted to the Tygerberg Forensic Pathology Laboratory between the period 01 January 2016 to 31 December 2017 formed this study's population.

3.2 Study design

This was a retrospective descriptive study over a two-year period of all railway-associated deaths that were admitted to the Tygerberg Forensic Pathology Laboratory. We reviewed autopsy- and case reports acquired from the Tygerberg Hospital Forensics Mortuary as part of our data collection.

3.3 Inclusion criteria

- All cases admitted to the Tygerberg Forensics Pathology Mortuary as railway- or train-related deaths, including bodies found on railway tracks and on-board trains, were included in the study in the period 01 January 2016 to 31 December 2017.

- Only cases found at train stations; on or next to the railway tracks; or on-board trains were included in this study.

3.4 Exclusion criteria

- All cases/bodies/fatalities not recovered from railway stations, trains or tracks were excluded from this study.

- Cases where the final post-mortem report was either incomplete or not available.

3.5 Data collection

3.5.1 Documents used for data collection

3.5.1.1 **Final Autopsy/ Examination report**

The document completed by the forensic medical practitioner with all the post-mortem findings.

3.5.1.2 **SAPS Form 180**

This is the incident report form completed by the South African Police Service (SAPS). This form gives the necessary party permission to remove the body from the scene of death.

3.5.1.3 **FPS 100 Form**

This form should be completed by the treating medical practitioner when an unnatural death is suspected. This only applies to cases where the patient was treated in hospital.

3.5.1.4 **Interview questionnaire**

This is a document completed by the forensic pathology officers during interviews with the relatives in cases of sudden unexpected deaths in adults. It serves to add additional information relating to circumstances surrounding the person's death that may be of clinical value.

3.5.1.5 **Additional statements added to the autopsy report**

If any information or findings come to light during the investigation/autopsy, they are recorded in this additional statement document.

3.5.1.6 **Scene photography**

Photographs of the scene taken by the forensic pathology officers were reviewed. These were scrutinized to determine the body position, the body's relation to the tracks and the presence of rail security measures at the scene.

3.5.1.7 **Case data collection sheet**

This was an Excel® Spreadsheet created by the principal data collector to capture the following categories of information from the autopsy reports, FPS007, FPS100 and SAPS180 forms:

- Demographic data of the injured persons (including their age, sex and race).
- Geographical data of the injured person (including the station and the suburb of where the person was injured).
- Circumstances of where the incident took place (determining whether the injured person was a passenger vs. non-passenger at the time of the incident).
- Information about the time of the incident (noted the time of day, night, day of the week, month and year when the incident took place).
- Train demographic factors (includes the type of train involved in the incident, railway area and the train speed at the time of the incident where documented).
- Collision information (whether the incident involved a collision with another object).
- Injury patterns noted associated with the incident.
- Manner of death was determined based on the available history of the incident.

3.6 Data analysis

- Data analysis was performed by the author and with the help of Mrs Tonya Esterhuizen, statistician from the University of Stellenbosch.
- The results of the descriptive analyses were done in conjunction with the statistician are presented in graphs in the results section.

3.7 Ethical considerations

- Informed consent did not apply to this study.

- Ethics approval was granted by the Health Research Ethics Committee (HREC) of the Faculty of Medicine and Health Sciences, University of Stellenbosch (Ethics Reference Number HEA 2017-1831).

- Permission to conduct the study, utilisation of the post-mortem reports and a waiver of consent was granted for this study and was given by the Director of the Western Cape Forensic Pathology Services (Mrs V. Thompson).

- All information used in this study was anonymous.

- Each individual case used was assigned a study number.

- Information was stored on a password-protected computer in the Division of Forensic Medicine, Department of Pathology, Faculty of Medicine and Health Sciences, University of Stellenbosch.

3.8 Waiver of informed consent

We requested a waiver of informed consent because:

- This study entailed a retrospective review of autopsy records only.

- This study did not involve any risk to the subjects of the study.

- Not obtaining consent would not affect the rights, welfare or future management of the subjects.

Chapter 4: Results

Of the 7900 cases admitted to the Tygerberg FPL over the study period under review, a total of 104 cases fulfilled the inclusion criteria to be considered rail-associated deaths. Forty-nine deaths were recorded in 2016 and 55 in 2017.

4.1 Demographic data

Eighty-seven males and 17 females were included in this study. The victims of railway fatalities were predominantly male, with a male to female ratio of 4.83 to 1. The mean age of the victims was 34.8 years of age. The youngest victim was 14 years old, and the oldest victim was 72 years old. Victims of railway-related fatalities were predominantly black or coloured. While there was a significant proportion of cases where the employment status of the victims was unknown, most of the victims were unemployed. See Figures 1, 2 and 3.

Figure 1. The number of fatalities documented between the years 2016 and 2017

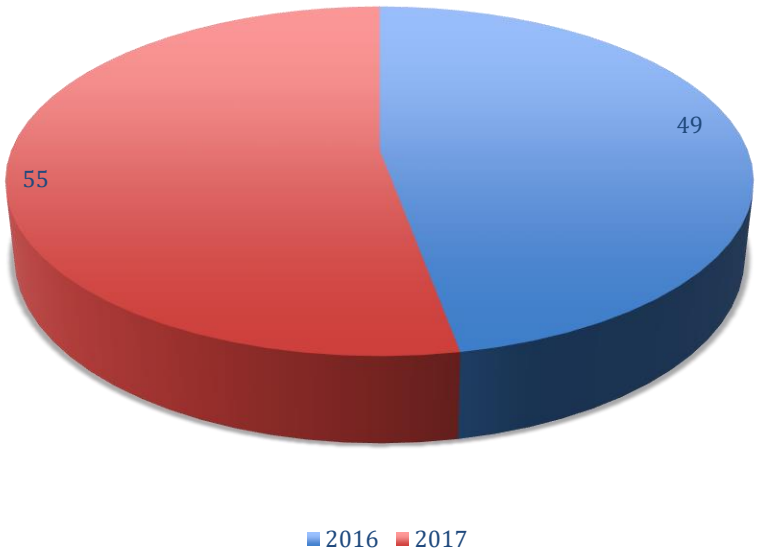


Figure 2. Distribution of the population group

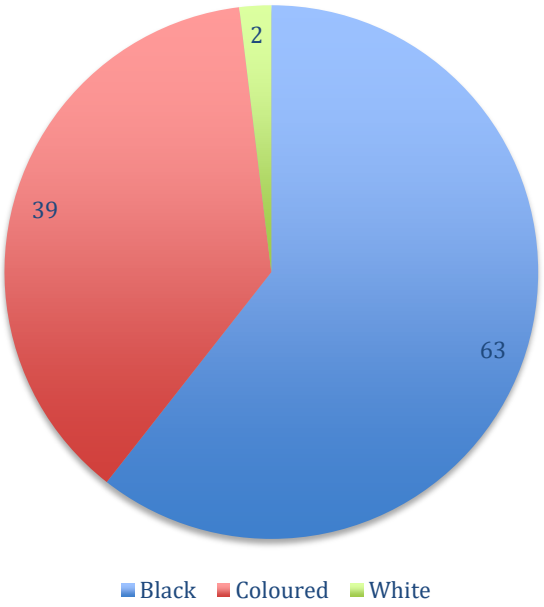
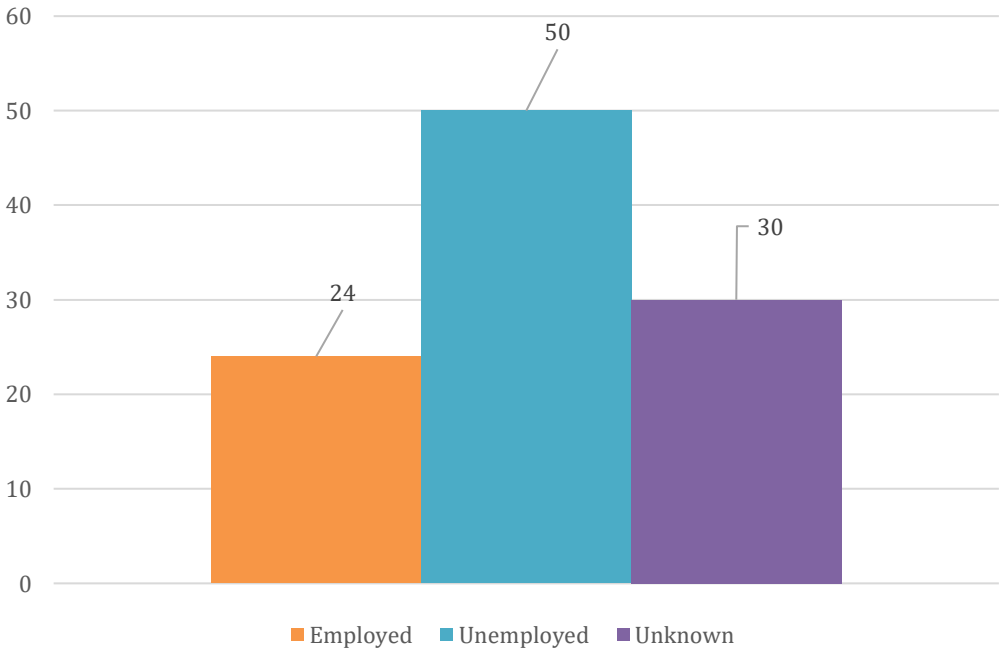


Figure 3. Employment status of the victims



4.2 Temporal data

The highest number of railway fatalities (33%) occurred in the 1st week of the month; a small peak occurred between the 14th and 17th and on the 27th day of each month. 40.1% of cases occurred between the dates of the 25th to the 5th of the following month. Railway fatalities occurring from Monday to Friday made up 78.2% of the cases. The months of May (14.3%), June (12.4%) and October (12.4%) had the highest number of fatalities recorded over the two years. See Figures 4 – 7.

The peak times of incidents during the day were found to be between 8 am to 11 am (31 fatalities) and between 7 pm to 10 pm (34 fatalities). See Figure 5.

Figure 4. The number of fatalities per day of the month

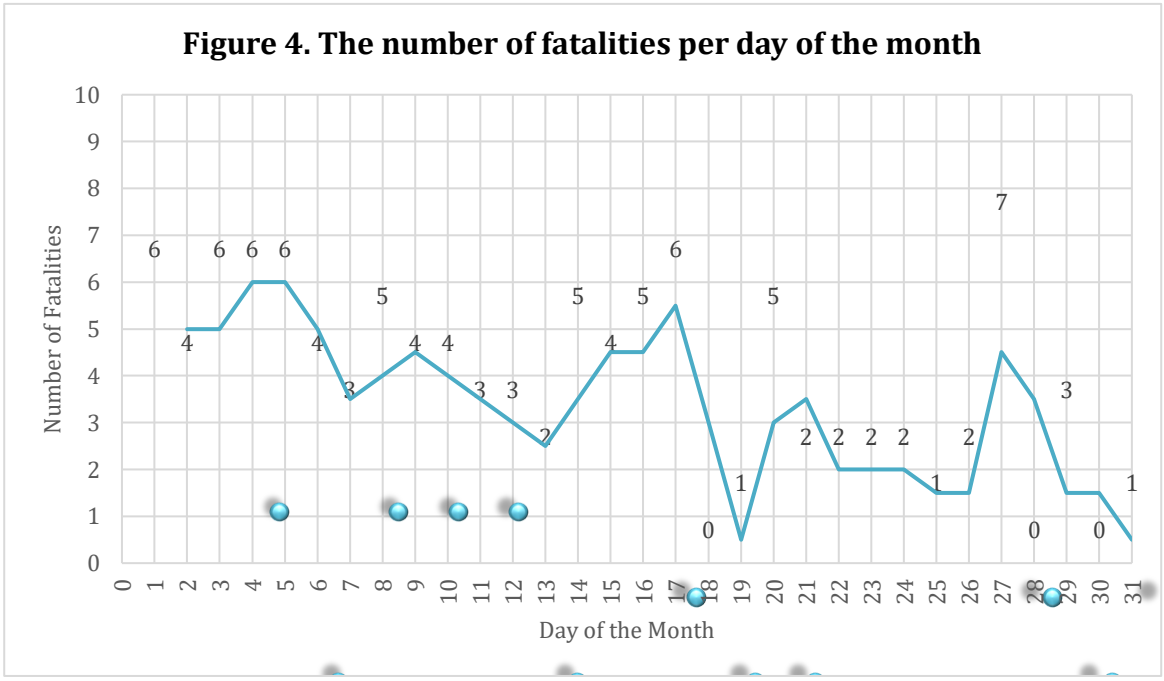


Figure 5. The number of fatalities occurring during the time of day

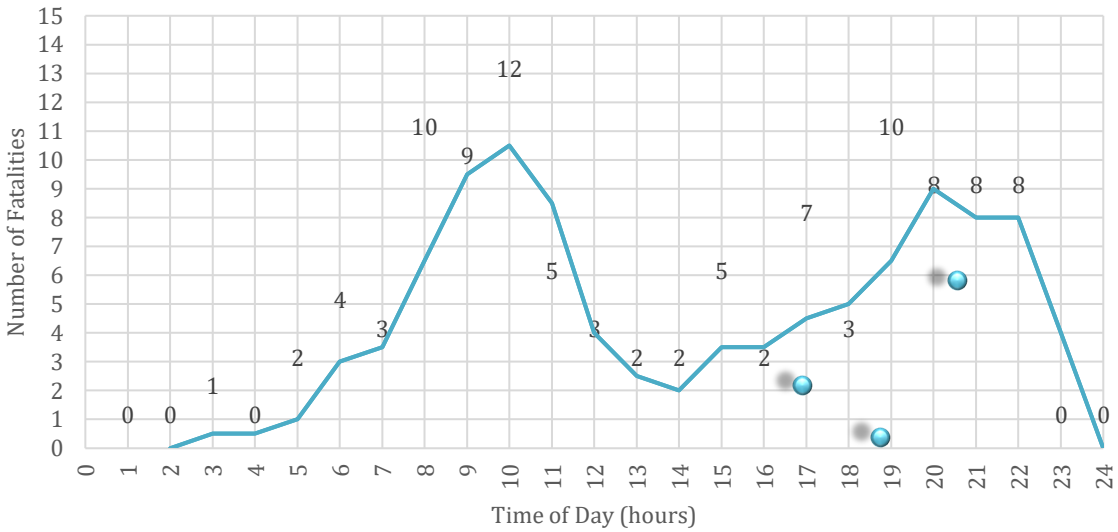


Figure 6. Number of Fatalities on the days of the week

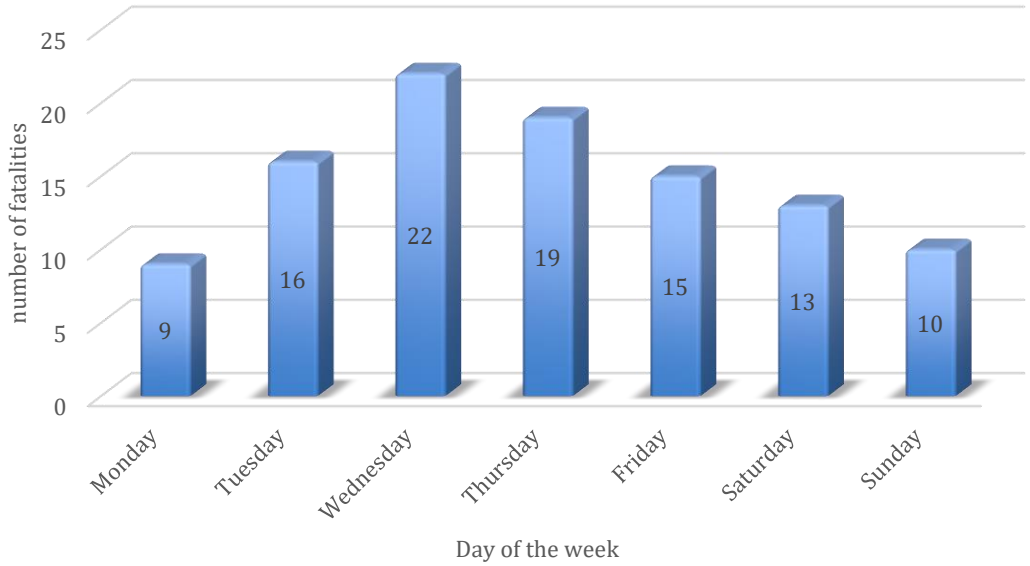
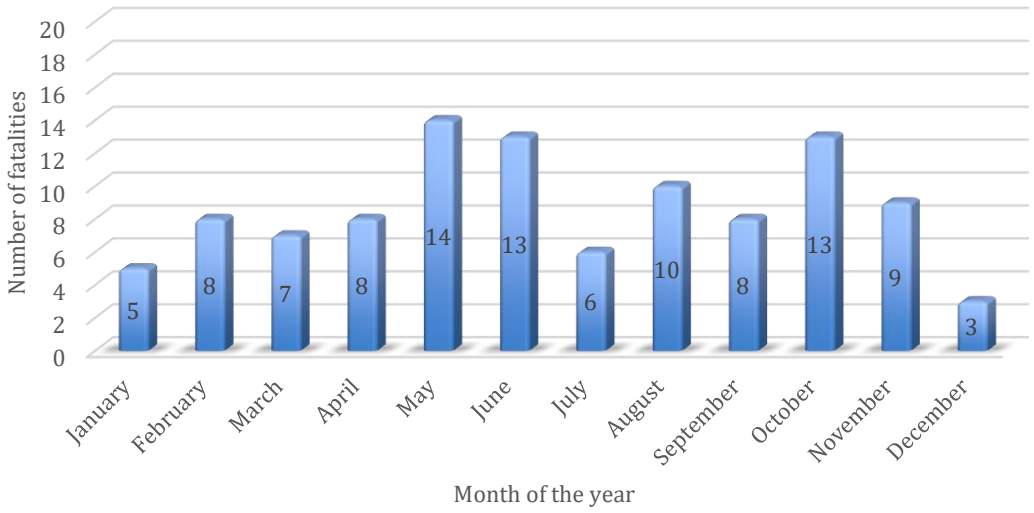


Figure 7. The number of fatalities associated with the month of the year



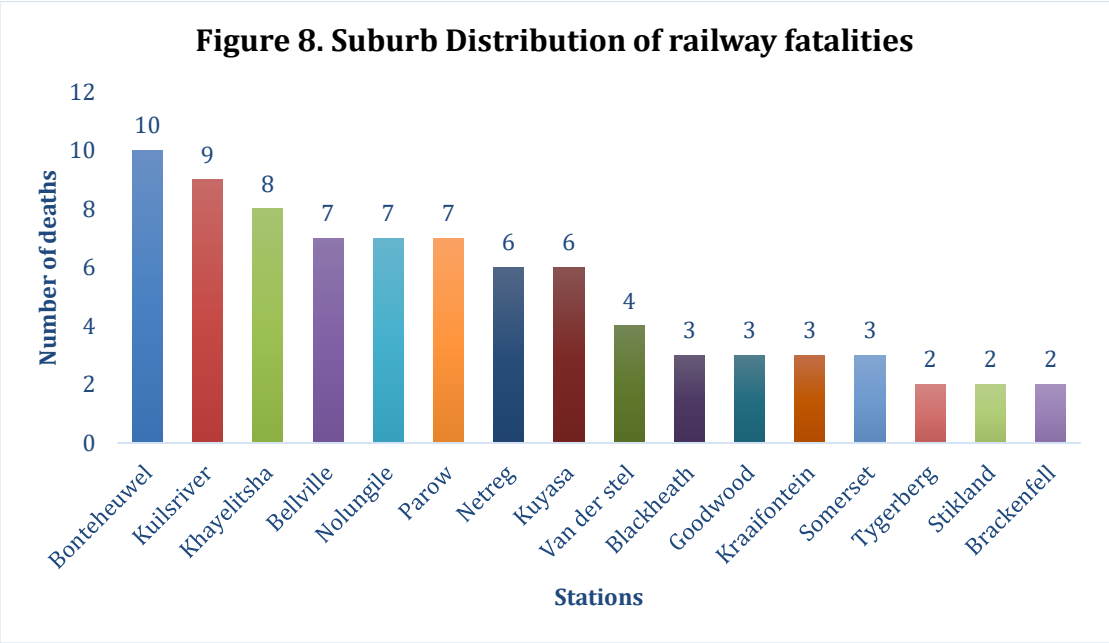
4.3 Circumstances of death

Pedestrians crossing railway tracks accounted for 62.5% (n = 65) of cases. A total of 19 cases were passengers. Seven of the 65 pedestrian cases were described as standing on the platform initially and later discovered on the tracks. In only eight cases, the victim of the railway-associated fatality was specifically described as a commuter. In one recorded case, the victim fell from a bridge and another ten victims fell from the train in unspecified areas.

From the data reviewed, three of the railway-associated deaths occurred inside the train. There was a significant number of cases (79.8%; n = 83) where this particular information was not recorded. Three of the railway-associated deaths outside the train were cases of train surfing and three were cases of hanging from the train. One case was reported as being found between stations and two were reported as unknown.

There was significant data missing to accurately interpret the circumstances surrounding the deaths associated with railway-associated fatalities.

4.4 Geography of railway-associated fatalities



The Metrorail service in Cape Town consists of four railway lines, which all have a central starting point from the Cape Town city centre (see Figure 9. Three of these lines pass through the study area, namely:

Green Line (Northern Line) – via Bellville to Paarl, Stellenbosch and Somerset West.

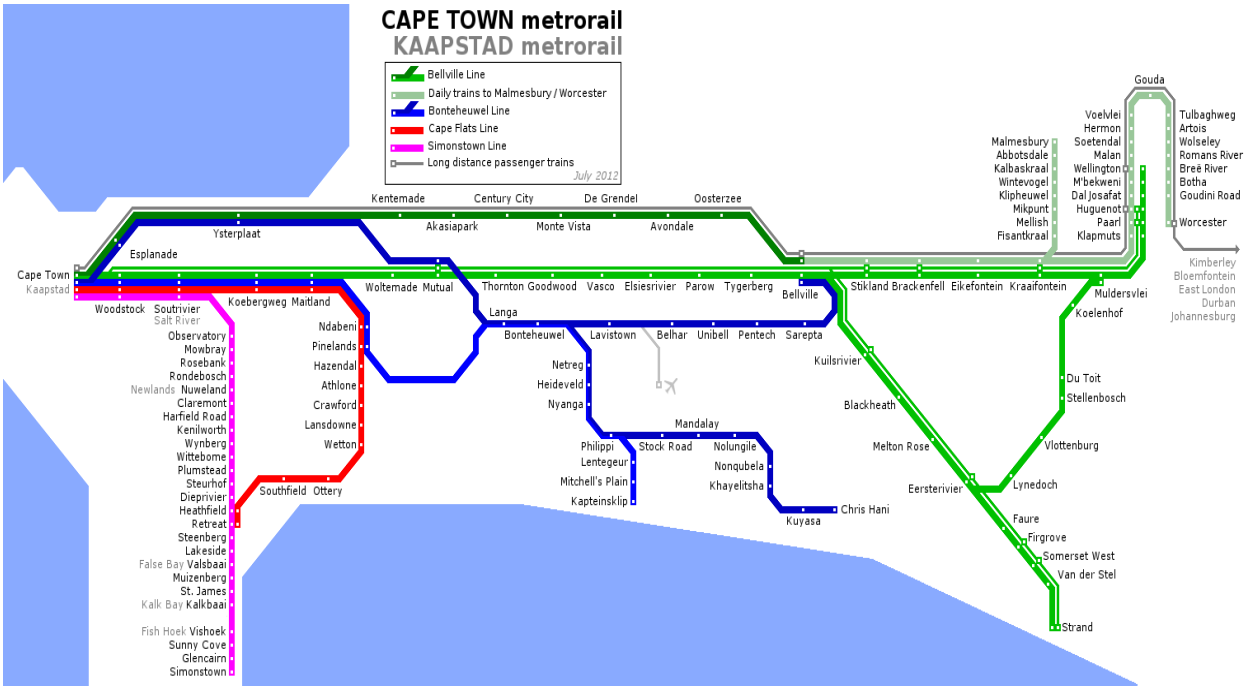
Pink line (Cape Flats Line) – via Athlone to Retreat.

Blue line (Central Line) – via Langa to Mitchell's Plain, Khayelitsha and Bellville.

Most of the fatalities 50% (n = 52) occurred on the Blue Line in this study.

Khayelitsha was the suburb where the most railway-associated fatalities had occurred (22.9%; n=24) and it contains six stations namely Mandalay, Nolungile, Nonkqubela, Khayelitisha, Kuyasa and Chris Hani along the railway line. Following this, Kuilsriver and Parow both had 11 cases accounting for 10.5% of the fatalities. The single station that had the most railway-associated fatalities in this study was Bonteheuwel Station (Figure 8) which accounted for 9.5% (n = 10) cases and forms part of the Blue Line (Central Line).

Figure 9. The Cape Town Metrorail map (27)



Fatalities by location of railway and railway area

Most of the bodies were found either between stations (50%; n = 42) or within close proximity to the stations (20%; n = 21). Furthermore, 65.4% (n = 68) of the incidents were alleged to have taken place on the tracks, and 25% (n = 24) occurred on the verge between the railway track or adjacent to the railway track. According to the reports, three of the fatalities occurred on the train itself and four occurred either in or close to the train station.

4.5 Train accident factors

Train Type

Eighty-one of the fatalities involved passenger trains, with only one incident involving a train transporting goods. In 22 cases, the type of train was not specified.

Train speed

The information regarding the speed at which the train was travelling was obtained from the SAPS 180 from. The speed was documented in only one case and was recorded at the time of the incident as 30 km/hr. The train drivers are aware of the speed limits when approaching the stations and the legal maximum speed limit is 90 km/h (10) .

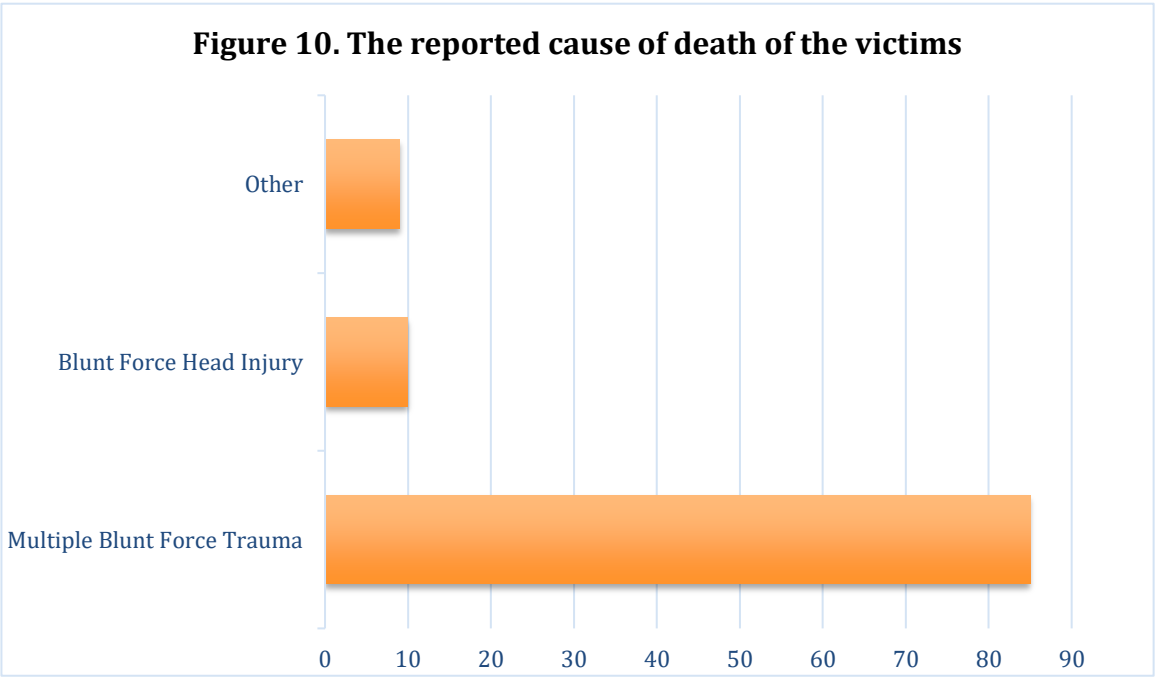
Train collisions

There were no train-to-train collisions or train-to-vehicle incidents recorded during the period of this study.

Falling from standing position

In four of the cases, victims fell from the outside or inside of the train onto the platform/railway track. In one case, the victim was described as “falling” from the platform and in another case, the victim fell over the railway tracks while walking/ crossing the tracks. In two cases, the position was not specified.

Figure 10. The reported cause of death of the victims



4.6 Reported causes of death

According to the forensic medical practitioner's autopsy report, the cause of death (see Figure 10) was mostly due to multiple blunt force injuries (81.7%; n = 85). Blunt force injuries to the head made up 9.6% (n = 10). Other causes of death were electrocution, drowning, spinal fracture, soft-tissue and head injuries, polytrauma against a background of cardiac issues, pneumonia secondary to injuries, head and spine injuries, abdominal and chest injuries with one case for each of these causes (more details below). None of the deaths recorded were as a result of natural pathology.

Assault

Of the alleged assaults, one victim jumped from the train and two victims were pushed.

Electrocution

Only one victim had died of electrocution in relation to train surfing. In this electrocution case, the circumstance of death was described as a result of train surfing.

Body dumping

There were no recorded cases where there was a suspicion of a body being dumped.

Drowning

One case was recorded as a drowning. This body was recovered from a water canal next to the railway.

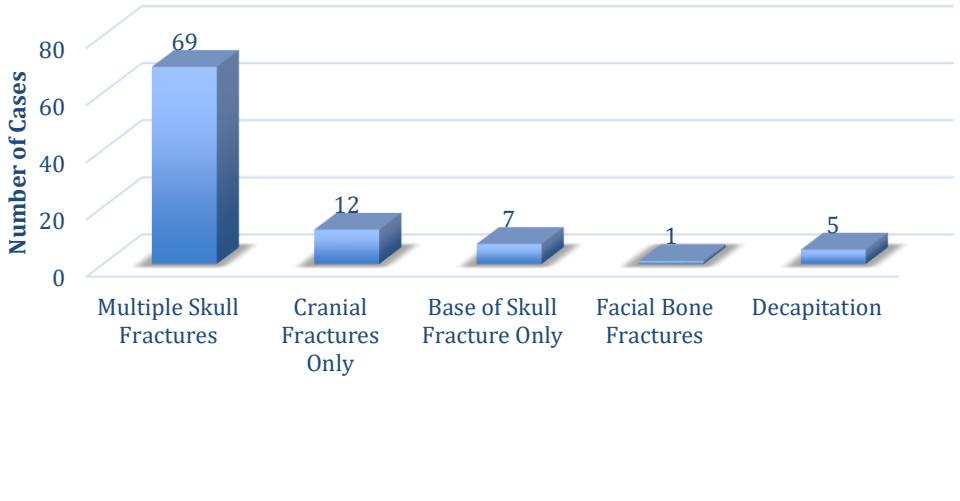
4.7 Patterns of Injury

Head injuries

Head injury was recorded in 91 of the cases. Head injuries were divided into open head injuries (n = 25), where there was a disruption of the scalp and skull and closed head injuries (n = 66) where the scalp remained intact. Multiple skull fractures were documented in 75.8%

(n = 69) of cases and these included the skull base and the cranium. In 12 of the cases head injuries only involved skull cap fractures and in seven of the cases fractures only involved the base of skull. There was one case where the victim only had facial bone fractures. Decapitation had occurred in five of the fatalities. See Figure 11.

Figure 11. The patterns of head injuries



Brain injury

Generalised (laceration, contusion and complete disruption) brain trauma, which includes diffuse traumatic brain injury was noted in 52 of the cases. The brain was intact in 21 cases. Focal brain injuries (a localised area of either a contusion or a laceration) occurred in seven and external herniation occurred in 22. See Figure 12.

Figure 12. The pattern of injury to the brain

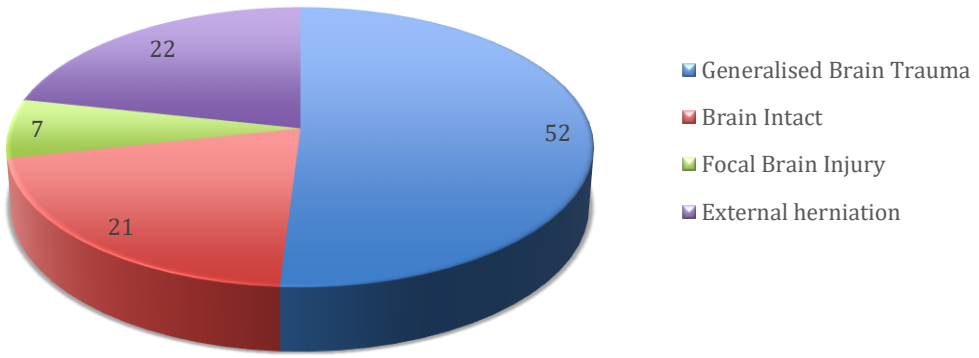
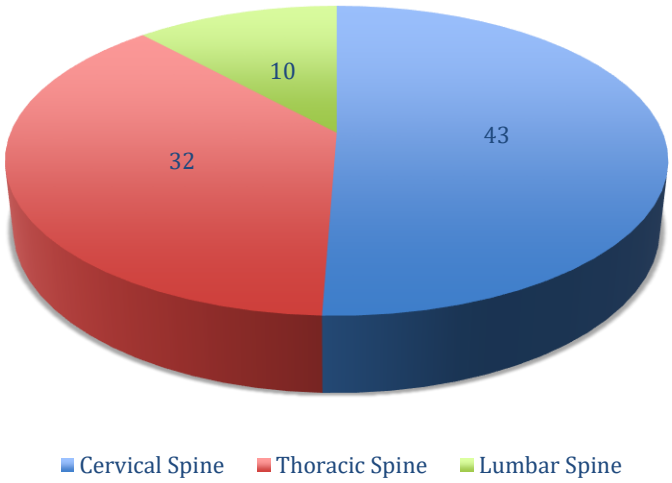


Figure 13. Spinal injuries



Spinal injuries

Spinal injuries occurred in 62 cases. Cervical injuries were most frequent (n = 43), followed by thoracic spine injuries (n = 31) and 10 lumbar spine injuries. There were 21 cases where multiple spinal injuries were identified (see Figure 13).

Pelvic fractures

There were 11 cases that had multiple pelvic fractures and 20 had a single fracture. Displaced pelvic fractures occurred in 18 cases.

Injuries to the thorax

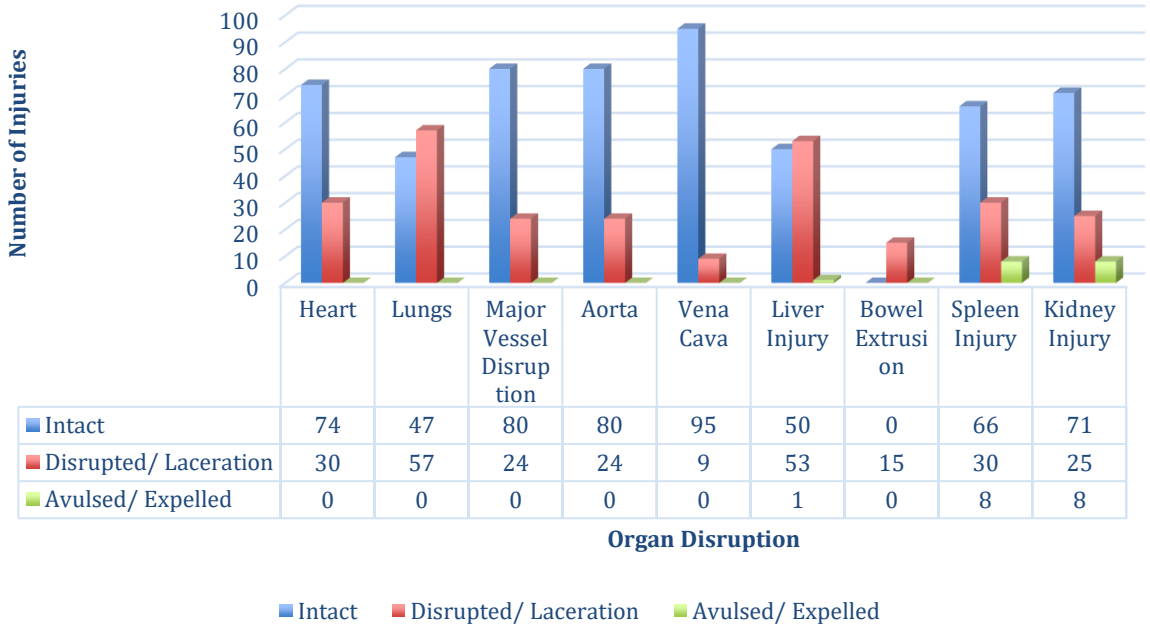
Thoracic injuries occurred in 83 cases. Transection of the thorax occurred in only eight cases. In the cases where the victims were transected, one case was reported as being inside the train, two cases were reported as being pedestrians, one case was reported as a commuter and four cases were reported as the circumstances being unknown.

Rib fractures were divided into either multiple (more than two) rib fractures (92%, n = 77) or single rib fractures (4.8%, n = 5). There was only one case where the victim did not have any rib fractures noted. Bilateral fractures occurred in 65% (n = 54) and unilateral fractures occurred in 33.7% (n = 28) of cases.

Thoraco-abdominal organ disruption or injury patterns

Organ disruption was noted for multiple organs, namely: heart, lungs, major vessels, vena cava, liver, spleen, kidneys and extrusion of the bowel. As for major vessel disruption, thoracic aorta injuries account for 18 vs. six abdominal aortic disruptions. There were five thoracic and four abdominal vena cava disruptions in this study (see figure 14).

Figure 14. The type and number of organ disruption



Limb injuries (see figure 15)

Upper Limbs

Upper limb injuries (Figure 15) were classified by side (right or left) and by region of the arm involved – namely upper arm, forearm or hand.

Right upper limb injuries occurred in 33 cases, 10 of which suffered amputation (eight of the hand and two at the level of the upper arm). The most common injury was noted to be multiple fractures of the upper arm (29 cases) with four single fractures. Multiple forearm fractures accounted for 11 cases.

Left upper limb injuries occurred in 21 cases, of which 10 were amputated. All the amputations were of the hand. Multiple vs. single fractures occurred evenly with 12 described in each. There were five multiple fracture cases to the forearm, 11 single fractures to the upper arm and six multiple fractures to the upper arm.

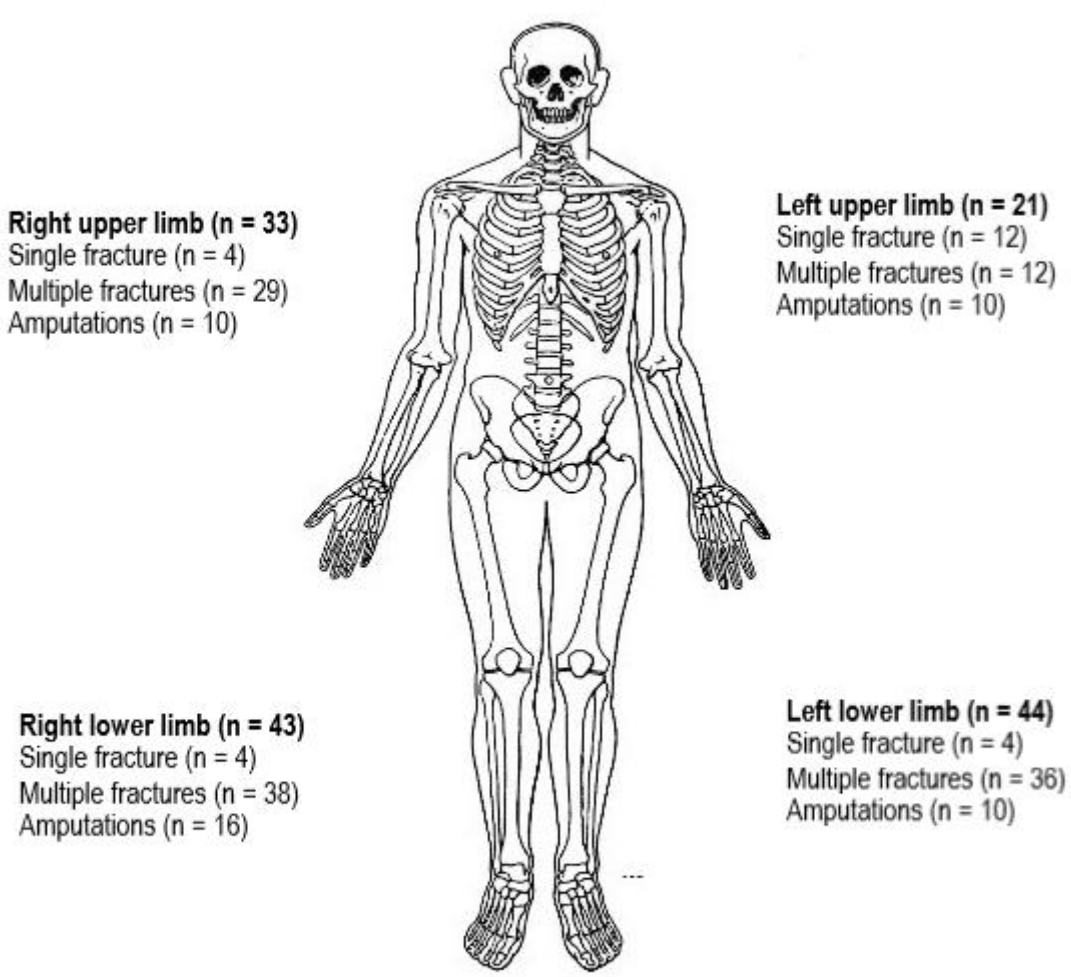


Figure 15. Injury patterns

Body pictogram adapted from ChulaPatho (29)

Lower Limbs

As with the upper limb, lower limb injuries (see figure 15) were classified by side and region of the limb involved - thigh, lower leg and foot.

Right lower limb injuries occurred in 43 cases, of which 16 were amputated. The most common injuries were noted to be multiple fractures of the thigh (n = 21) and lower leg (n = 15). Multiple fractures (n = 38) were more common than single fractures (n = 4).
Left lower limb injuries occurred in 44 cases of which 10 were recorded to be amputated. The most common injuries were multiple fractures of the lower leg (n = 20) and thigh (n = 13). Multiple fractures (n = 36) were more common than single fractures (n = 4).

4.8 Blood alcohol-related data

Blood alcohol samples were collected in 95 of the cases. Blood alcohol concentration levels (see figure 16 and 17) were 0.00 g/100ml (negative) in 65 cases. In this study, 17 of the victims' blood alcohol levels were above the legal alcohol limit of 0.05 g/100ml and of those, 12 were pedestrians. At the time of this study, there were still nine results pending, three samples were deemed insufficient and information on one case was not recorded.

Figure 16. Blood alcohol concentration levels of the victims

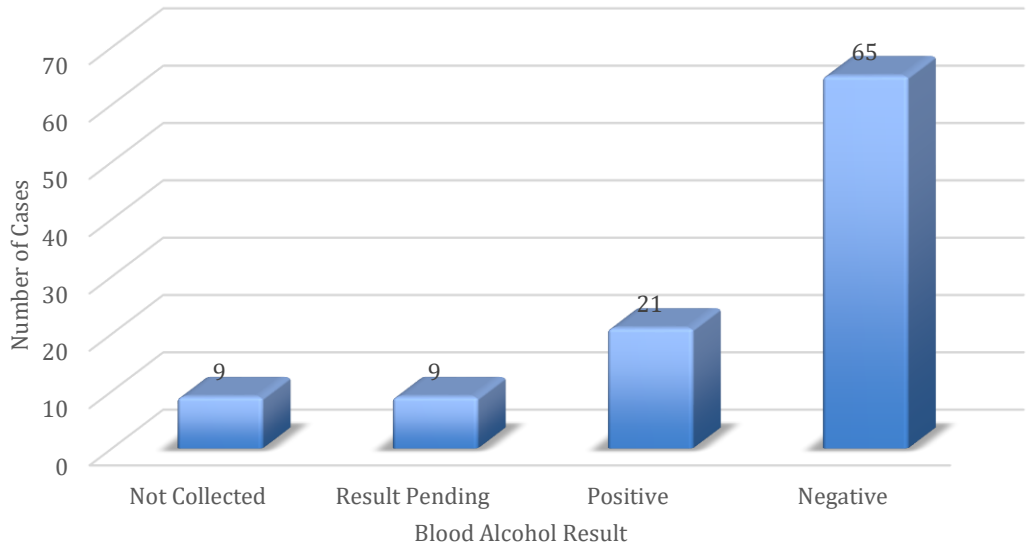
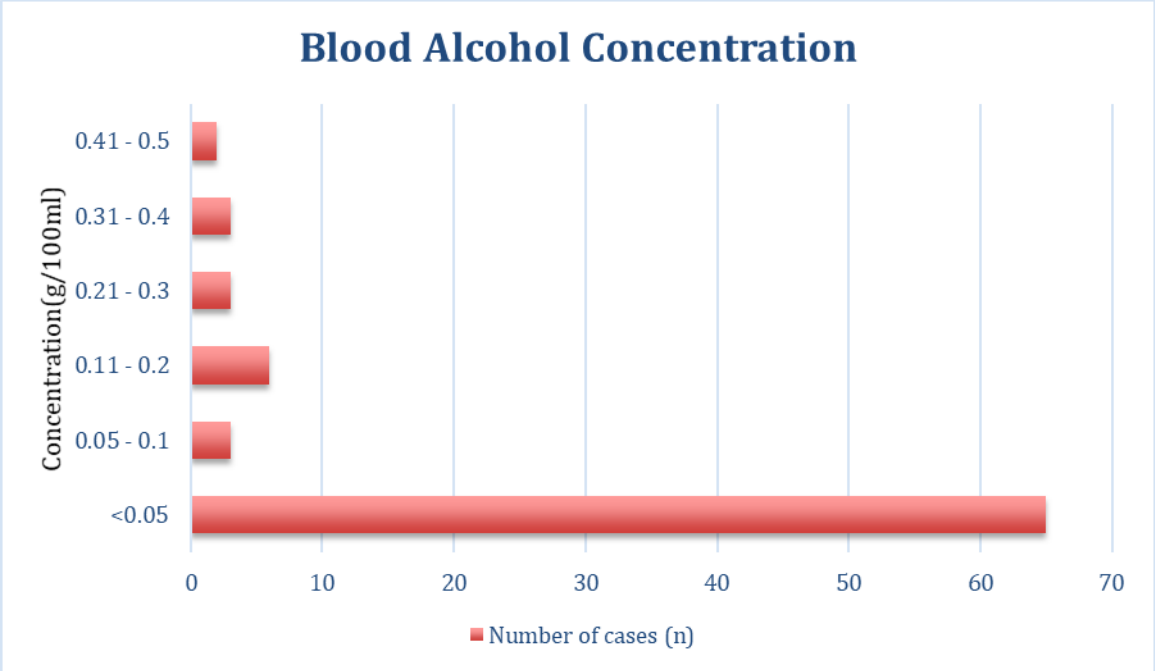


Figure 17. Blood alcohol concentration levels of the victims



4.9 Illicit substance-related data

In four cases, a rapid twelve-panel urine drug screen test was performed at the time of the post-mortem examination. Of these, one tested positive for methamphetamines and two were positive for cannabis. Full formal toxicology was not performed on any of the cases.

Chapter 5: Discussion

In this study, railway-associated fatalities in the Tygerberg region were reviewed as a retrospective descriptive study by collecting data of all railway-associated fatalities that were examined at the Tygerberg Mortuary over a two-year period. Research of this nature is limited in the South African context. In-depth descriptions of injury patterns, manner of death and temporal data related to railway-associated fatalities have not been sufficiently investigated before. There are no previous studies detailing specific injury patterns of railway-associated fatalities in South Africa.

5.1 Demographic data

The demographic data extracted found that most of the victims were male (83.7%). Victims were found to be predominantly black (63%) or coloured (35%). The data concerning the employment status was not always clearly documented but from the data available on the reviewed death notification forms, 47.6% of the victims were recorded as unemployed.

5.2 Temporal data

An analysis of time-of-day variability of fatalities in our study showed a peak in the morning and evening times. The peak times were 8 am to 10 am (30%) and 7 pm to 11 pm (26%). Savage (20) found in Chicago that 56% of unintentional fatalities occurred between the prime commuting period of 7 am to 9 am and 3 pm to 7 pm. In Cape Town, Lerer and Matzopoulos (18) found that more than 50% of both fatal and non-fatal railway injuries occurred during peak commuting times between 5 am to 9 am and 4 pm to 8 pm.

Most of the deaths in the current study occurred between Tuesday to Thursday (55%). Wednesdays accounted as the day with the most fatalities of 22. In South Africa, wage and salary payment dates vary. Wages may be paid weekly or fortnightly. Salary dates may be anywhere between the 15th to the end of the month. The peak number of railway-associated fatalities would have been expected to occur on a Friday, if there was a true association with the payday. From the data reviewed here, this was not the case. There was no obvious identifiable factor or association that accounts for the pattern of railway-associated fatalities in relation to days of the week.

The day with the greatest number of fatalities was the 27th of the month. This could suggest an association with salary payment dates. The period following the 27th of the month up to and including the first seven days of the month, accounted for 44% of fatalities suggesting that there may be an association with salary payments.

When reviewing months of the year, there was no clearly identifiable factor that we could attribute for the higher number of cases occurring in May, June and October. There was a decrease in the number of railway-associated fatalities for the months of December, January and February which may be attributed to a decrease in railway use over the holiday/festive season, as many places of work close during this period. Many people use this time to leave Cape Town for the holiday season. Sousa et al. (21) found that there were weak seasonal variations in the cases investigated in their study.

5.3 Circumstances of death

Data surrounding the circumstances of passenger fatalities were difficult to interpret because information regarding where the victim had been injured, died or found was not documented. Very little information regarding the circumstances of death was available. Overcrowding is often cited in newspapers and may contribute to railway-associated fatalities and some authors have mentioned this as a potential risk factor as well (29). Due to the lack of information received regarding the circumstances surrounding the incidents, I could not determine whether overcrowding was a contributing factor in any of the cases recorded in this study. There is lack of standardisation regarding the capture of information regarding the circumstances surrounding railway-associated fatalities, and often this was not recorded at all. The reason for this could be attributed to this information simply not being documented on the SAPS 180 or FPS007 document, not being known (if there were no witnesses) or that details of this nature are provided to the doctor performing the autopsy.

5.4 Geographical distribution of railway-associated fatalities

The Cape Town Metrorail (the main commuter train system) operates on a network of four railway lines. The three lines which pass through the study area are as follows: (see figure 9)

- Bellville Line (Green Line), which runs between Cape Town (city centre) – Bellville – Strand - Wellington
- Bonteheuwel Line (Blue Line), which runs between Cape Town (city centre) – Langa – Bonteheuwel – Nyanga – Phillippi – Mitchells Plain – Mandalay – Khayelitsha
- Daily trains to Malmesbury and Worcester (Light Green Line), which run between Bellville - Malmesbury – Paarl – Worcester

Half of the fatalities reviewed in this study (n = 52), occurred on the Bonteheuwel (Blue) Line of the Metrorail network. This may be due to the fact that residential housing is built close to the railway lines, with easy access for pedestrians to the railway tracks. A large proportion of the population reside in these areas as a result of Apartheid (19). The number of pedestrian fatalities found on this railway line was 52, suggesting that safety and security measures (fencing, security, lack of pedestrian crossings and criminal elements) should be assessed and changes implemented to decrease fatalities of this nature. Another factor to consider could be the poor lighting in these areas, making it difficult for pedestrians to navigate their way around railway tracks at night.

5.5 Cause of death

Fatal injuries associated with multiple blunt force injuries were the most common cause of death in this study (refer to figure 10). In cases of severe body disruption, identifying the specific fatal injury is often difficult or impossible, leading pathologists to use more general terms such “multiple blunt force injuries”. These bodies may potentially be viewed by some pathologists, in particular those with less experience, as simple cases leading them to diagnose “multiple injuries” without close scrutiny of the body and the injuries.

Careful examination and dissection of polytrauma cases are required to identify injury patterns and types. Injuries such as stab or gunshot wounds may be lost or altered due to the extensive soft tissue damage, leading to an erroneous diagnosis of blunt trauma in the absence of further information. Homicidal cases may therefore be mis-classified as accidental deaths based on the autopsy findings.

The lack of information available regarding the circumstances of death, makes determination of the underlying cause of death very difficult for the pathologist in polytrauma cases. History

and circumstantial evidence are important tools which would allow a better understanding of the fatal event and ultimately the cause and manner of death.

5.5.1 Exceptional cases

A case of drowning

The deceased was found in a canal of water next to the railway tracks in a prone position with the face fully submerged. Superficial external injuries were reported by the pathologist, with no obvious traumatic cause of death. Signs of immersion and pulmonary findings were suggestive of drowning. As no information regarding the circumstances of this death was available, it is unclear whether this represents a possible train casualty or an assault. This type of case highlights the importance of the scene investigation and the attendance of pathologists at a suspicious scene.

A case of electrocution

This was a case where the deceased was reported to have been train-surfing on top of a moving train when he was electrocuted.

5.6 Manner of death

Manners of death in South Africa include natural, accident, suicide, homicide and undetermined. In South Africa, the pathologist is not legally mandated to determine the manner of death as this function falls to the presiding officer of the court.

The majority of international research articles reviewed here, indicated the manner of death to be predominantly due to suicide. For example a study by Lin and Gill (30) in New York City, examined the manners of death and found that 111 cases out of 211 resulted from suicide, 76 were accidental and four related to homicide.

In that study (30), the manners of death were determined according to the history regarding the circumstances of death at the time of the autopsy. The current study highlights the significant lack of case history at the time of autopsy, which prevents a reasonable assessment of possible manner of death. Manner of death was determined by the use of keywords in the autopsy reports, for instance if suicide or accident was mentioned. There

was only sufficient information in 38 cases which allowed the manner of death to be determined, all of which were considered to be accidental.

It is crucial to have a clear understanding of the events that may have occurred at the scene, especially with regards to the position of the body in relation to the train, railway track and surrounding area. Documentation of the basic security measures on the railway, platform, station and the train are significant to determine not only how accidents occur but also how they can be prevented. An example, pedestrian fatalities could be minimised by limiting access to the railway tracks by erecting and maintaining boundaries.

The paucity of scene information available to the pathologist is in part due to the lack of witness statements, especially statements from the train drivers involved in train-pedestrian collisions. Closed circuit television (CCTV) footage of rail tracks and on the front of the train would be useful tools in investigation of cases.

The investigation of rail-associated incidents should involve various agencies such as railway police, investigation teams and the transportation department which may lead to in-depth documentation and reporting. Retrieving such information would be of significant value in identifying circumstances surrounding the cases. Overall, it is imperative for the pathologist conducting a prospective study to attend all of the scenes relating to a railway incident.

During the course of this study, a meeting was held with a representative of the Crime Information Management office of the Rapid Rail Police Unit railway safety team with a view to obtaining access to their records of incident reports. Due to time constraints and logistical difficulties with regard to required permissions, this avenue was abandoned. Future studies should endeavour to engage with such resources timeously to gain access to their data.

5.7 Patterns of injury

A study by Valsala et al. (31) investigated railway-associated injury patterns in Kerala, India over a one-year period. They classified the injury patterns into external injuries – abrasion, contusion, abraded contusion, lacerated wound; injury according to body part – head, neck, chest, abdomen, upper limb and lower limb (further divided into fractures and amputations). In this study, we classified the injuries as follows:

5.7.1 Head injury

- Open versus closed
- Anatomical (Multiple skull fractures, cranial fractures, base of skull fractures, facial bone fractures)
- Decapitation

A common pattern of injuries noted were head injuries (refer to figure 11). Most of these were closed injuries and associated with multiple cranium and base of skull fractures. This would be expected if the mechanism of injury sustained was blunt force trauma to the head. There were very few cases involving decapitation of the head. Some of the literature states that most of the decapitation-type injuries occur when the victim lies across the railway lines (31). Due to the lack of incident detail, this mechanism could not be confirmed from the cases of decapitation.

5.7.2 Limb injury

- Amputation
- Single fracture
- Multiple fractures

Right-sided (see figure 15) limb injuries were more common than left-sided limb injuries. Multiple limb fractures were noted, and these were likely due to blunt force trauma at high velocities, making this an expected pattern of injury. Spaite et al. (32) discovered that all five survivors sustaining major amputations received them while attempting to board a moving train or as pedestrians. A study performed by Valsala et al. (31) investigated deaths occurring with a history of falling from a running train and found that amputation and fracture of the limbs were less common in this group. In a second group investigated, individuals that jumped in front of a train, the limbs were most vulnerable for injuries.

5.7.3 Trunk injury

- Chest (single/multiple rib fractures; disruption of lung/heart/ chest organs, transection)

- Abdomen (Organ disruptions, avulsion, laceration, external herniation, transection)
- Pelvis (single/multiple fractures)

In the current study, multiple bilateral rib fractures were noted that were associated with disruption of the lungs. In most of the cases the heart was not disrupted (n = 72). The aorta was disrupted in 19 cases and the vena cava was disrupted in six cases. This may be due to the mechanism of blunt force trauma to the thorax where the heart becomes a pendulum during the injury and disrupts the aorta which would absorb most of the impact of the force. Transection of the trunk only occurred in eight of the cases, which is similar to the number of decapitations (n = 5).

The most common visceral organ injuries were lacerations to the liver (n = 53), spleen (n = 30) and kidneys (n = 25). When blunt force trauma impacts a hollow cavity, the force will be distributed along the closest solid organ, which is typically the liver. This is why the liver was the most common organ that was lacerated (compared to the spleen and kidneys). Interestingly, bowel extrusion and disruption only accounted for 15 of the cases in this study, which further supports the suggestion that the force travels via the solid organs preferentially. Avulsion of visceral organs was not a common occurrence.

5.7.4 Pelvis

- Multiple fractures
- Displacements

Of the 104 cases, 11 had multiple fractures of the pelvis and 18 had displacements. Driever et al. (22) made the discovery that collisions where persons were in an upright position caused predominantly pelvic and rib injuries. At speeds greater than 160 km/h parts of the pelvis were scattered into numerous pieces.

5.7.5 Spine injury

- Cervical
- Thoracic
- Lumbar
- Displacements

There were 61 spinal injuries of which 43 were cervical, 31 thoracic and 10 lumbar spine injuries. Twenty-one of these cases had more than one vertebral injury. Of these 21 cases, the cervical together with the thoracic spine were commonly injured. The fewest injuries involved the lumbar region. Only two cases had injuries to all three of the spinal areas, of which one was reported as a pedestrian and the other as unknown.

5.8 Blood alcohol and illicit substances

5.8.1 Blood alcohol concentration

Blood alcohol levels should be routinely taken in all cases of unnatural deaths. However, this is done at the discretion of the pathologist performing the post-mortem examination. In 95 of the 104 cases, blood alcohol specimens were collected. A positive test result is indicated by a level of 0.01 g/100ml and the legal limit at the time of the study was 0.05 g/100ml. In reviewing these results, it is important to be cognisant of the fact that in 18 cases, samples were either not collected or the results were still pending. The reason for samples not being collected were not mentioned in the autopsy reports. Thirteen of the cases with levels above the legal alcohol limit were non-passengers or pedestrians. Two cases had potentially lethal blood alcohol levels above 0.43 g/100ml, of which one case was reported as a pedestrian (non-passenger) and the other was a non-passenger with unknown circumstances. There was one case reported as being a passenger hanging outside of the train with a blood alcohol level of 0.20 g/100ml.

In our study, 65 cases had a negative blood alcohol test and in 17 cases the blood alcohol level was above the legal alcohol limit. Positive blood alcohol concentration levels in our study were approximately 20% higher in our cases compared to a study done by Lerer and Matzopoloulos in 1995/1996. Silla and Louma (17) described that among all their victims involved in a train accident in Finland, 153 (50.5%) were intoxicated by alcohol, medicines or other drugs .

There are no explicit rules against commuters boarding the trains after consuming alcohol. Alcohol has been associated with railway-associated fatalities in previous studies (5) and the findings of this study are in line with the conclusion that alcohol is a risk factor for railway-associated fatalities.

5.8.2 Illicit substances

In our study, there were only three documented rapid urine samples that were collected to test for illicit substances. Of the three cases, one was positive for methamphetamines and the other two for tetrahydrocannabinol (THC) or cannabis. Reported statistics suggest that over 200,000 young adults in Cape Town are methamphetamine abusers, of which 91% are teenage males 16 of years age (33). Methamphetamines and cannabis are the most commonly used and readily available illicit drugs in the Cape Metro.

Peter et al. (30) found that accidental cases had positive cocaine and benzoylecgonine tests in 25% of the deaths and cocaine with or without benzoylecgonine or ethanol was detected in 63% of accidental deaths in New York City.

Toxicology sampling at autopsy is at the discretion of the pathologist performing the autopsy. This combined with the delayed analysis of samples at the State Forensic Chemistry Laboratory, has resulted in toxicology not forming part of routine practice in the investigation of rail-associated fatalities. Although rapid urine toxicology screening is used as a screening tool, a more comprehensive approach should be adopted to assess the full extent to which illicit drugs contribute to these deaths.

Chapter 6: Conclusions

Study findings

In this study, there were 104 cases of railway-associated deaths recorded between the years 2016 and 2017. Most of the victims were young adult unemployed males whose deaths had occurred on the Blue Metrorail Line in Cape Town. Most of the cases occurred during high commuter peak times (8 am to 10 am and 7 pm to 10 pm), during the mid-week (Tuesday to Thursday) and predominantly in the first week of the month and towards the end of the month. Most of the fatalities were pedestrians where the victim was struck by a train. Head injury was a common pattern of injury with multiple skull fractures documented. Cervical injuries accounted for 70.5% of spinal injuries documented.

Thorax injuries occurred in 79.8% of cases and multiple rib fractures occurred commonly, with 51% of those being bilateral rib fractures. Internal injuries to the lungs, heart, liver and splenic injuries were commonly sustained in the internal injury category. Limb injuries were common, predominantly multiple fractures of either the upper or lower limb. Approximately one third of the victims tested positive for alcohol. Illicit substance data was insufficient as toxicology was not collected in all cases and the screening of illicit substances was not practised routinely.

Limitations encountered in the performance of the study

A lack of detailed documentation was a significant limitation in this study as there were many aspects to the circumstances surrounding the victim's deaths and incidents that were not accurately documented for review.

There was often a lack of detail in autopsy reports regarding the wounds found on the body, with regard to morphology and location. This limits the interpretation and possibly accurate determination of cause of death. Few cases were investigated for alcohol or illicit drugs, not allowing for the interrogation of drugs as possible contributors to rail-associated deaths.

Scene photography was inadequate which did not allow for assessment of factors contributory to the security around railway stations and lines. The photographs mainly focused on the body. There were no additional photographs of the surrounding area.

The SAPS dockets were not reviewed as the logistics of this was not feasible for the time-frame available. These may have contained more detail than was available in the autopsy report.

Medical record-keeping (documentation of injury patterns etc.) practices are not standardised and in reviewing the notes of the cases and autopsies, the information recorded by the pathologist varied.

Information regarding the circumstances of death and therefore the manner of death could not be adequately scrutinized in this study.

Recommendations

- An audit of the forensic approach to the investigation of railway-associated fatalities and its standardisation of practice as it relates to sample collection and record-keeping practices, is suggested.
- Alcohol and toxicology screening of all railway-associated fatalities should be undertaken
- Specific consideration of the formulation of the cause of death could be reviewed to avoid, where possible, the use of generic terms such as “multiple traumatic injuries” and attempt to make more specific diagnoses.
- Further studies into why some Metrorail lines have more fatalities than others should be conducted. It would be of great value if prospective studies into rail-associated deaths could include the attendance of qualified forensic pathologists at death scenes, which would allow for more detailed documentation of the environment and circumstances of these deaths.
- Safety mechanisms at railway crossings, security and passenger behaviour should be investigated further to ascertain what can be done to improve safety of passengers on or during their commute – possibly in collaboration with the South African Police Service.
- Education of learners and commuters with regard to safe use of railway environment, in particular the dangers of crossing the railway lines and “train surfing”.
- Emphasis should be placed on collecting information required for the determination of the provisional manner of death.

Chapter 7: References

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