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Patterns of injury and pathology in paediatric deaths processed at the Johannesburg Forensic Pathology Service over the period 2009 – 2011.

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DECLARATION

I declare that this thesis is my own unaided work. It is being submitted for the degree of Masters of Science in Medicine at the University of Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.



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Contents Page

Contents ii
Acknowledgements iv
Dedication vi
List of Figures vii
List of Tables viii
List of Terms and Abbreviations ix
Abstract xi

Chapter 1: Introduction 1
1.1 General 1
1.2. Macro-environmental influences on child mortality 4
1.3 Aims and Objectives of the study 5
1.4 Hypothesis 7
1.5 Importance of the study 7

Chapter 2: Child Mortality: a review of the literature 9
2.1 Accidental fatal injury 9
2.1.1 Road traffic injury patterns 10
2.1.2 Drowning injury patterns 12
2.1.3 Fall from heights injury patterns 13
2.1.4 Thermal injuries 14
2.2 Non-accidental fatal injury 16
2.2.1 Bruising patterns 18
2.2.2 Head injury patterns 19
2.2.3 Shaken baby syndrome 21
2.2.4 Skeletal injury patterns 22
2.2.5 Imaging of skeletal injuries 24
2.2.6 Child abuse fatalities 26
2.2.7 Asphyxia related deaths 27
2.2.8 Penetrating trauma 28
2.3 Procedure related (anaesthetic) deaths 29
2.4. Natural (illness related) deaths 31
2.5 Conclusion 33

Chapter 3 Materials and Methods 34
3.1 Methodological framework 34
3.2 Protocols and guidelines for the South African forensic pathology services 36
3.3 Materials 38
3.4 Methods 41
3.4.1 Identification of valid data 41
3.4.2 Data collection of case files 41
3.4.3 Transcription on data spread sheets 42
3.4.4 Categorisation of data 43
3.5 Statistical analysis 49

Chapter 4: Results 50
4.1 Description of paediatric mortalities 50
4.2 Age range for specific categories of death observed within associated variables 58
4.3 Relationship between race and other demographic variables within the sample 63
4.4 Relationship between sex and the associated variables within the sample 64
4.5 Comparison of the SAPS180 form to the post mortem examination report. 66
4.6 The association of categories of death, region of injury and prevalent pathological and physiological findings 67

Chapter 5: Discussion 76
5.1 Limitations of the study 76
5.2 Population Description 78
5.3 Prominent findings 79
5.4 Comparison of age ranges and causes of death with previous literature 81
5.5 Comparison of sex and race with previous literature 85
5.6 Discussion on the police documentation and post mortem report 87
5.7 Comparison of pathological findings and categories of death 88
5.8 Procedural efficiency of the South African Police Service and Johannesburg Forensic Pathology Service 97
5.9 Recommendations for future research 98

Chapter 6: Concluding remarks 101

Reference List 103

Appendices 111

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Dedication

This dissertation is dedicated to my mother, Lorraine Thornton, who is the very definition of a mother. Any child would be blessed and honoured to have you as a care giver. Your belief and faith in me has been essential to my education and wellbeing. Thank you for your unrelenting generosity of self, encouragement and altruism.

List of Figures

Page

Figure 1 Municipal map of the City of Johannesburg indicating categorized areas 45

Figure. 2: The number of paediatric cases observed in sample per year 51

Figure. 3: The age distribution of paediatric cases 51

Figure.4: The sex distribution within the sample 52

Figure. 5: Racial distribution within the samples 53

Figure. 6: Hospital admission distribution prior to death within the sample 53

Figure. 7: Circumstance categories of death (from the SAPS180 forms) prior to post mortem examination 54

Figure. 8: Categories of death after the post mortem examination 55

Figure. 9: Percentage of affected body regions within the sample 56

Figure. 10: The regions of early decomposition in the sample 57

Figure.11: Difference between categorized residential jurisdictional areas within the study 58

List of Tables

Page

Table 1 Non- accidental injury syndrome types and affected areas 18

Table 2 The standard radiological procedure for children of suspected non-accidental injury 26

Table 3 Criteria for inclusion of suspected NAIS fatalities in the sample 48

Table 4: External and internal injuries and findings in paediatric cases 57

Table 5: Prominent age ranges for categories of death observed in paediatric cases 59

Table 6: Category of death/age comparison 60

Table 7: Demographic difference between natural and unnatural deaths 61

Table 8: Demographic differences between deaths from natural illness and blunt force trauma as category of death by age 62

Table 9: Relationship between race and demographic variables within the sample 63

Table 10: Relationship between biological sexes and variables within the sample 65

Table 11: Associations between the SAPS180 cause of death assignment and post mortem examination category of death 67

Table 12: Association of category of death and region of injury 68

Table 13: Prevalence of post mortem findings in cases of blunt force trauma fatalities 69

Table 14: Suspected NAIS cases within the blunt force trauma fatalities 71

Table 15: Prevalence of post mortem findings in cases of natural illness fatalities 72

Table 16: Prevalence of post mortem findings in cases of drowning fatalities 73

Table 17: Prevalence of post mortem findings in cases of procedure related fatalities 73

Table 18: Prevalence of post mortem findings in cases of thermal fatalities 74

Table 19: Prevalence of post mortem findings in cases of asphyxia fatalities 74

List of Terms and Abbreviations

BFT – Blunt Force Trauma

Child – Any individual under the age of 14 years of age. For the purposes of this study, child is defined as prepubescent individuals under the age of 12.

Developing country - a non-industrialized low income country that is currently developing its resources by industrialization

DNF – Death Registration Form

FCL – Forensic Chemistry Laboratories

First world country – a major industrialized and non-Communist nation of the world

ICD – International Classification of Diseases

JHB FPS – Johannesburg Forensic Pathology Service

MRC – Medical Research Council of South Africa

MVA – Motor Vehicle Accident

NAIS – Non-Accidental Injury Syndrome

NDoH - National Department of Health

NIMSS – National Injury Mortality Surveillance System

PVA – Pedestrian Vehicle Accident

Racial Affinity: Biological racial group which individuals are categorized within.

SAPS180 – Police report accompanying body to the mortuary

SIDS - Sudden Infant Death Syndrome

WHO – World Health Organisation

UHC – Universal Health Coverage

UN – United Nations Organisation

Abstract

Within the field of paediatric pathology dominant universal trends have emerged with child abuse related fatalities and child murders being at the forefront. However, several authors have noted that such trends have not been documented within the South African context. This is due to the lack of data collection and research within South Africa. Patterns of injury and prevalence of paediatric fatalities received at the Johannesburg Forensic Pathology Service (JHB FPS) over three years were observed through a descriptive, retrospective study. Data were collected from FPS case files and Police reports (SAPS180) accompanying the body to the mortuary. The results indicated that the majority of paediatric deaths were due to blunt force injuries, natural disease processes and drowning. Subdural and subarachnoid haematomas, multiple blunt force internal injuries, hyperinflation and consolidation of the lungs and features of dehydration were the dominant patterns of injuries and disease. Additionally, results exhibited a significant difference in age range when correlated to category of death as well as a high risk of mortality within the first year of life. This study highlights the alarming figures of accidental and socio-economic paediatric death cases which are received at the JHB FPS.

Keywords: Child mortality, Injury patterns, Forensic Pathology

Chapter 1: Introduction

1.1 General

Children are not 'small adults'. They are a special population, with their own problems and dangers when referring to mortality and the risk thereof. Intervention and prevention programs which focus on adult mortality rates and the circumstance leading to that would be unsuccessful when applied to the minority group of children. Ethnically and anthropologically speaking, each nation is heterogeneous in its expression of mortality (Hon & Leung, 2010). The field of forensic paediatric pathology in the South African context is particularly interesting in this vein, as South African health care is considered a cross between a developed, industrialized country and a developing third world country (Saloojee & Pettifor, 2005). Support for this paper could be found in the discovery of possible variations in trends and patterns of disease or injury which are universally acknowledged to be due to the transition of developing to industrialized status. This 'bridging' period of development has produced a unique socio-cultural climate which impacts the health of children as well as the reporting of and data collection related to the medico-legal unnatural paediatric death investigations. Several authors have noted that within the South African context, empirical studies related to these trends are limited (Kotze et al., 2007). International research avenues in paediatric pathology focus around (but aren't limited to) topics of non-accidental injury (NAI) or 'battered baby syndrome', transport related deaths and the ever controversial Sudden Infant Death Syndrome (SIDS) (Hon & Leung, 2010).

From a statistical perspective, the injury mortality rate in South Africa is significantly more profound (157.8 per 100 000 within the population) than that of the global average (86.0 per 100 000 within the population) (Seedat et al., 2009). Furthermore, approximately half of the

injury-related fatalities within South Africa are consequent to interpersonal violence (Seedat et al., 2009). Although these findings explain the broad expression of mortality through all populations (Seedat et al., 2009) and not exclusively that of children, the link to interpersonal violence lends itself to the suspicion that children are in dire risk within home environments and that family dynamics aren't as stable as one might hope. Within the South African paediatric population, Mckerrow and Mulaudzi (2010) reported that the infant rate of mortality per 1000 is 46.1, with the under five years of age paediatric mortality rate being higher at 70.9 per 1000 within the population (Mckerrow & Mulaudzi, 2010).

From an African perspective, a prospective investigation of the prediction of child mortality at a hospital in Nigeria showed an increased risk for male children mortality and pre-school vulnerability (Adegoke & Oginni, 2011). This finding does not differ from universal proponents; however the authors stress that at present 90% of global deaths associated with injuries in children are from low-income countries.

Studies on these topics and others have produced invaluable information regarding the pathological findings, patterns of injuries, diagnostic criteria and macro-environmental influences which impose on the expression of these events. A 15 year long retrospective study on the medical, etiological and financial aspects of trauma demonstrates this initiative (Peclet et al., 1990). Their findings concluded that majority of the sample analysed produced a predominance of traffic related accidents, burns, falls and poisoning. This study highlights the circumstance of death; however within the mode of death – distinguishing of blunt and penetrating trauma is one of prominent interest in the current literature.

Recent publications on child injury fatalities in South Africa stress the prevalence of head injuries in children below five years of age. Du Toit-Prinsloo and Saayman (2014) conducted a 5 year retrospective study at the medico legal mortuary in Pretoria. Of the 107 cases analysed, 91% of head injuries where due to accidental circumstances, whilst only one case presented with findings conclusive with Non-Accidental Injury Syndrome (NAIS). This is indicative of a non-intentional circumstance of death being more dominant than intentional circumstances such as homicide. Pretorius and Van Niekerk (2014) found that burns were the most common cause of death in infancy, followed by PVAs in pre-schoolers and homicide in adolescence. This was equated through the examination of the National Injury Mortality Surveillance System (NIMSS) data of 5404 fatal injuries in Gauteng. This finding is in agreement with Herbert and colleagues in 2012 with respect to paediatric injury patterning in a hospital study. This research indicated that males were more at risk than females and traffic accidents, burns and assault were the highest circumstances of injury (Herbert et al., 2012). Similarly, Isaac and colleagues (2014) reported that road traffic injuries in children are mostly that of the pedestrian category between the ages of five and nine years of age.

With reference to public health, Ntuli and colleagues (2013) conducted research on the cause of death of children below five years of age within the Limpopo province of South Africa. The results of this research highlighted that communicable diseases and malnutrition were more common than accidental or intentional injuries (Ntuli et al., 2013). This is in keeping with the assessment of progress towards the Universal Health Coverage (UHC) in South Africa. The limitations of unequal access of the public to health care services, the shortage of health workers as well as the uneven distribution of service between sectors and geographical regions hinders the completion of this goal (Marten et al., 2014). Despite these shortcomings, an analysis for the global burden of

disease study found that there was a decline in child mortality in the sub-Saharan countries since 1990. This decline is most evident from 2000 – 2013 (Wang et al., 2014).

1.2. Macro-environmental influences on child mortality

The social, cultural and economic climate of a nation and its subsidiaries is hugely influential on the population groups that are socialized through them. For this reason, this component has been added to the chapter to provide a backdrop or foundation of understanding to the context of which the proposed study will function on. South Africa's turbulent and vivid history has left its mark on the current health care situation and social services efficiency. The 'apartheid' system and its consequences have far reaching effects on the culture we live in today. An examination on the trends and racial disparities on infant mortality in South Africa provides depth to these statements. Despite policy and governmental change, no shifts in mortality rates have been observed between that of the 'apartheid' era and now. It has been identified that the difference in personal and household resources in racial groups can equate to the differences in infant survival rates (Burgard and Treiman, 2006). Researchers found that Black infants are at high risk for mortality in South Africa. In congruence with universal trends, mothers with low education and of a poor economic level have children who are at higher risk. One query which elicits more questions than answers is that of investment. Greater investments have been made in public health – however no change (in mortality) is evident (Burgard & Treiman, 2006). This begs the questions as to whether it is too soon to see a change.

The health care system of South Africa has been impacted extensively by the historical context. The lack of policy implementation has exasperated this intricate situation (Coovadia et al., 2009). These authors highlight the current problems as being that of racial and gender discrimination, income inequalities, migrant labour, destruction of family life and the persistence of violence.

Although idealistic, suggestions were made for access to social services, an introduction to broad ranging development policy and gender equity (Coovadia et al., 2009). These observations and suggestions are mirrored in the work of Salti, as the support for the relative income hypothesis is found (Salti, 2010).

1.3 Aims and Objectives of the study

The broad objective of this study was to establish the prevalence of paediatric deaths (with age range between birth to twelve years) within a South African setting by collecting data on child fatality cases admitted to the Johannesburg Forensic Pathology Service, which serves a particular metropolitan catchment area within Johannesburg.

For the purposes of clarification of the study context, it is important to define the processes of death certification within South Africa. According to the World Health Organization (WHO), a post-mortem examination is required for all deaths suspected to be the result of external or unknown causes. Under this category, the cause of unintentional (accidental) and intentional (assault or homicide) forms of death can be termed as 'unnatural'. The opposite of this would be 'natural', whereby death occurs as a result of an illness/disease or old age as opposed to an injury or violence (Bartolomeos et al., 2012). The Johannesburg Forensic Pathology Service was utilised as the location of the study as initially its main mandate is to perform the medico-legal death investigations of all 'unnatural 'deaths within the Johannesburg jurisdiction. According to the regulations of the Forensic Pathology Services, the definition of 'unnatural' includes (amongst others) any sudden, unexpected or unknown cause of death (Regulations Regarding the Rendering of Forensic Pathology Service, 2007). The Johannesburg Forensic Pathology Service admits cases from the greater Johannesburg area which combines a variation of high income and low income residential areas and hospitals and clinics. Natural deaths are processed through the regional and

national home affairs offices and unnatural death reports are presented to the SAPS and the Courts for further judicial processes. Cases for medico-legal death investigations are admitted to the medico-legal mortuary in the jurisdiction which it serves. Following the routine post mortem examination, the Death Notification Form (DNF) is completed. This form determines the further processing and investigation of the decedent's cause and circumstance of death. As a member of the United Nations (UN), South African health systems should ideally be using the system of the International Classification of Diseases (ICD). This system advocates that the underlying cause of death in terms of mortality coding is far more import then the immediate cause of death. This determines the causal relationship which leads to the decedent's demise. Therefore it has critical value to both public health and forensic pathology avenues (Pieterse et al., 2009). However, since the Gauteng Forensic Pathology Service does not as yet have an electronic / computerised health informatics system, the ICD10 codification system has not yet been added to the documented causes of death, as determined through post mortem death investigations.

The overall aim of this study was to correlate and distinguish trends and patterns within the demographic and pathological sphere of the mortality in the paediatric population within the Johannesburg area.

The objectives of the study were to:

1. Describe the paediatric population with associated variables of age, sex, race, socio-economic status, and previous hospital admission, patterns of injury and pathology and common regions of injury seen at the JHB forensic services over a three and a half year period.

2. Determine the age range for prevalent categories of death with associated variables within the sample age range of birth to twelve years.

3. Determine the relationship between sex and the variables associated in the sample (age, race, socio-economic status, and previous hospital admission, patterns of injury and pathology and region of injury).

4. Determine the relationship of racial affinity and the variables associated in the sample.

5. Compare the police cause/circumstance of death assignment in the SAPS 180 form and post mortem examination findings.

6. Determine the association of category of death, region of injury and injury patterns and/or pathological findings within the sample

1.4 Hypothesis

The hypothesis of this study is that the prevalence and pattern of paediatric injuries within the sample deviate from those of trends noted in affluent (first world) countries and correlate with those of nations of similar socio-economic and cultural construction to South Africa.

1.5 Importance of the study

Chapter two highlights the prevalence, demographics and nature of fatal injury patterns in the population group of children. Several of the publications cited were undertaken within first world or affluent countries. As mentioned before, the South African nation is unique sociological context to study as the socio-economic climate and that of its cultural makeup is complexly diverse. Our political and inter racial relations of the past have produced a nation currently in its recuperation stage. The efforts of Baralic and colleagues as well as Saloojee and Pettifor (Baralic et al., 2010;

Saloojee & Pettifor, 2005) demonstrate how the greater macro-environment and societal constraints impact the expression of paediatric fatalities and injuries. The importance of these studies lies in findings of analogous perspectives. Focus on specific contexts and environments yields the potential of uncovering unique data and variables associated with paediatric deaths. An enquiry into the prevalence and expression of child mortality is vital in order to produce awareness and intervention programmes for different socio-economic groups. In addition to this, a movement towards diagnostic criteria that are standardized through a South African lens could assist the investigation processes of unnatural deaths in the paediatric population and more specifically that of malicious intent. The paucity of literature in the South African context cements the need for this study.

The following chapters will focus on a review of paediatric unintentional (accidental) and intentional (non-accidental) mortality, a detailed description of the data collected and methods incorporated in the study as well as a description of the results following data analysis. This paper will conclude with a discussion on the results interpreted and suggestions for future research.

Chapter 2: Child Mortality: a review of the literature

The following literature review groups' child mortality into two broad categories of accidental and non-accidental. The aspects described under them represent the frequency and prevalence of certain injury patterns. This does not preclude one form of injury from being associated with that of another category. In addition to this, a separate division has been created to describe research within the avenues of procedure related deaths, natural (illness related) deaths, macro environmental factors and psychological considerations.

2.1 Accidental fatal injury

According to Wecht and Larkin cited in Mason (1989), the paediatric group suffers from more accidental deaths than all other caused combined. This trend appears to be stagnant as Imamura et al., (2012) provide an overview of the most prevalent unintentional injuries which cause childhood mortality. Through their review of relevant published literature, these authors were able to surmise that road traffic accidents, followed by drowning and falls were universally prevalent (Imamura et al., 2012). As stressed by the previous authors, several of the reviews and studies within the field of paediatric accidental fatalities have been done in affluent, high income countries. However, the study by Hyder et al., (2008) provides clarity to the complex issue of road traffic fatalities within poorer nations. In their research on road traffic accidents in urban Africa and Asia, the authors' findings concluded that children compose of a large proportion of pedestrian road traffic victims (Hyder, et al., 2008). This is suggestive that the prevalence of road traffic fatalities operates independently from economic constraint or influence.

2.1.1 Road traffic injury patterns

The 1989 study by Derlet et al., (1989) highlighted the high incident rate of head and distal extremity injuries in paediatric pedestrian accidents (Derlet et al., 1989). In pedestrian traffic fatalities, young children are impacted by cars larger than themselves and in these circumstances, the point of contact is higher and thus the victim's body regions will possibly make contact with more of the vehicle. Injuries in these scenarios produce a pattern of pelvis, abdomen, chest and head injuries (Shepherd & Simpson, 2003). Serre et al., (2010) demonstrate the relationship of a child's anthropometry to impact point in pedestrian vehicle accidents. Through experiments with three different vehicle types – namely a car, utility vehicle and light truck, differences within the impact trajectory were discovered. It is clear from this research that head impact with the 'hood' or bonnet of the vehicle is imminent (Serre et al., 2010). A study on the traffic injuries of pedestrians, cyclists and motor vehicle occupants provides a broader spectrum of injuries to pattern (Töro et al., 2005). Though this study was designed on an adult sample, patterns within the different groups are most instructive. Toro et al., (2005) found that pedestrians suffered explicitly from skull fractures, epidural haemorrhages, subdural haemorrhages, brain contusions and injuries to the extremities. Motor vehicle occupants suffered from thoracic and abdominal injuries (Töro et al., 2005).

The findings by Hyder et al., (2008) can be supported by the population based study conducted by Diamond et al., (2009). The phenomenon of blunt and penetrating trauma within the paediatric population is explored here. Previous literature can surmise the findings of these authors as 68% of their sample were characterised as traffic accident fatalities (Diamond et al., 2009). The main type of trauma in traffic accidents is that of blunt force trauma. Similarly, the work of Peclet et al.,

(1990) mirrors the above as traffic related injuries accorded for a large proportion of their sample size (Peclet et al., 1990).

Saukko & Knight (2004) discuss the importance of seatbelt use for young children as they are particularly vulnerable within a vehicle collision (Saukko & Knight, 2004). Although intended as a protective measure, seatbelts have been shown to cause injuries to the liver, spleen, kidney and mesentery (Tso et al., 1993). The types of injuries presented in this finding included contusions and lacerations. Conclusive with previous literature (Shkrum & Ramsay, 2007; Saukko & Knight, 2004; Shepherd & Simpson, 2003), associated injuries with that of seatbelt syndrome include that of head, chest, vertebral, pelvic and orthopaedic injuries. Interestingly and rarely seen in the literature is the presentation of abdominal thoracic aortic injuries resulting from blunt force trauma and more specifically that of road traffic accidents. Choit et al., (2006) describe three cases of this phenomenon and note its prevalence with chance fractures (Choit et al., 2006). With respects to developmental age parameters – a retrospective analysis produced some categorical information about the circumstance of child mortality and its relationship to life experiences. Infants and toddlers were found to die more from thermal injuries and poisoning incidents than that of school age children, whom suffered fatalities of road traffic accidents, drowning and falls (Kanchan et al., 2009).

In terms of vehicle occupant injuries, through the utilization of a multidisciplinary crash reconstruction network (CIREN), severe paediatric injuries were examined through the variables of seat location, directionality of impact and velocity of impact. In sum, lateral-impact crashes lead to more injuries in the head and thorax area as compared to those from a front-impact direction. However in contrast the injury severity scale was higher for those sitting in front-seat positions (Brown et al., 2006). This increase in severity reiterates the importance of restraining infants and

children within the back seats of vehicles. Studies such as these stress the importance for enquiry in not only the general patterns of injury from road traffic accidents but the consideration of variables of biomechanics, directionality and velocity to be included in research designs in the transportation of children.

2.1.2 Drowning injury patterns

Despite the difficulties of proving drowning at post mortem, there are some characteristics which are universally recognized at autopsy. Classically these are a plume of froth at the mouth or nostrils, internal froth in the trachea and bronchi and pulmonary oedema in the lungs (Shepherd & Simpson, 2003). Children under the age of five are at particular risk of drowning. With underdeveloped motor skills and balance, they can't extricate themselves from a dangerous situation (Shkrum & Ramsay, 2007). For these reasons, drowning is a serious and prudent issue which requires inspection. In a review of the epidemiology and pathophysiological features of drowning, the incident of drowning was stated to be one of the leading causes of accidental death in children of industrialized countries despite prevention programmes (Salomez & Vincent, 2004). An additional feature to the ones described above is that of conjunctival and periorbital petechial haemorrhages in paediatric accidental drowning. Although not well documented, the presence of these manifestations provides insight and broadens the options for diagnostic purposes. Through a retrospective study of autopsies from the last 20 years in Toronto, Canada – researchers provided a characteristic list of features which has value in protocol proceedings. Researchers surmised the manifestation of petechial haemorrhages in the conjunctivae and periorbital region (13% incidence) as well as in the mucosa of the oral airway and thoracic viscera (28 % incidence) to be indicative of a drowning mechanism. Common features of a frothy exudate in the upper airway,

pleural effusions and increased lung weights added to the typical expected autopsy (Somers et al., 2008).

2.1.3 Fall from heights injury patterns

Falling from a height is a common fatality circumstance in children. Sometimes a fall from height situation could be due to the compulsion for suicide, but this is rare. Saukko & Knight (2004) describe the primary impact sites in falls. They state that depending on the point of impact, there may be a multitude of injury patterns and this can be variable. Most prevalent of these involve skull fractures, intracranial damage, vertebral and spinal damage and fractures to the long bones of the body (Saukko & Knight, 2004). The transmission of forces additionally results in fractures of sites of non-impact. For example, in a fall from height, the fall can end at the point of impact of the skull or the feet, and in both situations this can result in a ring fracture at the base of the skull around the foramen magnum. Saukko & Knight (2004) further emphasize the forensic importance of skull fractures in children as the interpretation of such fractures is complex and the delineation of either an accidental or non-accidental injury will be dependent on relevant information and the collateral history of the event (Shepherd & Simpson, 2003). It should be noted that the weight of children and their bony development will influence the mechanisms and injury patterns seen when compared to adult individuals (Shepherd & Simpson, 2003).

The developmental age of a child/ infant and the associated neurodevelopment of the brain and its associated cranial vault bones may influence the expression of skull fractures. Ibrahim et al., (2012) explored the influence of fall type and age on head injuries in a retrospective study. Primary findings highlighted that in low or immediate falls from heights, infants sustained more skull fractures then their older counterparts. Toddlers who fell from a low height sustained brain injury without associated external trauma (Ibrahim et al., 2012). This work reinforces previous

controversy and complexity in the literature relating to skull fractures in young children. The authors further stress that the presence of external trauma doesn't always correlate with intracranial injury. Although the brain and cranium has the advantage of flexibility and plasticity, children are still vulnerable and defenceless with relation to protective physical and skeletal mechanisms.

2.1.4 Thermal injuries

The physiological mechanisms of death in burns are complex. The interplay of effects of heat on the respiratory tract leading to asphyxia, the toxic effects of the carbon monoxide, cyanide and other noxious gases combined with the release of toxic material (Shepherd & Simpson, 2003) produce a lethal combination. Highly associated with burn and electrocution fatalities, ante-mortem injuries are extensive in forensic settings. Dominant ante-mortem injuries present in these circumstances are those of strangulation and penetrating injury (Shepherd & Simpson, 2003). In Peck's (2011) introduction on the epidemiology of burns, 'injury' is cited as a leading cause of death and disability in low-intermediate income countries. A component of injury is that of burns. Peck's investigation states that burn mortality worldwide has declined. However, the individual characteristics of a nation as well as the social, cultural and economic status of the country influences the trends in injury related deaths (Peck, 2011). This claim could not hold more conviction than a publication of Blom et al., (2011) who conducted a study of the epidemiology of fatal burns through a mortuary register study in Mpumalanga, a province of South Africa. Blom et al., (2011) found that fatal burns were more common in urban areas and groups of some older individuals and children were at greatest risk. In agreement with Peck (2011), these burn fatalities appear to be directly related to low income living conditions and lifestyles (Blom et al., 2011). The influence of socio-economic factors is not exclusive to South Africa; Edelman (2007) highlights the risk of burn injury within this sphere. "At risk" factors identified included "non-

Europeans'', poverty, family patterns of single parents and large families, a low educational base, low employment rates and poor living conditions (Edelman, 2007). Burns are consistently listed as among the top ten causes of injury in children younger than five. The above influences and risk factors are not rare or recent trends in the literature. The work of Mason (1989) reiterates the above findings as children under the age of five are the most vulnerable particularly when low socio-economic variables are prevalent. As instructive as these factors are, variations between nations are surely expected. These results should operate as a foundation to studies on the socio-cultural influences of injury in children.

Although, burn fatalities are more closely related with accidental injury, it is imperative to note that the opposite is still likely, with some intentional burn injuries inflicted by so-called care givers. Pelter et al., (2001) outlined the injury patterns within paediatric burns. A trend has emerged here in the differentiation of intentional (care-giver) and accidental burn injuries. The authors define burns such as immersion and inflicted burns as indicative of intentional abuse and harm by care-givers. Immersion burns are often the result of water being used as a form of punishment or for homicidal reasons. These burns are defined and distinct in pattern with "sharply defined waterlines" (Pelter et al., 2001, p.6). Inflicted "dry" burns are usually patterned and imposed as a form of 'branding'. Distinctions such as these assist in the process of categorisation and identification in investigations.

Within the avenue of intentional burns, children are at the forefront of likely victims. Perpetrators are care-givers like parents, guardians, siblings or partners of the parent. Within this realm, fatalities are not always the outcome and inflicted burn wounds of this nature in various stages of healing and scarring are indicative of long term abuse. The mechanisms perpetrators use to inflict injury range from scalds, contact and or electrical and chemical materials (Greenbaum et al., 2004).

Electrocution is another form of localised thermal injury. 'Sudden death following an electrical shock is most often attributable to ventricular fibrillation' (Bailey et al., 2001, p. 58). As a form of accidental injury, electrocution can be prevented, as many fatalities are the result of misuse and improper maintenance of equipment (Bailey et al., 2001). Through the category of death is included here under thermal origins, the mechanism of death is in most cases that of cardiac arrhythmia. Children are at particular risk of fatalities of this nature when poor supervision is practiced and home environments aren't child friendly.

2.2 Non-accidental fatal injury

Non-Accidental Injury Syndrome (NAIS) is a term that is used interchangeably with that of "inflicted child injury" and "child abuse". McDonald (2007) lists a number of "diagnostic" injuries as potential child abuse indicators. Criteria include posterior rib fractures, retinal haemorrhages, complex skull fractures in infants and long bone fractures. Van As & Garach (2008) also cite these criteria in addition to findings of femur fractures in infants. Among the case studies the trend of distal femur and transverse fractures were apparent. Concerning oro-facial trauma, Phillips & Van de Heyde (2006) provide further insight into child abuse fatalities. They list the characteristics of bruised and/or lacerated lips, torn frenula, bruised alveolar mucosa and avulsed teeth, all of which are suggestive of child abuse. These authors also reiterate several other findings with respect to the main causes of death in child abuse cases. Head trauma, blunt abdominal trauma, burns, multiple injuries and strangulation were attributed as leading causes of fatalities.

Bernard Knight in Mason (1989) describes key features which clearly distinguish the manner of death from accidental to malicious or inflicted. He stresses the meticulous identification of the following in an autopsy setting. Firstly injuries of the lips and mouth; contusions, lacerations and abrasions (all forms of kinetic injury impact) should be noted. On examination of the eyes –

intraocular damage consisting of vitreous and retinal haemorrhage is extremely indicative. Petechiae on the eyelids, conjunctivae and sclerae should be ruled out, as these could be suggestive of neck injuries. Of critical importance in the post mortem examinations of any suspected child abuse fatalities, is the performance of a full skeletal radiological survey (more commonly known as a "babygram") to be performed prior to the medico-legal autopsy by relevant experts. Concerning skin bruises – a pattern of new and old bruises that are prominent on areas of the body not 'developmentally' exposed to the elements and accidental injury, must be included for investigation (Mason, 1989). The above features are universally accepted in the literature. In addition to Knight, another text highlights and scaffolds on the introductory features. Child abuse fatalities are more common in children under the age of two years (Shepherd & Simpson, 2003). Table 1 below is an adapted summary from Simpson's Forensic Medicine, 12th edition (2003) which defines which injuries are indicative of physical child abuse.

It must be stressed that within the investigation of such occurrences, additional information besides that of the forensic evidence present at post mortem examination for suspected non-accidental injury syndrome needs to be examined. The medical history of the child as well as collateral information from parents and primary caregivers regarding the circumstances of death is of vital importance. Spitz and Fishers (2006) reiterate this by stressing the importance of the circumstance or history of the injury patterning in conjunction with inconsistencies in care givers and parents account of events leading up to injury. The child abuse workup devised by the authors is an all-inclusive guideline for investigations into suspected NAIS. This criterion is in agreement with the authors reviewed in this chapter and indicates a universality of opinion and characteristics when diagnosing child abuse fatalities.

Table 1 Non- accidental injury syndrome types and affected areas

Type of Injury	Affected area/Pattern
Bruising	Face, ears, lips, neck, upper arms, lateral thorax, anterior abdomen, buttocks and thighs
Skeletal Injury	Recent fractures of the skull, ribs and limbs. Old fractures represented by callus formation, sub periosteal calcification in old haematomas, slipped epiphyses and metaphyseal damage
Head Injuries	Subdural haemorrhages, cerebral trauma, axonal damage
Ocular Injuries	Eye lesions of retinal haemorrhages, vitreous haemorrhage, dislocated lens or detached retina
Oral Injuries	Bruises, lacerations, torn frenulum
Visceral Injuries	Rupturing and intra peritoneal bleeding of the intestine, liver and mesentery.
Other injuries	Burns and bites.

(Adapted from Shepherd and Simpson (2003), pages 146-149).

In addition to the above, the following is an exploration of the data available concerning the non-accidental injury syndrome and the injury patterns associated with it.

2.2.1 Bruising patterns

In a 1985 study on injury variables, the most significant injury type documented from a sample of 616 child abuse reports was that of bruising (Johnson & Showers, 1985). Bruising appears to be prevalent in child abuse cases and is indicative of chronic, long term physical harm. Saukko & Knight (2004) describe surface bruising and identify key sites for bruising as that of around the limbs, wrist, forearms an upper arms as the perpetrator utilizes these sites for gripping the child. Bruising via beating, using a strap or by hand on the buttocks is also common. Bruises on the chest, abdomen and neck are usually caused by finger pressure (Saukko & Knight, 2004).

Bruising in particular areas on children has been a subject of much debate and controversy. Carpenter (1999) provides insight into a point of discrimination between accidental and intentional

patterns of abuse – emphasizing bruising on the trunk and cheeks as indicative of abuse, whereas bruising on the bony prominences on the body suggests an accidental history. One topic within that of bruising is that of perception. Munang et al., (2002) claim that there is large variation in how people perceive the colouring of bruising and thus the age of the bruise and the severity of injury. This variation in perception can obviously lead to misclassification and the subsequent interpretation of the injuries. Thus, some movement towards standardization is of great import. The evaluation of external bruising as well as its prevalence and associated injuries has been one of interest in the literature. Through the retrospective analysis of twenty four cases of fatal child abuse, researchers aimed to understand the association of fatal head injury with that of external 'gripping' bruises. Results of the study proved to be inconclusive – providing insight into the fact that external bruising is not definitely associated with that of head injury and more specifically that of subdural haemorrhage. Interestingly though, the authors did hypothesize that external bruising when present could be a product of punches and slaps and not that of gripping (Atwal et al.,1998). However, suspicious bruising patterns of vary ages, seen in conjunction with previously mentioned "diagnostic" or typical injuries must raise a high index of suspicion during the post mortem examination.

2.2.2 Head injury patterns

Kotze et al., (2007) reviewed fatal child abuse cases within the South African context and uncovered a pattern within the sample selected. The majority of these cases were female, there was an even distribution concerning race and no malnutrition was evident. In this finding, head injury was the most common cause of death. Technically a skeletal injury, skull fractures have a close association with that of intracranial damage in child abuse fatalities. Skull fractures have a controversial and complex nature. However, there are some patterns or characteristics which assist

diagnostic and judicial processes. The most common skull fracture suggestive of child abuse lies in the occipito-parietal area. It is increasingly difficult to differentiate between this fracture as a consequence of for example a fall from height and that of child abuse (Saukko & Knight, 2004). For this reason, each individual case needs to be evaluated in its exclusivity and independent characteristics. A constellation of key features and the history of the individual influence the suspicion of non-accidental injury syndrome. The authors stress that there is a large amount controversy in the literature on paediatric skull fractures. This controversy is possibly due to the contradictory factors and reactions of the developing skull to blunt force. Two opposing factors operate on the skull. Firstly, because the skull is thinner, less force is required for fracturing. However, the elasticity and 'springiness' of the skull lends to a greater recovery from distortion caused by impact (Saukko & Knight, 2004). These contradictory adaptations have caused a lack of consensus in the literature, resulting in ambiguity. This subject matter and dilemma is shared by that of Simpson & Shepherd (2003). The topic of skull fractures will be discussed in further detail later in the chapter.

Matschke et al., (2009) concluded that subdural bleeding in infants under the age of one is highly indicative of non-accidental injury (Matschke et al., 2009). These researchers discredited the unified theory that bleeding is caused by hypoxia and swelling instead of traumatic axonal tearing. Through their analysis, subdural bleeding was found in 82.4% of non-accidental head injury cases. Subdural haematomas are a common type of fatal injury in accidental and non-accidental childhood deaths. A retrospective review of children under the age of two, revealed that subdural haematomas are strongly suggestive of non-accidental injury syndrome (Tzioumi & Oates, 1998). The authors' aim was to formulate some consensus on the prevalence and frequency of subdural haematomas in accidental and inflicted injury. Child abuse presented as the most likely of

candidates. The presence of subdural haemorrhage is not exclusively bound to non-accidental injury. Researchers examining the histology of intracranial and subdural haemorrhages in the autopsies of fifty paediatric cases in which there were no head injury-related fatalities, lead to the hypotheses of a physiological aetiology and not that of trauma (Geddes & Whitwell, 2004).

2.2.3 Shaken baby syndrome

A topic of intense interest and controversy both within the sphere of pathology and that of socio-cultural interventions encompasses the topic of shaken baby syndrome. Bandak (2005) provides a comprehensive history of the initiation of the term 'shaken baby syndrome' into clinical literature. The typical pattern of behaviour in this syndrome is that of vigorous shaking of an infant in frustration which often concludes with the infant being thrown and head impact ensuing (Shepherd & Simpson, 2003). The acceleration-deceleration motion of 'shaking a baby' vigorously results in the presence of retinal haemorrhages. It is widely accepted today that an infant presenting with an acute subdural hematoma (ASDH) and retinal haemorrhages together with an incongruent biomechanical history is commonly diagnosed with SBS (Shaken Baby Syndrome) (Bandak, 2005). Bandak's investigation into the biomechanics of this injury type provided results which are encouraging for the understanding of the causation effect of this syndrome.

The violence and repercussions of these actions were confirmed by Adamsbaum et al., (2010). The authors in this forensic study compared cases of perpetrator-confessed 'shaking' head trauma with those of non-confessed cases. Interestingly, there were no significant statistical differences between the variables of the two groups and these findings hint at the hypothesis that clearly defined characteristics can be employed to refute and question perpetrators denials of 'shaking'. Through a review of the previous literature regarding the topic, Leestma (2005) examined the cases of brain injured shaken infants. Through this sample, it was discerned that the majority of the cases

represented a pattern of denial by perpetrators. The shaking was imputed, suspected and determined via forensic means (Leestma, 2005).

Infants who have fallen prey to the circumstance of shaken baby syndrome are subject to a high rate of mortality and morbidity. Even if the outcome isn't death, the clinical survivor prognosis isn't encouraging. A study examining the outcome of these occurrences found that demographically, male infants under the ages of 6 months are at extreme risk (King et al., 2003). Additionally, 55% of the sample had neurological injury and 65% exhibited visual impairment as clinical consequences. Not surprisingly, a large amount of the infants had medical histories congruent with child maltreatment.

2.2.4 Skeletal injury patterns

The literature on skeletal injury is extensive. Major research has been invested in understanding the presentation, patterns, epidemiology and types of fractures prevalent and congruent with that of child abuse and/ or 'battered child syndrome'. Several authors have composed categorisation systems for diagnostic purposes based on the frequency of occurrence and severity of injury. High specificity for child abuse related fractures include metaphyseal lesions, posterior rib fractures, scapular fractures, spinous process fractures and sternal fractures (Bandyopadhyay & Yen, 2002). Authors such as Mason (1989) and Shepherd and Simpson (2003) have formulated similar systems. One of the suspicious indicators to look for in the examination of a suspected child abuse case is the presence of 'old' fractures or injuries. Ross et al., (2009) aimed to examine the bony injuries of fatalities of child maltreatment victims. One of their main objectives was to discern the prevalence of ante-mortem and peri-mortem fractures in their sample. The authors established that the majority of deaths were those of black, male children, with infants under the age of 9 months being at greatest risk. Consistent with previous studies, the craniofacial areas of the body proved

to be the most frequently fatally injured regions (Ross et al., 2009) . These findings represent a positive correlation with research on skeletal injuries in NAI-related child deaths. However, the vast majority of the sample did not show any ante-mortem and peri-mortem fractures. The authors contend that the lack of fracture presentation is possibly due to the vascularity and osteogenic activity of children's bones (Ross et al., 2009), resulting in rapid healing and remodelling of older fractures. The healing rate of young children's bones is directly related to age. This explanation is consistent with that of Mason (1989); Shepherd & Simpson (2004) and Saukko &Knight (2003).

It is well versed that younger children are the most vulnerable to head injury and skull fractures. Among these, depressed and linear fractures are significantly common. The pattern of injury in older children is not as prominent or clearly defined in the literature (Lee et al., 2003). Authors examined the cases of three children aged 11, 9 and 7. The weapon utilized in these cases to inflict these depressed fractures was a hammer. This caused serious blunt force injury, however, the children survived (Lee et al., 2003). Circumstances such as these closely resemble that of attempted murder. In another clinical paper by Skellern et al., (2000) examined non-accidental fractures and the risk for fatal abuse in younger infants. In agreement with the previously discussed literature, infants under the age of one are at extremely high risk for abuse. Infants under the age of four months are especially vulnerable to fractures and surprisingly, the implementation of intervention did not quell the risk of further abuse (Skellern et al., 2000). Another common site for fractures in maltreatment is that of the chest and ribs. The predictive validity of rib fractures in non-accidental trauma was tested by Barsness et al., 2003) over a six year period, where the medical records of children with rib fractures were reviewed as inclusion data. The results produced a factorial that in children younger than three, rib fractures have 95% positive predictive value for non-accidental trauma (Barsness et al., 2003). A rare manifestation is that of

costochondral junction fracture. It is accepted that rib fractures in younger children are strongly associated with child abuse; however fractures of the costochondral junction are under described. In a case based enquiry on intra-abdominal trauma, these under scored fractures were noted as similar in appearance to that of metaphyseal fractures of the long bones (Hall & Ng, 1998).

2.2.5 Imaging of skeletal injuries

Radiology and its proponents are an indispensable discipline to the investigation process of non-accidental injury patterns in children as observed in the work of Rao & Carty (1999). Typical patterns of skeletal fractures have emerged. In addition to the above literature, specific sites and diagnostics have been specialized. A review of radiology by Rao & Carty (1999) included not only skeletal injuries but also the associated soft tissue injuries in non-accidental injury in children. Highlighted are those of subdural haemorrhages and hypoxic ischaemic encephalopathy in head injuries and rare thoracic and abdominal injuries (Rao & Carty, 1999). The process of a skeletal survey is imperative when child abuse is suspected (Kraft, 2011). Kraft's (2011) review of the radiological processes include radiation dose, which population group should be imaged and other modalities of imaging. Descriptions of fracture sites and types are also discussed. These descriptions are within the range of consensus with literature previously discussed in this chapter. In sum, the primary radiological findings describe that children 18 months and younger often present with fractures of Non-Accidental Injury (NAI) in 80% of occurrences. In contrast, children over the age of five commonly suffer from accident related fractures.

The predictive value of living and post-mortem skeletal surveys were recently questioned (Hughes-Roberts et al., 2012). Skeletal surveys are widely utilized as standard practice in radiology to discern the presence of accidental or non-accidental fracture patterns. Through this retrospective review of skeletal surveys, researchers found a higher prevalence of younger children

in post-mortem surveys when compared to that of living patients. It is stressed by the authors that obtaining a clear post mortem image in surveys is problematic as post-mortem artefacts compound the representation. Thus caution needs be practiced when interpretation and diagnostics are made relating to this material (Hughes-Roberts et al., 2012). These findings have tremendous ramifications for the field of forensic paediatric radiology and anthropology. However, if the full skeletal radiological survey is performed by experts prior to autopsy related artefacts being introduced, it remains an invaluable tool in recognising prior, old, healing or fresh fractures and thus remains a gold-standard investigation which must be performed prior to autopsy in all suspected NAIS- related child deaths.

Table 2 below (adapted from Kraft, 2011) indicates a skeletal survey for suspected non-accidental injuries in children.

Table 2 The standard radiological procedure for children of suspected non-accidental injury

SKULL
Anterior posterior (AP), lateral and Townes view

CHEST
AP view including clavicles
Oblique views of both of the sides of the chest to show ribs

ABDOMEN
AP view of the abdomen including pelvis and hips
Spine
Lateral view of the cervical, thoracic and thoracic-lumbar regions
AP projections of the spine are included on the AP projection of the: chest and abdomen and limbs
AP view of both arms
AP view of both forearms
AP view of both femurs
AP view of both legs
Posterior-anterior view of both hands
Dorso-palmar view of both feet

(Adapted from Kraft, 2011, p. 110).

2.2.6 Child abuse fatalities

Fatal child abuse is considered a homicidal death. Homicide is defined as a death at the hand of another human being (Vellema, pers. comm., 2013). Key demographic characteristics place infants at risk of abuse and possible death at the hand of their care-givers. These 'circumstances' include risk factors such as a younger than average mother (15 to 17years), a mother with low education as well as a mother who did not benefit from prenatal care (Overpeck et al., 2006). Findings by Fujiward et al., (2009) and Bennett et al., (2006) agree with that of Overpeck et al., (2006). Clearly, there is a preoccupation with identifying key at risk factors which lead to the non-accidental death of children. For the objective of formulating prevention and intervention programmes, studies of

this design are of grave importance. In terms of mentality and stability of caregivers, psychiatric disorders have been found to be indicative of neonaticide cases, although in many cases the perpetrator of such cases is found to be a male relative or permanent male resident (Spinelli, 2001).

Though family structure and dynamic is indicative of intentional injury, it seems to have a generalized effect in unintentional or accidental injury fatality categories. In a comparison of family structure and the influence of a step parent on risk factors for unintentional fatalities, researchers discovered that the effect of not living with either of one's biological parents is the greatest risk of injury (Tooley et al., 2006). These trends provide insight into the complex nature of childhood mortality. The definitive lack of a 'stable' family structure and/ or an absence of emotive attachment to one's blood relation sets a precise precedence for a disrupted and troubled life and more important, a serious disadvantage to survival.

2.2.7 Asphyxia related deaths

Simpson & Shepherd (2003) clearly define asphyxia in a forensic context as the obstruction or physical barrier to access of air to the lungs. This text describes classical (but not diagnostic) features of asphyxia, which include congestion of the face, oedema of the face, cyanosis (blueness) of the skin of the face and petechial haemorrhages in the skin of the face and eyes. Drowning and thermal injury are also forms of asphyxia. Gilliland et al., (1994) claim that the presentation of retinal haemorrhages can be found in asphyxia and blunt force trauma. However for the purposes of this chapter, we will be covering the topics of strangulation and smothering. In an exploration of the largely unexplained and unstudied paediatric strangulation, the gender bias seemed to have reversed as in the Indian sample in Verma's study. Here, female victims were more prominent. The majority of victims were in the age range of eight to twelve. Ligature methods were found to be dominant in the causation of death. These were found to be largely homicidal in occurrence,

with accidents in the vast minority (Verma, 2007). Strangulation fatalities in childhood accidents are rare. On the playground, strangulation injuries are expected however fatalities are uncommon – there is only one such report in the literature. Researchers examined the case of one such playground fatality (Sep & Thies, 2007). The rarity of the occurrence leaves clinicians and investigations at a disadvantage. Further research and training is needed to deal with these serious injuries which could easy escalate to fatalities.

Indicative findings at autopsy concerning smothering comprise of injuries such as bruises on the lips and gums, around the neck and part of the neck. Pressure marks at the back of the neck, upper chest and arms are also often encountered. Nail marks around face and neck and foreign material stuffed into nose and throat are also congruent. Very fine petechiae of the face, especially the eyelids is also common (Banaschak et al., 2003). The developmental age of a child allows for a certain measure of autonomy and independence to arise. With independence comes the ability to defend oneself. The ability to fend for oneself as a vulnerable and defenceless infant is inconceivable. Morphological and external findings in cases of smothering can be diagnostic and assist in the investigation process. Researchers studied the cases of six smothered children between the ages of one and seven years and this revealed that an increase in external defence-type injuries such as abrasions and petechiae were evident in older children (Banaschak et al., 2003).

2.2.8 Penetrating trauma

Paediatric firearm fatalities represent a small sample of the population. However, certain studies have been able to successfully highlight important variables and characteristics which were also found to be evident in the work of Beaver et al., (1990). Here the ratio of male to female victims was significantly dominant. Over a retrospective evaluation of nine years, 132 cases of gunshot trauma were reviewed. In comparison, 101 males and 31 females were documented. The racial

distribution was relatively even, except for four additional cases for the Black population affinity. Interestingly, a common trend emerged where several of the perpetrators were a family member or a friend of the victim. The home environment served as a common site for the firearm fatalities (Beaver et al., 1990). These findings positively correlate with the parameters and descriptors reported in the review of non-accidental injury. Firearm injuries are sometimes accidental and more commonly so in a paediatric population, where awareness of dangers of handling firearms and consequences of firearm-related injuries may be lacking. Each nation is heterogeneous in its portrayal of injury fatalities and its associates. Arslan et al., (2002) retrospectively evaluated 27 fractures in 22 children who had suffered from gunshot wounds. This study reported that the majority of the children treated were older than six years of age. The firearm used was noted as a high velocity weapon in a significant amount of cases and the key sites included that of the tibia, femur, humerus, pelvis and acetabulum.

2.3 Procedure related (anaesthetic) deaths

According to the text by Saukko and Knight (2004, p.480), "Deaths which occur during or within a short time after surgical operation, invasive diagnostic procedure or an anaesthetic, become the subject of a medico legal investigation". In South Africa, the Health Professions Amendment Act 2007 (Act No.29 of 2007) defines clearly which procedure-related deaths require medico-legal autopsies and subsequent Inquest Court investigations. These are often difficult autopsies and inquiries due to the consequences and artefacts of surgery i.e. hard to allocate and identify sutures due to autolysis and decomposition of the body, distortion of normal anatomy, oedema and haemorrhage (Saukko & Knight, 2004). Within the South African legal framework, the investigation of a procedure related death has no fixed time restriction between surgical procedure and death, for a medico-legal autopsy to be undertaken. Causes and mechanisms of death are often

multifactorial and clinical management errors are difficult to assess (Moar, 1996). Lourens (2006) provides a concise description of the widely ranging possible causes of death in procedure related deaths including those due to hypersensitivity reactions, complications of blood transfusion and poor postoperative care.

The above descriptions highlight the need that a multifactorial approach as well as an assessment of quality control be adopted in procedure related fatality investigations and Inquests. When reviewing the literature connected to procedure related paediatric fatalities, consistencies arose in topics relating to congenital heart disease and paediatric tracheotomy outcomes. The following is a brief overview of publications sourced.

The efficiency and technique of congenital heart surgery is a topic of advanced and sophisticated debate in the literature. Considering birth defects, those of the heart are responsible for more deaths in the first year of life than any other (Hewitson & Decker, 2011). The authors' overview a multitude of surgical interventions and stress that access to paediatric surgical services is paramount in producing a satisfactory long term outcome. Additionally, they argue that palliative surgery is an assurance of survival until the patient is at an age where definitive surgery is more plausible (Hewitson & Decker, 2011).When reviewing the challenges of combating the prevalence of heart disease in children, Hewitson and Zilla (2010) articulate that unlike infectious diseases, congenital heart defects are prevalent internationally and not susceptible to socio-economic trends, however South African health services is underservicing this condition and population (Hewitson & Zilla, 2010). The current level of state services provides an unstable foundation and setting for advances in paediatric surgery. Researchers in Finland conducted a retrospective review of late death after paediatric cardiac surgery. Findings indicated that the majority of deaths were due to heart failure and lack of perioperative care (Nieminen et al., 2007). Reviews such as these illustrate

the importance of the relationship between individual case presentation and the operative strategies employed.

The perioperative and postoperative care and preparation of premature and young patients which require surgical interventions as treatment demands specialized skills and administration of anaesthesia (Spear, 1992). Risk factors such as an infant less than 36 gestational weeks and patients undergoing cardiovascular and neurosurgical procedure influence the future complications or resultant mortality in these cases (Weinberg et al., 2011). Positive outcomes of these procedures have become more prevalent in western and socio-economic countries due to advances in surgical procedures and perioperative care (Hastings & Bushman, 2006).

The current climate of paediatric procedure-related deaths at the Johannesburg Forensic Pathology Service centres on fatalities due to complex congenital heart abnormalities in premature infants (Vellema and Nel, pers. Comm., 2013) and non-accidental or accidental post-traumatic lifesaving procedure-related fatalities.

2.4. Natural (illness related) deaths

Illness related fatalities in early development are especially prominent in the African countries. This trend is congruent with that of developing countries, as argued by Saloojee and Pettifor. The consistency in the nature and number of these fatalities depend on the low standard of potable water, sanitation utilities and electricity. Due to improvements in these services, the decline in communicable diseases is encouraging. However, the majority of child mortality and morbidity in developing countries remains to be a consequence of illnesses and infection (Saloojee & Pettifor, 2005). The work of Andrews and colleagues reiterates these findings, as children under the age of five are at risk of natural death. As stressed by the authors, these deaths could be prevented through

interventions in improving basic needs such as water, sanitation and immunizations against infections (Andrews et al., 2008). Globally, the interaction between the political and social context of societies and the level of public health is intimately intertwined and dependent on the countries socioeconomic development and integration into the global economy. This claim by Andrews and colleagues is positively correlated with previous literature (Saloojee & Pettifor, 2005; Williams et al., 2002).

In an alternate vein, Guildea and colleagues posit that the risk of mortality within the first year of life is higher in urbanized areas as opposed to rural living situations. The authors of this study in the United Kingdom found that infants developing in industrialized areas and cities are at a far greater risk for infection than neonates and infants in country environments (Guildea et al., 2005). Despite the lack of basic resources and the interventions which have been implemented by global institutions, communicable and infectious diseases remain a constant threat to juveniles. Three themes which possible explain this persistent reality were identified by Colvin et al., 2003. The cultural, religious and societal constraints on a family environment impact significantly on the treatment outcome and prognosis of a patient. This statement adds an evaluative quality to the findings by Colvin and colleagues. The themes of how a household understands illnesses, recognition and response to the illness and how the household acts to prevent and seek out treatment were dominant in this study (Colvin et al., 2013). This systematic review and framework illuminates the great influence which ethnic and cultural beliefs, psychology as well as education has on the health of children in Sub-Saharan Africa. South Africa is currently bridging the difference between that of developing country and that of first world. Even so, the top three most common causes of child mortality in South Africa are pneumonia (17.3%), septicaemia (14.5%)

and diarrhoea (12.3%) (McKerrow & Mulaudzi, 2010), which are all entirely preventable and treatable illnesses in first world settings.

2.5 Conclusion

The effects of the macro-environment as well as that of culture and individuality operate strongly on the survival outcomes of the paediatric population group. The above review has attempted to clarify accidental and non-accidental fatal injury. Additionally, components of procedure-related and natural fatalities were described. These attempts might have been pursued with idealism and naivety, as from the literature, we can account that child mortality and its epidemiology, influences, diagnostics and key agents are intertwined and operate on a causation model which is dependent on a multitude of variables.

These variables include exclusive and unique circumstances and biological makeup. On an optimistic note, headway has been made in relation to the topic of child abuse and the vast international literature connected to it. The accidental circumstances of road traffic fatalities with reference to the biomechanics of such occurrences are furiously studied and paediatric fracture sites have served the role of diagnostics superbly. Despite these universal trends, South Africa is a uniquely multicultural country with its own dynamics and representations. A need for local standards, characteristics of injury patterns and their circumstances and diagnostic criteria in the investigation of unnatural childhood deaths is paramount.

For these reasons, the purpose of this study was to examine the prevalence and injury patterns of paediatric fatalities from the catchment area of the Johannesburg Forensic Pathology Service medico-legal mortuary.

Chapter 3 Materials and Methods

3.1 Methodological framework

The overall aim of this study was to correlate and distinguish trends and patterns within the demographic and pathological sphere of paediatric deaths (birth to 12 years) that will hopefully encourage the production of awareness and future intervention programmes within different social economic groups of South Africa. The design of this study took on that of an open descriptive retrospective review.

The Johannesburg Forensic Pathology Service (JFPS) was used as particular catchment area for data. Under the National Health Act, 2003 (Act No. 61 of 2003), the core function of the Forensic Pathology Service in the Department of Health (DOH) within South Africa is the medico-legal investigation of unnatural death. For the purposes of a medico-legal investigation, the term 'unnatural death' is defined as follows in the Regulations (to the National Health Act) Regarding the Rendering of Forensic Pathology Service:

(a) Any death due to physical or chemical influence, direct or indirect, or related

complications;

(b) Any death, including those deaths which would normally be considered to be a death due to natural causes, which in the opinion of a medical practitioner, has been the result of an act of commission or omission which may be criminal in nature; or

(c) Where the death is sudden and, unexpected, or unexplained, or where the cause of death is not apparent (Regulations Regarding the Rendering of Forensic Pathology Service, 2007).

Furthermore, any death as contemplated in section 48 of the Health Professions Amendment Act 2007 (Act No. 29 of 2007), is also considered an unnatural death:

Section 48: "The Death of person undergoing, or as a result of, a procedure of a therapeutic, diagnostic or palliative nature, or of which any aspect of such a procedure has been a contributory cause, shall not be deemed to be a death from natural causes as contemplated in the Inquest Act, 1959 (Act No. 58 of1959), or the Births, Marriages and Deaths Registration Act, 1992 (Act No. 51 of 1992)."

These definitions involve the investigation of the circumstance and cause of death which requires obtaining information from collateral sources, the death scene investigation as well as the performance of a post mortem autopsy examination (Steenekamp, 2010). In terms of the Inquests Act 1959 (Act No. 58 of 1959), it is the statutory obligation of any person to report an unnatural death and for that case to be submitted for medico-legal investigation (Steenekamp, 2010).

Under these investigative parameters as well as the necessary inspection into the prevalence and nature of paediatric fatalities in South Africa, the collaboration between Division of Forensic Medicine and Pathology, University of the Witwatersrand and the Johannesburg Forensic Pathology Service (JFPS) served to support this study, which was conducted over a two year period.

Ethical approval was granted through the University of Witwatersrand's Human Research Ethics committee. An unconditional approval was given with the clearance certificate number of M110520 (Appendix B).

3.2 Protocols and guidelines for the South African Forensic Pathology Services

The rendering of forensic pathology services in South Africa, include a strict legislative framework as well as a number of protocols and regulations. These duties include but are not limited to: "investigation of the death/crime scene, obtaining information crucial for the investigation, collection of the deceased, taking custody of the deceased from the scene of death, maintaining and collecting evidence relating to a body and associated items, assisting in the identification of the deceased, conducting a post mortem autopsy examination, requesting and conducting special investigations, providing medico-legal reports and expert testimony in court, archiving of documents and specimens, reviewing and analysing related data related to trends or prevalence of incidents of unnatural deaths and providing information and advice to health or other government authorities" (Regulations Regarding the Rendering of Forensic Pathology Service, 2007).

Thus the forensic pathology service encompasses a wide variety of duties essential for the comprehensive and in-depth investigation of all unnatural or suspicious deaths in South Africa. The forensic pathology service works very closely with the South African Police Service (SAPS). The removal and transportation of the deceased by an authorized forensic investigating officer prior to admission to the mortuary requires the written authority of the South African Police Service (SAPS) or the written approval from the person in charge of the facility, in cases of anaesthetic/procedure related deaths (Regulations Regarding the Rendering of Forensic Pathology Service, 2007).

Following the admission and designation of a decedent to a qualified forensic medical practitioner, a through routine internal and external examination is carried out. Specialized investigations which could be conducted by the forensic medical practitioner could include the following according to

the National Code of Guidelines for Forensic Pathology Practice in South Africa. (National Forensic Pathology Services Committee – Academic and Professional Advisory Sub-Committee, 2007):

- Histology: samples to confirm macroscopic diagnoses and in indicating microscopic lesions.
- Specimens for the identification purposes: includes tissue specimens for DNA analysis i.e. blood, bone, muscle and teeth. These specimens are submitted to the SAPS Forensic Science Laboratory (Biology Section).
- Specimens for biochemical investigation: samples of ocular fluid, cerebrospinal fluid, urine and gases etc.
- Toxicology specimens: samples for the analysis of blood alcohol concentration and/or ancillary forensic toxicological screening include (blood, urine, eye fluid and cerebrospinal fluid) submitted to the Forensic Chemistry Laboratories of the National Department of Health (NDoH)
- Ballistic samples: projectiles from the deceased body as well as gunshot residue from cases of suspected short range shots can plus a dissected skin portion of the surrounding entrance wound are sent to and processed by the SAPS Forensic Science Laboratory.

In admissions which present with advanced decomposition or skeletonization, scientific analysis in the form of (inter alia) anthropology and entomology can be requested by the forensic medical practitioner to discern, qualify and quantify identity, trauma and post mortem interval among other evidence variables. In circumstances such as these, relevant and authorized experts are consulted. The above specialized investigations assist and contribute towards providing and reporting a clear,

extensive and exhaustive portrait and history of the deceased patient, who is the Forensic Pathology Service main mandate and concern.

In circumstances where the external examination of the deceased coincides with a natural medical history and/or a SAPS180 description with no evidence to the contrary to support that of an unnatural death, the decision to perform a limited or viewing autopsy may be made. This decision is made by the forensic medical practitioner based on documentation accompanying the decedent to the Johannesburg Forensic Pathology Service such as the police SAPS180 documentation or clinical patient management summaries obtained from e.g. the hospital. A limited autopsy is most commonly performed to exclude any unnatural cause of death and to confirm natural disease processes such as gastroenteritis or pneumonia. This protocol is thus confirmatory and not exploratory when signs of an alternative, suspicious cause of death are absent (Hansmeyer, pers. comm., 2013).

3.3 Materials

Inclusion data for the materials used included that of all cases of children under the age of 12 who were admitted to the JFPS between the periods of January 2008 and July 2011. Cases which were ascertained as illness related after autopsy and therefore classified as 'natural deaths', were included as per the regulations of the Forensic Pathology Service, since these deaths were admitted as 'sudden unexpected deaths' or 'unknown deaths'.(Regulations Regarding the Rendering of Forensic Pathology Service, 2007). All deaths which were related to the non-viability of a foetus, stillbirths and abortions were excluded. Any documentation or information regarding the decedents' medical history and / or history of congenital abnormalities, were not included for analysis in this study. The decedents' medical history was not included as an objective in this study.

Primarily, two forms of reports, namely the police report (SAPS180) (Appendix D) and post-mortem examination reports (Appendix C) were used to extract relevant information on to data sheets (Appendix A).

The police report (SAPS180) includes the demographic particulars of the individual. This includes the administrative details below:

- SAPS CAS number.
- The FPS body number (assigned at the Medico-legal mortuary).
- The name, personal number and rank of the FPS staff member(s) removing the body from the scene and admitting the body to the mortuary.
- The demographic particulars of the deceased individual include the name and address, identity number, racial affinity and sex, age, marital status and nationality.
- Information on the place, date and time of death as well as the circumstances of death, for example “motor vehicle accident”, “firearm” or “sudden death”.
- A full history must be completed by the police officer at the scene as well as a description of any a property found with/on the deceased. For the purposes of this study, data was transcribed for each case relating to the information on the SAPS180, including anonymous demographic data and clinical hospital summaries in cases of procedure-related death.

The medico-legal autopsy report contains information about the cause of death of the individual and represents the official documentation based on the contemporaneous notes made during the autopsy session itself. Typically the report contains the FPS Death Register number, the DHA-1663 Notice of Death number, and the date of autopsy and chief post-mortem findings by the

forensic medical practitioner. Autopsy findings are reported regarding injuries, pathology and abnormalities, and are categorised into the following headings and anatomical regions:

- General - length, mass, build, nutritional state, special identifying marks and post-mortem changes.
- External appearance – external condition of the body, wounds evident as well as kinetic injuries such as contusions, abrasions, lacerations and fractures. Any therapeutic measures are also noted.
- Anatomical regions:
- Head and Neck – injuries of the skull, scalp, intracranial contents, eyes, nose and ears, mouth, tongue and pharynx and neck structures.
- Chest – chest and diaphragm, mediastinum and oesophagus, trachea and bronchi and pleurae and lung, heart and pericardium and large blood vessels.
- Abdomen – abdominal cavity, stomach, intestine and mesentery, liver and gallbladder, pancreas, adrenal glands, kidneys and ureters, pelvis and genitalia.
- Spine – spinal column and spinal cord
- Specimens retained - in cases requiring further specialised investigations, tissue or body fluid samples for (inter alia) histological, toxicological or DNA investigations are retained and evidentiary objects (such as e.g. bullets or ligatures) may be retained as evidence and for further e.g. ballistic or ligature investigations.
- Other observations – additional information such as the DHA-1663 Notice of Death number

The descriptions of injury and pathology within each of these categories were utilized for each case to satisfy the objective of determining injury patterns and cause of death in this study.

If vital information was missing, additional forms within the FPS case file were used as secondary sources. These forms included affidavits, hospital transcripts and copies of the birth certificate or identity documents of the deceased.

3.4 Methods

3.4.1 Identification of valid data

Sample numbers were obtained via sorting through the death register numbers in the Johannesburg Forensic Pathology Service Medico-legal Mortuary case file office. Chronologically, deaths are entered into the system and file catalogue as they are admitted to the Johannesburg Forensic Pathology Service Medico-legal mortuary. For example, the Death Register (DR) number 432 for the year 2012 would be filed as DR432/ 2012 regardless of the cause of death. Beginning with 2008, each file was evaluated and then identified if within the inclusion criteria. Samples of 20 to 30 cases were sourced at a time.

3.4.2 Data collection of case files

The case files were manually located from the Department of Health Johannesburg Forensic Pathology Service Medico-legal Mortuary Case File office, and were then photocopied. The data from these photocopies were then transcribed onto a data sheet. The photocopied case file and its corresponding data sheet were then stored away for safekeeping. From this point, the data remained anonymous and unlinked as no personal information was recorded thus each case included within the sample was granted absolute confidentiality and anonymity. A template of the data sheet can be examined under Appendix A.

The collected variables were:

- JFPS DR or case number, date of death and autopsy, age at death, ancestry, sex, stature, socio-economic status (address).
- Description of "circumstance" of death. Categories include MVA/PVA, hospital case, poisoning, SIDS, burns, fall, assault, gunshot wounds, drowning/ asphyxia and illness.
- External appearance of affected area – visible or non-visible injuries, wounds, contusions, abrasions, lacerations, incised wounds, fractures or therapeutic measures.
- Region of soft tissue/ skeletal injuries – anatomical regions of the body.
- Description of soft tissue/ skeletal injuries with relation to region of the body.
- Indication of whether admission to the mortuary cause of death correlates with that of the post-mortem cause of death.
- Additional comments such as if samples were taken for histology, DNA or toxicology were taken. Information on whether the report was complete or missing information.

3.4.3 Transcription on data spread sheets

Following the collection of all cases for each year, a data spread sheet was devised to assist statistical analysis. Further attempts were made to enquire/collect cases missing from the sample. At this stage, if the cases could not be located they were noted but excluded from the sample as no information could be gathered for those particular cases. The transcription of information was made onto an electronic Microsoft Excel spread sheet.

A separate workbook was created for each year. Within each workbook – regulation cases, those cases which didn't require any further investigation or analysis as autopsy determined a cause of

death, were transcribed onto the DATA spread sheet. Cases of an unascertained nature or those undergoing toxicological and histological analysis were placed on a TOXI/ HISTO sheet.

3.4.4 Categorisation of data

Due to the large amount of differentiating assigned and recorded variables of age, residential address for socio-economic status, external findings and cause of death nomination, categories had to be restructured and formulated to assist in the statistical analysis of this data sample. The following decisions were made prior to data analysis:

On examination of the variable of age, the sample behaved in a skewed fashion. As such the following numerical categories were devised to account for children less than one year of age:

- 0.10 – Neonatal or within the first two months of life.
- 0.30 – two to four months of age. Three months average.
- 0.60 – five to seven months of age. Six months average.
- 0.90 – eight to 10 months of age. Nine months average.
- 1 year – 11 to 12 months.

The subsequent age categories followed that of a yearly denomination up to the age of twelve.

Whilst constructing categories of residential area, the suburbs where the body came from was recorded on the SAP 180 forms and transcribed onto the data spread sheet. Six major groups were created to give clarity on the larger areas these children originated from.

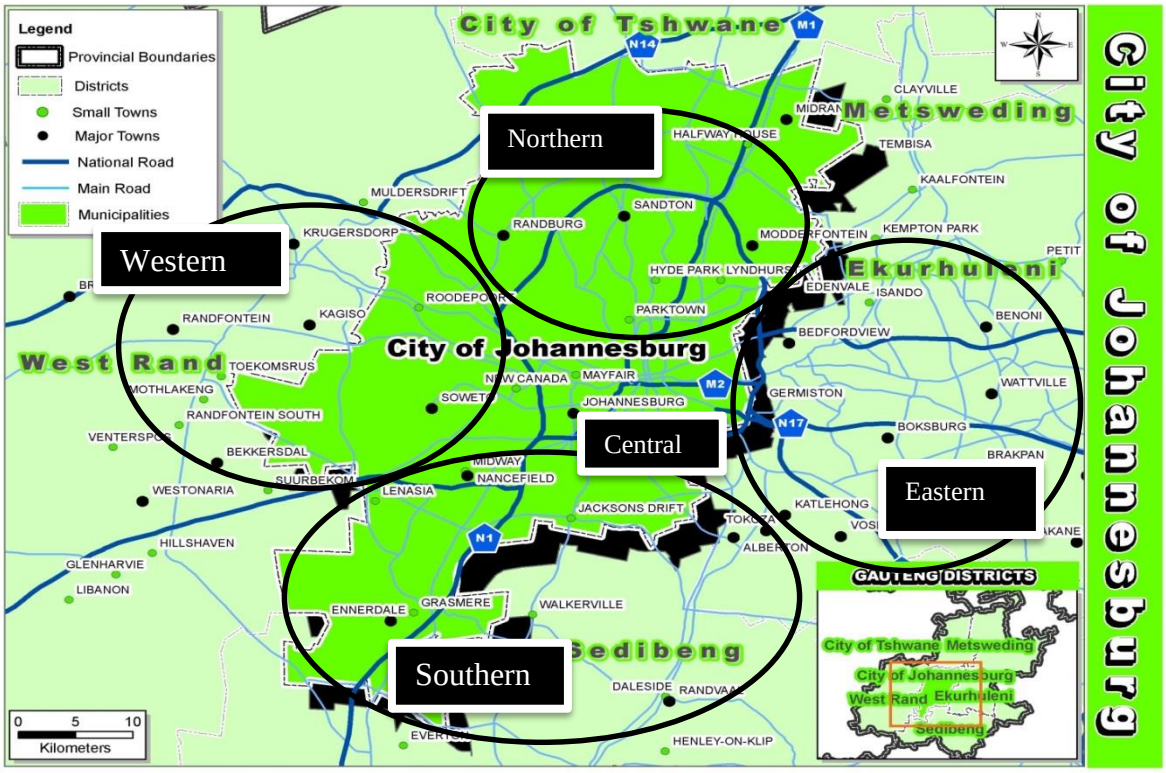
- Northern suburbs included the following SAPS180 address nominations: Alexandra, Sandton, Atholl, Bramley, Cosmo City, Blairgowrie, Craighall, Diepsloot, Douglasdale, Emmarentia, Fairlands, Ferndale, Fourways, Houghton, Inanda, Johannesburg North,

Jukskei Park, Kya Sands, Kyalami, Limbro Park, Linden, Lyndhurst, Mayfair, Midrand, Morningside, Newlands, Newclare, Norwood, Olifantsfontein, Orchards, Parklands, Parkview, Parkmore, Presidents Park, Randburg, Rand Park Ridge, Rivonia, Robindale, Sandhurst, Saxonwold, Sharonlee, Sunninghill, Westcliff, Windsor, Woodmead and Wynberg.

- Western suburbs included the following SAPS180 address nominations: Auckland Park, Riverlea, Brixton, Westburg, Sophia town, Cresta, Kew, Grasmere, Honeydew, Soweto, Lenasia, Orlando and Roodepoort.
- Eastern suburbs included the following SAPS180 address nominations: Boksburg, Brakpan, Camelot Court, Cyrildene, Davieton, Dubuza, Germiston, Kempton Park, Kensington, Malvern, Modderfontein, Nigel, Primrose, Springs, Steeldale and Witfield.
- Southern suburbs included the following SAPS180 address nominations: Booysens, Rochelle, Turnfontein, Regents Park, Ormonde, Eldorado Park, Glenvista, Mulbarton, Mondeor, Oakdene, Ridgeway, South Rand, South Hills and Winchester.
- Central suburbs included the following SAPS180 address nominations: Berea, Braamfontein, Hillbrow, Doornfontein, Highlands, Jeppe, Johannesburg Town, Joubert Park, Riverlea, Rosettenville, South Dale, Turfontein and Yeoville.
- Outside of Johannesburg jurisdiction SAPS180 address nominations: Centurion, Claremont, Fochville, Kwazulu Natal (province), Ladysmith, Limpopo (province), Magliesburg, Nelspruit, Middleburg, Newcastle, Pretoria, Rustenburg, Volkrust and Vryburg.

A ‘non-specific’ category was created for nominations which were illegible or didn’t correspond with suburbs or residential addresses in Johannesburg as well as cities and provinces in Southern Africa.

The representation in Figure 1 is a rudimentary simplified illustration of the categorized suburbs described above.



(Source: Adapted from www.mapsharing.org.za)

Figure 1 Municipal map of the City of Johannesburg indicating categorized areas

The category of external findings were originally reserved for ‘external injuries’, however the number of remarkable or noteworthy characteristics and features was exhaustive. The following core findings were noted for the purposes of this study:

- Injury occurrences and effects of – contusions, abrasions, lacerations and open fractures, haemorrhages and recent, healing and old burns wounds (thermal injury).
- Incised wounds – typically not from stab wounds. Incised wounds from therapeutic measures either procedure related or from emergency services i.e. tracheotomy.
- Therapeutic measures – signs of medical and emergency services intervention.
- Signs of dehydration or sickness – turgid skin, sunken eyes and poor physical condition of the body.

The post mortem report cites the external and physical appearance of the deceased e.g. soil on the body and clothing of the deceased. For the purposes of the study mandate, these observations were not documented. External signs relating to a category or cause of death were documented with the category of death findings. For example – a plume of either clear or blood stained froth from the mouth and nostrils are typically associated with drowning fatalities.

When organising cause of death findings, common trends arose from the cases observed within key circumstances of death, thus individual causes of death were grouped into categories. Combinations could involve of the mechanism of injury (head, chest, abdomen or multiple injuries) or could be isolated in a single region of the body. The following list indicates the categories of death and corresponding causes or mechanisms associated within each category.

- Blunt force trauma: includes road traffic accidents (MVA and PVA), fall from heights and suspected assault.
- Asphyxia: included cases of suffocation, smothering, gagging and choking.
- Drowning: purely cases of drowning and immersion in water fatalities.
- Thermal: cases of burns or electrocution.

- Unascertained: cases which were inconclusive and cited unremarkable findings at autopsy. In most of these cases, samples for toxicological, DNA and histological analysis were taken.
- Illness-Natural: cases admitted at the JFPS with a sudden or unknown (death) history and who, following post mortem examination, were found to have demised from natural causes. Examples of these included gastroenteritis with dehydration and bronchopneumonia.
- Illness-Procedure: includes all procedure-related deaths which underwent examination at the JFPS.
- Other: includes poisonings, gunshot fatalities and cases in advanced stages of decomposition and skeletonization, where cause of death is unclear.

When evaluating the data set, several cases within the category of blunt force trauma presented with circumstance of death (based on the SAPS180 form), which were incomplete or listed as 'sudden' or other. Official post mortem reports within the FPS case files which lacked substantial information concerning manner/circumstance of death were assessed for compatibility with the syndrome of Non Accidental Injury. Due to the limitations of the SAPS180 form as well as the lack of pre-empted opinion of suspected NAIS by the forensic medical practitioner within the JFPS case files, consultation was made with the doctors at the JFPS in conjunction with the criteria by Spitz and Fishers (2006), Saukko & Knight (2004), Shepherd & Simpsons (2003) and Mason (1989) to ascertain manner of death. This consultation and process was untaken through a manner of exclusion where a history or circumstance of death was vague or unrecorded. The following criteria (table 3) were devised based on the above authors' contributions to categorize cases into a suspected NAIS category within the blunt force trauma group.

Table 3 Criteria for inclusion of suspected NAIS fatalities in the sample

Suspected NAIS signs at Post Mortem Examination*

Region of the Body	Description of Injuries and/or Findings
External surface of the body	Dehydrated and wasted appearance Healing/healed lesions, wounds and scars Contusions in various stages of healing (especially to the face, neck, wrists, arms, thighs and buttocks) Scalding 'wet' immersion burns Bites Cigarette burns
Skull and Scalp	New and old complex fractures in various stages of healing (especially the occipitoparietal region) Contusions, lacerations and abrasions
Intracranial contents	Subdural and subarachnoid haemorrhages Cerebral cortical contusions and lacerations
Face (eyes, ears, cheeks and mouth)	Haemorrhages to the conjunctivae and retinae; dislocation of the lens or retinal detachment Contusion and/or laceration to the pinnae Laceration and /or abrasion to the cheeks Laceration and/or abrasion lips and mouth; chipped or dislodged teeth
Chest	New and old fractures in various stages of healing (especially to the ribs)
Abdomen	Rupture/perforation; especially the liver and spleen
Pelvic Region	Evidence of sexual assault: lacerations and contusions of the anal-genital region
Extremities	New and old fractures in various stages of healing

* Adapted from Spitz and Fishers (2006), Saukko & Knight (2004), Shepherd & Simpsons (2003) and Mason (1989)

When examining the injury or primary findings in the sample, the region of primary finding was documented for example head, neck, chest, abdomen and extremities. Within the main categories of death cited above – common injury patterns and physiological responses of the patient's fatal condition were recorded in conjunction with the category of death to assist with the objective of characterizing child mortality. To satisfy the aim of determining prevalence of injury patterns and pathological changes in this paediatric group, a percentage of prevalence only above 30% of the sample was presented in the results.

Once categorization of data was complete, a frequency distribution was done regarding the number of cases expressing key study variables. For example, the number for hospital admissions and external findings was calculated. In addition, the numbers of cases for each category of death i.e. drowning and its frequency in a given year i.e. 2008 was observed.

3.5 Statistical analysis

As all numerical data was skewed and as such medians and interquartile ranges were used to describe them. For comparative statistics the Kruskal-Wallis test was used for numerical data and the Fishers Exact for the categorical data. For comparisons of ages, groups were delineated into birth to five years and six to twelve years old. Data analysis was related to comparisons of cause of death recorded on the post mortem report.

Chapter 4: Results

4.1 Description of paediatric mortalities

An estimated 800 paediatric cases (birth to twelve years old) were identified from the records housed at the Johannesburg Forensic Pathology service (JFPS) between January 2008 and July 2011. Of these – 655 were available and obtainable. A primary reason for this discrepancy was that files were "missing" from the filing system. These "missing" files included "unascertained" causes of death cases, where further specialised investigations had not yet been finalised (for example toxicological investigations) and consequently the forensic medical practitioner had not been able to finalise the official report. In addition to this, these unascertained case details were limited in information vital for statistical purposes. Further exclusions included cases where the causes of death were attributed to stillbirths, in concealment of birth circumstances.

After copying and transcribing all data and variables relevant to these cases, 468 met the criteria for statistical analysis.

There was a relatively even distribution of cases over the time period. 2008 represents 28%, 2009 – 29%, 2010 – 27% and 2011 16% of the sample (Figure 2). An exception to this is 2011, as this year only included seven months of data obtained.

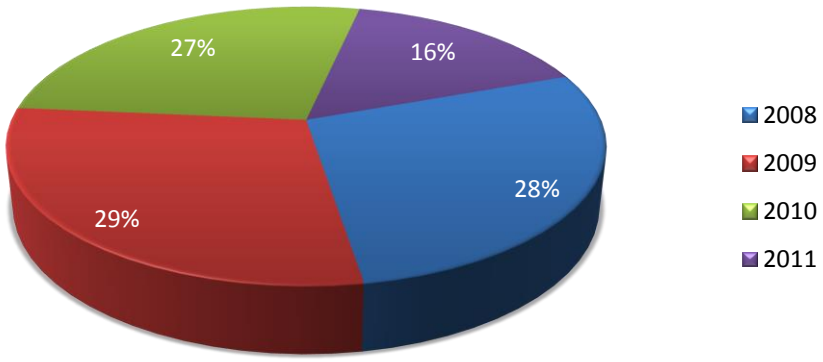


Figure. 2: The number of paediatric cases observed in sample per year

The median age of the sample was 2 years old within a range of birth to 12 years (Figure. 3). Within the paediatric age group, the highest number of cases was less than 1 years old (155 cases (33%)). There is a decline in deaths following the first year of life.

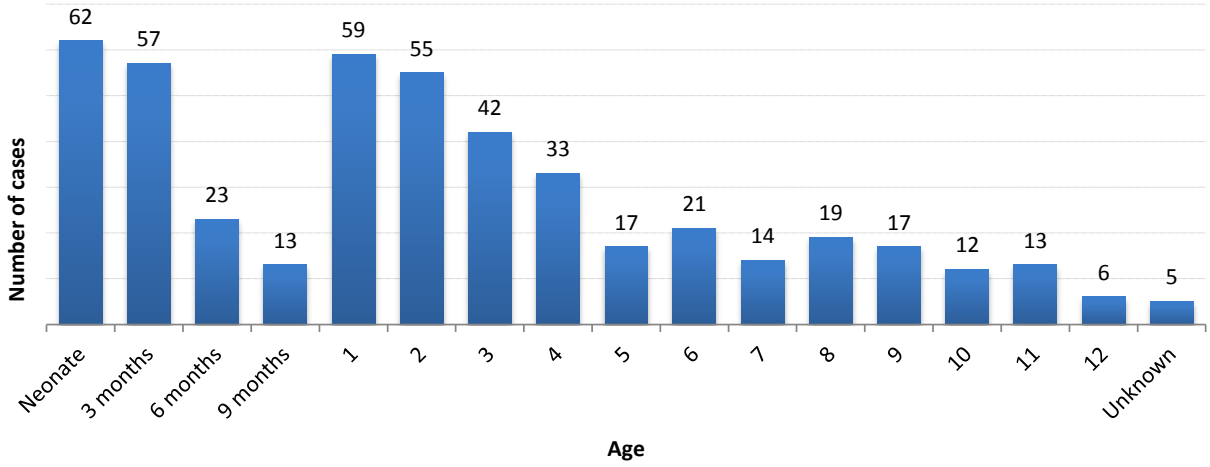


Figure. 3: The age distribution of paediatric cases

With respects to biological sex differences, males (58%) are clearly more prevalent than females (42%) (Figure. 4).

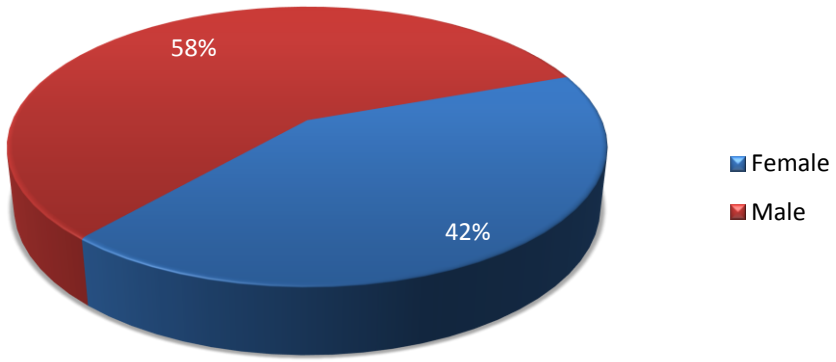


Figure.4: The sex distribution within the sample

Racial affiliation is (Figure. 5) dominated by that of the African population which is represented by 81% of the sample. A total of 51% of cases were admitted to a hospital prior to arriving at the JFPS.

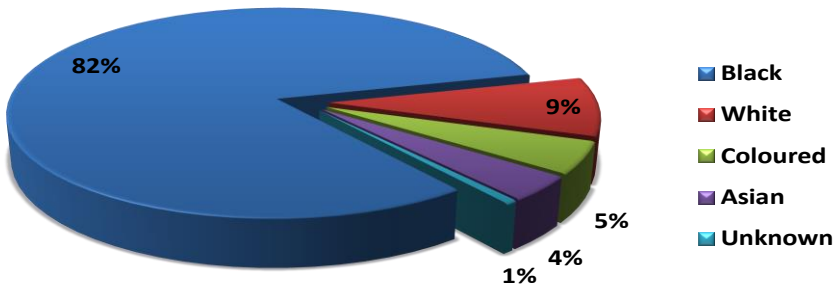


Figure. 5: Racial distribution within the samples

The distribution of prior hospital admissions is relatively even within the sample. 1 % of cases where unaccounted as the documentation relating to this objective was absent within the case files (Figure.6).

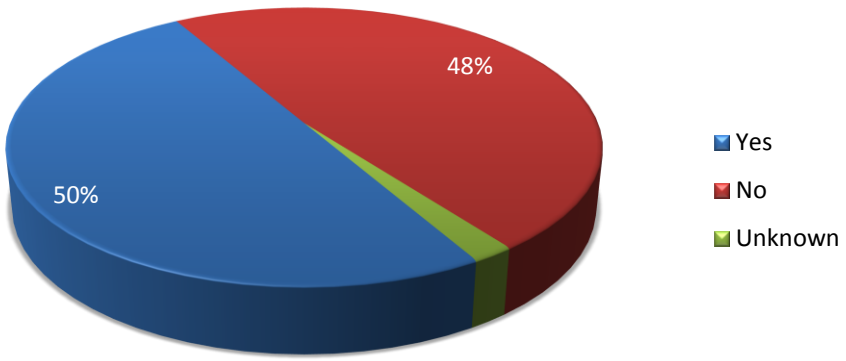
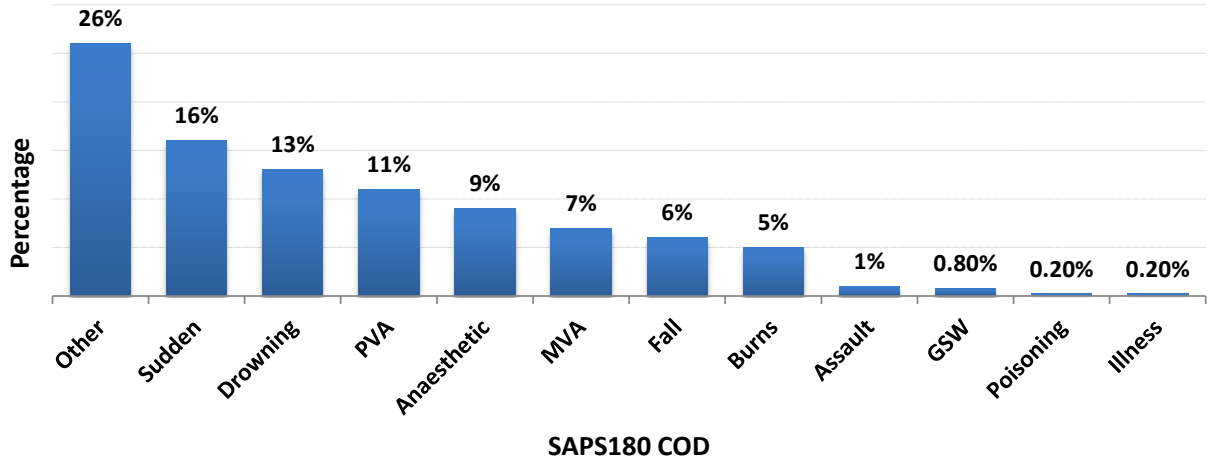


Figure. 6: Hospital admission distribution prior to death within the sample

Interestingly, the SAPS 180 form descriptions correlate highly with that of the post mortem examination categories of death findings (Figure.7&8). The most common categories of death observed in the sample were that of blunt force trauma, natural (illness related) deaths and drowning fatalities. The police SAPS 180 form data cite drowning with 65 recordings, pedestrian vehicle accidents (PVA) with 53 assigned causes of death, motor vehicle accidents (MVA) with 33 cases and fall from heights with 31 allocations. These results however are not indicative of the Johannesburg jurisdiction sample due to the prevalence for the 'other' category being allocated on police documentation in 26 percent of cases (Figure.7).



SAPS180 COD – SAPS180 Circumstance of death

Figure. 7: Circumstance categories of death (from the SAPS180 forms) prior to post mortem examination

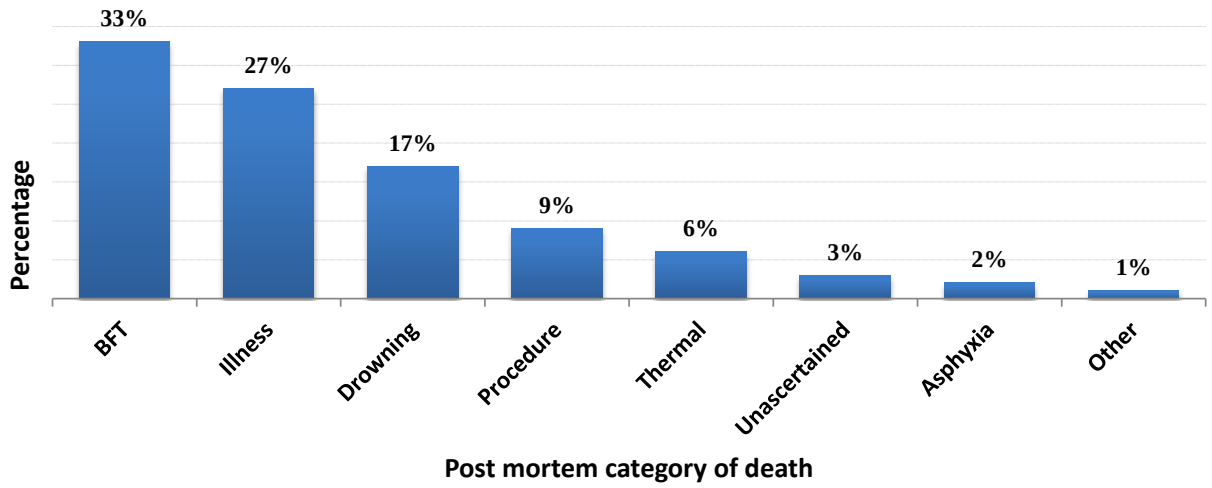
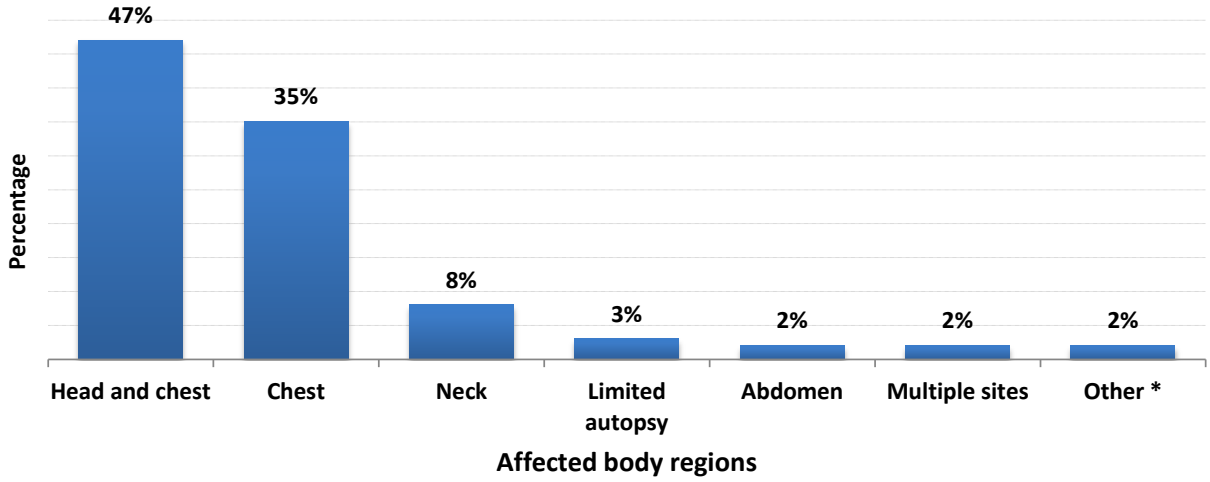


Figure. 8: Categories of death after the post mortem examination

The two most prevalent categories of death within the sample were that of blunt force trauma (BFT) – 33 % and illness related (ILL-N) deaths – 27% (Figure.8). Circumstances of blunt force trauma were correlated with that of motor vehicle accidents (MVA), pedestrian vehicle accidents (PVA), and fall from heights, freak accidents and possible assault scenarios. Several of these individuals received therapeutic measures prior to death either within a hospital setting or through emergency services.

With respects to the region of injury of findings in the cases illustrated below, in 47% of cases, the head and chest area were impacted or presented with remarkable changes (Figure. 9).



* Other = includes severe dehydration, chronic disease, unremarkable findings and extensive decomposition.

Figure. 9: Percentage of affected body regions within the sample

External observations made prior to the internal examination of the individual admitted are represented in table 4. Of the 468 cases observed and analysed, 306 cases presented with the following injuries and findings. Remaining cases recorded with unremarkable findings due to the unascertained nature of the death, extensive decomposition and limited autopsy conditions. Table 4 below illustrates the most prevalent of findings in the sample.

Differing pathological conditions, co-morbidity factors and prevalent findings within the sample (Table 4) illustrate findings conclusive with the three most prevalent categories of death (blunt force trauma, natural illness and drowning) as well as physiological and common effects of injury on the body from accidents, assault, falls or illness. The findings illustrated below were directly reported from the post mortem autopsy documentation.

Table 4: External and internal injuries and findings in paediatric cases

Prevalent External injuries and finding(n=306)	%	Prevalent Internal injuries and findings (n=468)	%
Therapeutic measures	39	Cerebral Oedema	94
Abrasions	36	Congestion of internal organs	86
Lacerations	19	Haemorrhages	50
Contusions	17	Bronchopneumonic changes	19
Incised wounds	12	Therapeutic measures	18
Dehydration	11	Pulmonary consolidation	15
Fractures	7	Pulmonary Oedema	14
Burns	7	Voluminous Lungs	13
Haemorrhages	2		

Not surprisingly, the most common region of the body which presented with early signs of decomposition was that of the abdomen (52%) of cases followed by 11% in the head (Figure.10). In 33.5% of cases admitted, no findings related to the natural decomposition of the body were noted within the post mortem reports examined.

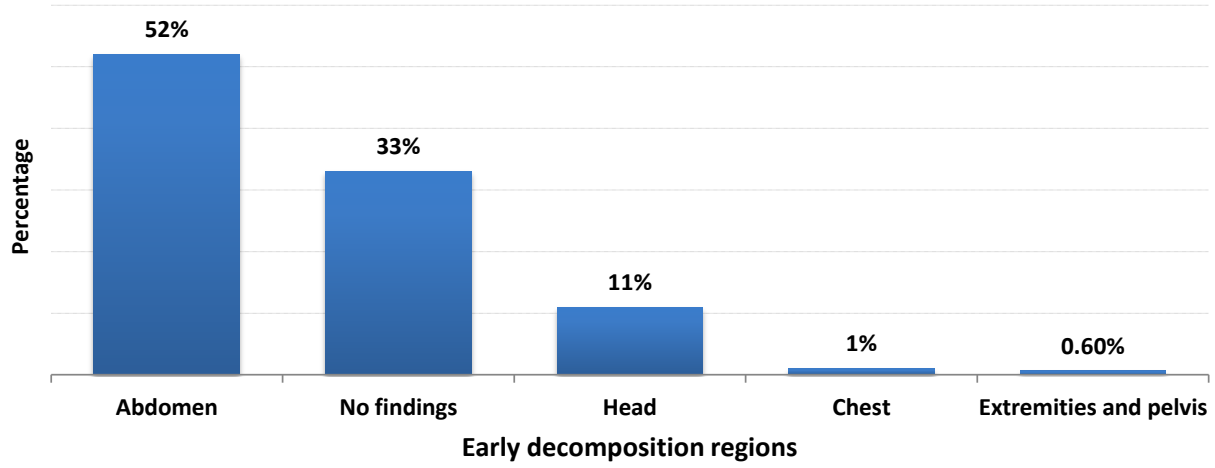
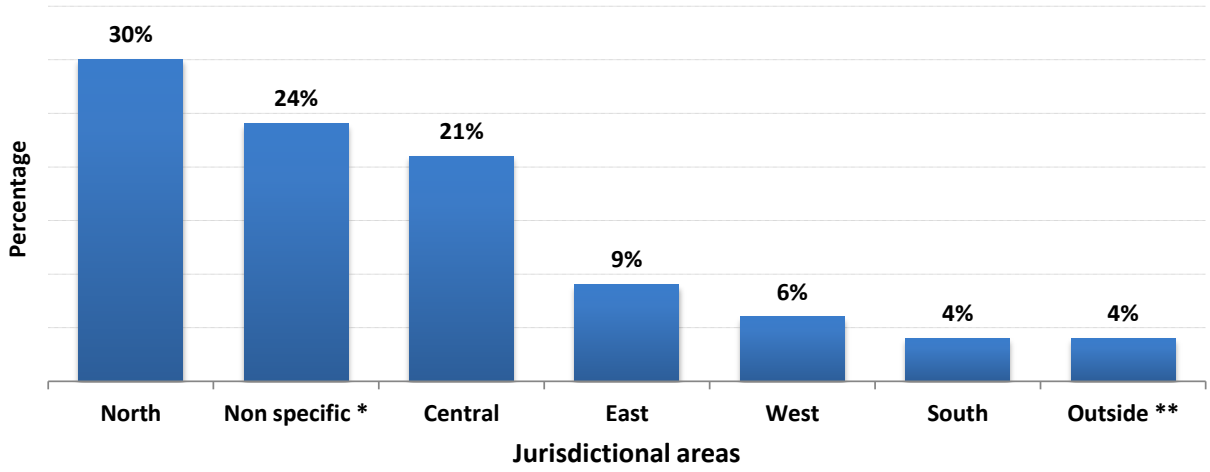


Figure. 10: The regions of early decomposition in the sample

The Johannesburg Forensic Pathology Services are located in central Johannesburg; however it serves the greater Johannesburg metropolitan area. The majority of the cases examined for this study were of deceased individuals originating from the northern suburbs in the greater Johannesburg metropolitan area. Several of the cases collected were grouped in a non-specific category due to illegibility of writing, missing information or incorrect assignment/ invalid area representation. The non-specific category accounted for 25% of the sample, 'Northern' represented the majority with 30%; 'Central' represented 22% and smaller subsidiaries accounted for the rest of the population with 5% in the south, 6% in the 'West', 9% in the 'East' and 4% for provinces, cities and towns outside of Johannesburg (Figure.11).



*Regions recorded incorrectly or illegibly.

** Individuals originating from outside of the Johannesburg Forensic Pathology Service jurisdiction,

Figure.11: Difference between categorized residential jurisdictional areas within the study

4.2 Age range for specific categories of death observed within associated variables

The prevalent categories of death which were significantly different in terms of age were that of natural fatalities (six months to two years) and blunt force trauma (two to three years of age).

Table 5 below illustrates the age ranges for the prevalent categories of death observed at the Johannesburg Forensic Pathology Service.

Table 5: Prominent age ranges for categories of death observed in paediatric cases

CATEGORY OF DEATH	AGE RANGE IN SAMPLE	NUMBER OF CASES (%)
Blunt Force Trauma fatalities	Two to three years	156 (33.3)
Illness related fatalities	Six months to two years	127(27.1)
Drowning fatalities	One to two years	82(17.5)
Procedure-related fatalities	3 months to 3 years	44(9.4)
Thermal fatalities	Two to five years	31(6.6)
Unascertained cases	Neonate to six months	13(2.7)
Asphyxia fatalities	Neonate to three and a half years	8(1.7)
Other causes of death*	Six months to seven years	7(1.4)

*Gunshot fatalities, poisonings and possible assault

When comparing the major causes of death (illness – natural and blunt force trauma – unnatural) from birth to five years age grouping there was a significant difference in terms of race and external findings. While the results regarding the race influence are difficult to interpret, it would appear as through White infants and children are more likely to present with blunt force trauma pathology. Similarly, children dying of blunt force trauma were more likely to present with external findings in the sample. In the older age group, no significant differences were observed. Interestingly though, the sample number for the younger age group is equal in distribution across natural and BFT fatalities, however in the older grouping; BFT outweighs that of natural fatalities. Table 6 below represents these findings.

Table 6: Category of death/age comparison

Category of Death N (%)	Mean Age (SD)	Median	IQR**
BFT* 156(33.3)	3.5(3.4)	2	(0.1,5)
Natural 127 (27.1)	2.2(2.8)	1.0	(0.2,3)
Drowning 82 (17.5)	3.3(3.3)	2.0	(1,5)
Procedure 44 (9.4)	2.8(3)	1.5	(0.2,6)
Thermal 31(6.6)	3.7(3.3)	3.0	(2,8)
Unascertained 13(2.7)	1.4(1.9)	0.2	(0.2,4)
Asphyxia 8 (1.7)	3.5(4)	1.5	(0.1,7)
Other 7 (1.4)	3.5(3.6)	2.0	(1,7)

*Blunt Force Trauma, **Interquartile Range

Table 7 represents the categories of death within the broad grouping of natural and unnatural deaths. In this comparison, the Fishers Exact test equated the variable of age and socio-economic area as significantly different with respects to the categories of death delineated in table 3 and 4. This difference highlights that developmental constraints as well as the social and economic influence and circumstance of a child's welfare affects their risk of mortality. The social economic distribution of the metropolitan areas expressed in this chapter will be approached in the discussion chapter.

Table 7: Demographic difference between natural and unnatural deaths

Variable		NATURAL (%)	UNNATURAL (%)	P value**
N		127	341	
SEX	Female	60 (47.2)	136 (39.8)	0.1707
	Male	67 (52.7)	206 (60.4)	
AGE	Under 1	76 (59.8)	138 (40.4)	0.0002
	Over 1	49 (38.5)	200 (58.6)	
RACE	Asian	3 (2.3)	15 (4.3)	0.1233
	Black	112 (88.1)	270 (79.1)	
	Coloured	5 (3.9)	18 (5.2)	
	White	6 (4.7)	36 (10.5)	
SES*	Central	37 (29.1)	64 (18.7)	0.0086
	East	4 (3.1)	39 (11.4)	
	West	10 (7.8)	18 (5.2)	
	North	43 (33.8)	97 (28.4)	
	South	6 (4.7)	16 (4.6)	
	Non specific	22 (17.3)	93 (27.2)	
	Outside	5 (3.9)	14 (4/1)	

*Socio-Economic Status; * * significant difference = $p<0.05$

Table 8 below illustrates these differences even further with respects to the age categories and prevalent categories of death in the sample (natural illness and blunt force trauma). The recording of external findings at post mortem examination differs within these categories in the age groupings of below five years of age and over five years of age (0.0001). This difference is understandable as typically blunt force trauma cases will exhibit more external findings then that of natural illness. This highlights the importance of mechanism of injury as opposed to developmental constraints.

Table 8: Demographic differences between deaths from natural illness and blunt force trauma as category of death by age

VARIABLE	0 – 5 years ILL- N N=108	BFT N=109	P value*	6 – 12 years ILLL - N N=18	BFT N=45	P value*
SEX			0.4081			1.000
FEMALE	50	49		9	22	
MALE	57	63		9	23	
UNKNOWN	2					
RACE			0.0386			0.5465
ASIAN	3	3		0	3	
BLACK	95	83		15	37	
COLOURED	4	6		1	3	
WHITE	4	16		2	2	
METROPOLITAN AREAS			0.0967			0.1926
NORTH	37	29		6	11	
SOUTH	3	4		3	2	
EAST	3	14			4	
WEST	9	5		1	3	
CENTRAL	30	28		6	10	
OUTSIDE	5	3				
NON-SPECIFIC	19	25		2	15	
UNKNOWN	1					
EXTERNAL FINDINGS			0.0001			0.0001
YES	45	96		7	42	
NO	62	12		11	3	
HOSPITAL ADMISSION			0.7824			0.5797
YES	49	52		11	23	
NO	57	54		7	22	

ILL-N-Illness related fatalities, BFT-Blunt Force Trauma fatalities; *significant difference = $p<0.05$

4.3 Relationship between race and other demographic variables within the sample

The relationship between racial affinity and the demographic variables included in the study are indicated in Table 9. As illustrated by the values for the Fishers Exact test, the comparison of the age categories of under a year (Neonate - 11months) and 12 months to 12 years of age produced an insignificant result across the racial groups. Indicating that racial affinity doesn't influence the category of death variables explored in this study. Similarly, there was no significant difference between males and females among the different racial groups. In contrast, prior hospital admission before death and the presence of external injuries (abrasions, contusions, and lacerations) were significantly different between the races (0.002-prior hospital admission and 0.0110-presence of external findings).

Table 9: Relationship between race and demographic variables within the sample

Race	**Asian**	**Black**	**Coloured**	**White**	**Unknown**	**P value***
N	18	382	23	42	3	
AGE (%)						0.4085
>1 year	7(38.8)	115(30.1)	9(39.1)	9(21.4)	2(66.6)	
<1 year	11(61.1)	258(67.5)	13(56.5)	31(73.8)	1(33.3	
SEX%						0.9347
FEMALE	8(44.4)	159(41.6)	11(47.8)	17(40.4)	1(33.3)	
MALE	10(55.5)	223(58.3)	12(52.1)	25(59.5)	1(33.3)	
H/A (%)						0.002
YES	11(61.1)	182(47.6)	9(39.1)	34(80.9)	2(66.6)	
NO	6(33.3)	198(51.8)	11(47.8)	7(16.6)	1(33.3)	
UNLISTED	1(5.5)	2(0.5)	3(13.0)			
EXTERNAL FINDING (%)						0.0110
YES	17(94.4)	244(63.8)	13(56.5)	33(78.5)	2(66.6)	
NO	1(5.5)	138(36.1)	10(43.4)	7(21.4)	1(33.3)	

Comparisons done with Fishers exact test * significant difference = $p<0.05$, H/A- Previous hospital admission prior to death

4.4 Relationship between sex and the associated variables within the sample

Table 10 represents the relationship of biological sex and the associated variables in the study. A male to female ratio of 1.38:1 is present in the sample. There were no significant differences between biological sex in terms of race, hospital admission, and external injury findings. However, the regions of the affected by trauma and disease differ among the sexes (0.0029), similarly the areas where female and male children had resided in also display a difference (0.0455). The latter is probably due to the high numbers of 'north' and central suburb fatalities. The difference in external injury findings indicates a possible modification in cause of death risk between the sexes.

Table 10: Relationship between biological sexes and variables within the sample

VARIABLES	FEMALE N 196	MALE N 271	P VALUE *
RACE			
Asian	8(4)	10(3.6)	0.9755
Black	159(81.1)	223(82.2)	
Coloured	11(5.6)	12(4.4)	
White	17(8.6)	25(9.2)	
Unknown	1(0.5)	1(0.3)	
HOSPITAL ADMISSION			
Yes	103(52.5)	134(49.4)	0.5716
No	91(46.4)	134(48.7)	
Unknown	2(1.0)	5(1.8)	
EXTERNAL FINDING			
Yes	139(70.9)	169(62.3)	0.0603
No	57(29)	102(37.6)	
REGIONS OF THE BODY			
Abdomen	6(3)	3(1.1)	0.0029
Chest	74(37.7)	91(33.5)	
Head and Chest	49(45.4)	131(48.3)	
Neck	16(8.1)	23(8.4)	
Multiple sites	5(2.5)	5(1.8)	
Other	6(3)	18(6.6)	
AREAS			
North	50(25.5)	90(33.2)	0.0455
South	9(4.5)	13(4.7)	
East	14(7.1)	29(10.7)	
West	16(8.1)	12(4.4)	
Central	51(26.0)	50(18.4)	
Outside of Johannesburg	11(5.6)	8(2.9)	
Non specific	45(22.9)	69(25.4)	
EXTERNAL INJURY TYPES**			
Abrasions	50(23.4)	62(24.1)	
Burn wounds	7(3.2)	17(6.6)	0.2560
Contusions	27(12.6)	25(9.7)	
Signs of dehydration	17(7.9)	19(7.3)	
Fractures	7(3.2)	15(5.8)	
Haemorrhages	3(1.4)	4(1.5)	
Incised wounds	23(10.7)	15(5.8)	
Lacerations	22(10.3)	36(14.0)	
TM	57(26.7)	64(24.9)	

N (percentage in variable), TM= Therapeutic measures noted at post mortem examination;* significant difference = $p<0.05$; **Number of external injury observations in female and male paediatric fatalities =470

4.5 Comparison of the SAPS180 form to the post mortem examination report.

The admission of medico-legal fatalities to the Johannesburg Forensic Pathology Service encompasses the inclusion of a police document (SAPS180). Below is a comparative representation in the form of percentage of assigned 'Cause of Death' from the SAPS180 versus that of the final category of death (Table 11). Correct assignment by the police documentation prior to post mortem examination can be observed in fatalities due to drowning (76%), other/unascertained deaths (84.6%), burns/ thermal cases (83.8%) and falls (19%), MVA (21%) and PVA (34%). SAPS180 assignments correlate with that of blunt force trauma. Incorrect SAPS180 assignments are observed in natural/illness determination. The distributions of these fatalities were assigned into sudden (49.6%) and other (46.5%) categories on the SAPS documentation.

Table 11: Associations between the SAPS180 cause of death assignment and post mortem examination category of death

Confirmed PM category of death	ASP	BFT	NAT	PR	THERM	OTHER	UNASC	DROWN
SAPS180 Cause of Death %*	8	156	127	44	31	7	13	82
Sudden	25	3	49			14.2	7.6	6.0
Other	50	19	46.5		3.2	14.2	84.6	14.6
Drowning	12.5	0.6						76.8
Burns					83.8			1.2
Assault	12.5	1.9				14.2	7.6	
Poisoning			0.79					
GSW			0.79			57.1		
Illness								1.2
Falls		19						
MVA		21						
PVA		34						
Procedure Deaths		13	2.36	98				
Unlisted				2				

*Percentage of SAPS assignment within the accurate final post mortem autopsy category of death, ASP =Asphyxia, BFT= Blunt Force Trauma, NAT=Natural Fatalities, PR= Procedure related fatalities, THERM=Thermal fatalities, OTHER= minority cases of poisonings and GSW fatalities, UNASC= Cases which at post mortem yielded unremarkable findings, DROWN= Fatalities due to drowning.

4.6 The association of categories of death, region of injury and prevalent pathological and physiological findings

The association of region of injury or finding versus that of the category of death provides insight into the patterns of injury or disease associated with different categories of death (Table 12).

Primary findings include that of head and chest (observed in 40.9% of blunt force trauma fatalities; multiple sites (exclusively associated with blunt force trauma (100%)), chest (50.6% of natural deaths and a recording of limited autopsy being performed in 66.6% of natural fatalities).

The following tables illustrate the corresponding percentage of prevalent findings of pathology, injuries and physiological findings with the broad categories of death found in the sample. The prevalent regions of injury associated with these categories of death as seen below (Table 12), are linked to the subsequent tables illustrating prevalent findings within the different categories of death.

Table 12: Association of category of death and region of injury

Region of Injury	HC	CHEST	NECK	LA	MS	ABD	OTHER
COD	220	166	39	15	10	9	9
Asphyxia	6(2.7)*	1(0.6)	1(2.5)			1(11.1)	
Blunt Force Trauma	90(40.9)	25(15.0)	27(69.2)		10(100)	4(44.4)	
Drowning	56(25.4)	22(13.2)	3(7.6)			1(11.1)	
Other	5(2.2)	1(0.6)	1(2.5)				
Natural	23(10.4)	84(50.6)	1(2.5)	10(66.6)		3(33.3)	6(66.6)
Procedure	20(9.0)	19(11.4)	3(7.6)	1(6.6)			
Thermal	16(7.2)	10(6.0)	3(7.6)	2(13.3)			
Unascertained	4(1.8)	4(2.4)		2(13.3)			3(33.3)

COD: category of death; HC: head and chest; LA: limited autopsy; MS: multiple sites; ABD: Abdomen*Number of observations (percentage), other category includes: poisonings, gunshot fatalities, advanced stage of decomposition and skeletonization.

Compared to that of illness fatalities, that of blunt force trauma encompasses that of an older age group as well as presents with more injuries in comparison with physiological changes or effects

in the body. Haemorrhages including those of subaponeurotic, subarachnoid, subdural, extradural, subendocardial, petechial, advential nature, were the most common findings in fatalities caused by blunt force trauma (Table 13). Cerebral oedema was also a highly prevalent finding in the post mortem reports examined. Due to the tendency and commonality of the 'other' category of assignment being selected on the SAPS180 documentation (26% of sample), as well as a portion of BFT cases (9%) being unaccounted for by motor vehicle accidents, pedestrian accidents and falls from heights, the investigator examined suspected NAIS and assault fatalities resultant from BFT. After consultation with the doctors at the JFPS as well as with previous literature, eighteen cases of black children were identified as potential NAIS or assault cases.

Table 13: Prevalence of post mortem findings in cases of blunt force trauma fatalities

BLUNT FORCE TRAUMA FINDINGS – N=156	**%**
Haemorrhages	93.5
Contusions	77.5
Fractures	67.9
Cerebral Oedema	59.6
Congestion of internal organs	59.6
Therapeutic measures	48.7
Internal lacerations of organs	46.1

Table 14 summarizes the detailed injury patterning for suspected NAIS cases. The main trend from these findings is that of internal soft tissue damage to the head. This is especially relevant to female fatalities (N=6) in the under five years of age group. Additionally, this percentage are also evident within the over five age group overall. Other high percentage observations are indicated in the

recorded external surface of the body findings within the over five years of age group (83.3%) and the findings of facial injuries within the female category (75%). With respect to the incidents of Sudden Infant Death Syndrome (SIDS); no cases were recorded within the data collection period.

Table 14: Suspected NAIS cases within the blunt force trauma fatalities

Suspected NAIS* signs at Post Mortem Examination **Description of Injuries and/or Findings**	**Female** **N =8(%)**	**Male** **N =10(%)**	**Under 5 years of age** **N =12(%)**	**Over 5 years of age** **N =6(%)**
External surface of the body Dehydrated and wasted appearance Healing/healed lesions, wounds and scars Contusions in various stages of healing (especially to the face, neck, wrists, arms, thighs and buttocks) Scalding 'wet' immersion burns Bites Cigarette burns	4(50)	3(30)	2(16.6)	5(83.3)
Skull and Scalp New and old complex fractures in various stages of healing (especially the occipitoparietal region) Contusions, lacerations and abrasions	4(50)	6(60)	5(41.6)	5(83.3)
Intracranial contents Subdural and subarachnoid haemorrhages Cerebral cortical contusions and lacerations	8(100)	8(80)	10(83.3)	6(100)
Face (eyes, ears, cheeks and mouth) Haemorrhages to the conjunctivae and retinae; dislocation of the lens or retinal detachment Contusion and/or laceration to the pinnae Laceration and /or abrasion to the cheeks Laceration and/or abrasion lips and mouth; chipped or dislodged teeth	6(75)	2(20)	5(41.6)	3(50)
Chest New and old fractures in various stages of healing (especially to the ribs)	1(12.5)	1(10)	1(8.3)	1(16.6)
Abdomen Rupture/perforation; especially the liver and spleen	1(12.5)	2(20)	2(16.6)	1(16.6)
Pelvic Region Evidence of sexual assault: lacerations and contusions of the anal-genital region	1(12.5)			1(16.6)
Extremities New and old fractures in various stages of healing	1(12.5)	1(10)	1(8.3)	1(16.6)

N= 18 cases of black individuals; N (%) = number (percentage) of observations with sex and age categories;* Adapted from Spitz and Fishers (2006), Saukko & Knight (2004), Shepherd & Simpsons (2003) and Mason (1989).

Table 15 illustrates the prevalent findings congruent with natural illness related deaths. Clearly, the occurrences of congestion of the organs, bronchopneumonia changes and lung consolidation were present as prominent findings within the sample. Natural fatalities include fatalities of dehydration, bronchopneumonia and infectious diseases. The recorded incidences of a 'limited or viewing autopsy performed in these fatalities were noted 65 times.

Table 15: Prevalence of post mortem findings in cases of natural illness fatalities

NATURAL ILLNESS FINDINGS – N=127	**%**
Congestion of organs	44.8
Bronchopneumonic changes in the lungs	41.7
Lung consolidation	33.8
Cerebral oedema	30.7

Characteristic of drowning is that of frothy airways and emphysema aqueosum (hyper expanded and waterlogged lungs). However in the sample, the changes of pulmonary oedema and congestion, congestion of the organs and cerebral oedema were the most prevalent documented (Table 16).

The most common and prevalent diagnosis and post-mortem recorded cause of death for procedure related fatalities were predominately congenital heart abnormalities and cardiac fibrosis. In a minority of cases, necrotizing enterocolitis, bowel perforations as well as nephroblastoma were also recorded. Therefore the most common site of intervention was that of the chest. All cases cited evidence of surgery (100%) within the anatomical regions of the body where intervention would have taken place (Table 17).

Table 16: Prevalence of post mortem findings in cases of drowning fatalities

DROWNING FINDINGS - N=82	**%**
Congestion of organs	93.9
Cerebral oedema	78.0
Voluminous lungs (Pulmonary oedema and congestion)	48.7
Haemorrhages	42.8
Froth in the nose and mouth	34.1

Table 17: Prevalence of post mortem findings in cases of procedure related fatalities

PROCEDURE RELATED FINDINGS – N=44	**%**
Surgical intervention	100
Haemorrhages	59.0
Cerebral oedema	52.2

When examining the findings related to thermal mechanisms of death (Table 18), the characteristic features such as soot in the airways or a pugilistic attitude of the body, to be expected in "flame burns" with charring (of living victims), were not documented in the majority of cases. However in 50% of the fatalities evaluated, dry burn wounds were present. Interestingly, the age range found prominent in this category of death was synonymous with a more mobile and independent developmental stage. During data collection, six of the post mortem reports cited 'limited findings 'due the condition of the body and lack/absence of biological evidence. The median age across the years sampled was two to five years.

Table 18: Prevalence of post mortem findings in cases of thermal fatalities

THERMAL FINDINGS = N 31	**%**
Cerebral oedema	67.7
Congestion of the organs	64.5
Burn wounds and Haemorrhages	48.3

In fatalities where no remarkable findings are found at autopsy to form an explanation regarding an individual's death, further investigations are often employed in the form of toxicological, histological or anthropological analysis. The fatalities recorded in this sample were still under investigation at the end of the study period. 'Limited Findings' are commonly cited in cases such as these. Seven of these cases cited 'limited findings'.

In asphyxia related deaths in children (Table 19), the circumstances of obstruction of airways through a foreign object, as well as strangulation and smothering were documented in the eight cases recorded. With respects to haemorrhages, the sub pleural haemorrhages over the surfaces of the lungs, sub-epicardial petechial haemorrhages of the heart and petechial haemorrhages of the conjunctivae were evident.

Table 19: Prevalence of post mortem findings in cases of asphyxia fatalities

ASPHYXIA FINDIGNS (Head and Chest) – N=8	**%**
Congestion of organs	100
Haemorrhages	87.5
Cerebral oedema	50
Airway obstruction	37.5

Fatalities categorized under the ‘other’ category of death include that of the minority incidences of gunshot fatalities, poisoning and child abuse (N=7). Congruent with prevalent findings in the sample, the changes of oedema and congestion of internal organs as well as the effect of haemorrhages as at the site of injury are prominent within this grouping (71.4%). In four of the cases documented, gunshot fatality was determined as cause of death. Two of the cases presented with a history of poisoning.

Chapter 5: Discussion

This chapter will highlight the major findings from the study and compare these findings with previous literature. Insight and suggestions will also be brought to the forefront to aid the questioning of how and why these trends occur. Limitations encountered will serve as a framework for this discussion.

5.1 Limitations of the study

Hindrances in the current study centre on the retrospective study design and materials which the study is reliant on. In the early stages of data collection, the investigator encountered the obstacle of limited or complete absence of vital information from specifically that of the SAPS180 form (appendix D). The main purpose of this form is to accompany the body to the mortuary. Information that should be recorded on this form includes the particulars of the deceased, the particulars or circumstance of death, a full history of the death circumstance as well as additional remarks by the police investigator. Recorded information such as this was instrumental to the analysis of the included sample. As stressed in the introduction of the results chapter, the sample for the current study was significantly amended due to complete lack of information. Cases were omitted primarily due to the lack of demographic details (age, sex and race), the residential address of the deceased (important for the variable of social economic status) and most crucially the circumstance of death (to ascertain the manner of death). However, the situation of 'missing files' in the JFPS case file office, due to axillary and specialized ongoing investigations (mainly toxicological in nature) also added to this dilemma. In majority of SAPS180 forms evaluated, information or remarks about the scene or history of death was completely absent. Following the sample collection, difficulties were experienced with respects to categorizing causes of death. An

adequate and complete circumstance of death would have assisted this categorization process exponentially and possibly altered the results reported in this paper.

In a similar vein, the manner in which the SAPS180 form was completed was in majority of occasions illegible or not understandable by the researcher. This was especially relevant where information about the residential area of the deceased needs to be transcribed for data collection purposes. This lead to the category of 'non-specific 'areas being formulated and accounting for a large proportion of the sample. On a technical note, the SAPS180 form is imperative for administrative, record keeping and investigative purposes. The options cited on the SAPS180 form for particulars of death do not allow for discrimination of accidental or non-accidental delineation. Specific to child fatalities is the importance of ascertaining a full history where suspicion of child abuse or murder is a dependent. The section where full history needs to be recorded doesn't allow for a scene description or account by informants (caregivers or parents) to be recorded. The race classification options provided on the form completely dismisses the recording of Indian South Africans, as Asian is the only option which could be applicable to this population affinity. Correspondingly, the option of 'Brown' is also ambiguous and imprecise.

The above mentioned shortfalls are not only evident on the SAPS180 form. The post mortem examination report (appendix C) doesn't provide for the pre-empted informed opinion of the forensic medical examiner with respect to a NAIS classification. Many of the pathological signs and injuries reported on the post mortem report in the cases included within this sample could be the consequence of an accidental or non-accidental history. If the main directive of researcher was to investigate the nature of homicidal deaths in children received at the Johannesburg Forensic Pathology Services utilizing the above forms as core materials, limited results would be reported. The South African judicial system doesn't classify a death with respect to criminal intent until

weeks, months or years following the post mortem examination and judicial investigation. Research into homicidal death would have to include facilities and services at every level of law enforcement.

Thus, the above limitations obscures the clarity of enquiry in the current study, the discussion which follows shall consider these pitfalls.

5.2 Population Description

Within the sample of 468 (three unknown) fatalities admitted and processed at the Johannesburg Forensic Pathology Services, the median age was that of two years of age. Percentages concerning this include 33% of the sample under the age of one, 58% of the sample being male and 42% that female, 81% were of Black racial affinity and 51% had received medical attention at hospitals prior to death in the jurisdictional areas within which the service operates. In terms of the residential areas which patients originated from, cases were admitted primarily from the northern suburbs of Johannesburg (30%), central Johannesburg (22%) and alarmingly a 25% incidence of 'non-specific' or unknown residential addresses were observed. The prevalent categories of death were that of blunt force trauma (33%), natural/illness related fatalities (27%) and drowning (17%). Consistent with the above, the regions of injury or finding at autopsy were predominately the structures and organs of the head and chest combined (47%) and the chest exclusively (35%).

Within the sample, the injury findings which were observed externally revealed a high percentage of therapeutic signs (39%), abrasions (36%), lacerations (19%) and contusions (17%). Abrasions, lacerations and contusions were located at the sites of impact or injury. These sites are dependent on the circumstance of death. Internally, patients presented with oedema, primarily that of the brain (94%), congestion of the organs (86%) and haemorrhages (50%).

5.3 Prominent findings

When highlighting the most prevalent findings from the study, accidental deaths tend to be more common than homicidal, murder or child abuse fatalities. This could be indicative of environmental stressors or constraints as determinants of child mortality within the Johannesburg jurisdiction as opposed to human behavioural or psychosocial determinants. This result elicits questions regarding the infrastructural influence and public safety of not only children but adult individuals living within the Johannesburg catchment area. Additionally, significant difference was observed in the comparison of age and cause of death (natural and unnatural). Interpretation of this leads one to deduce that certain age groups are more at risk for particular mechanisms and causes of death than others. The current study results herald that natural communicable and infectious diseases affect younger infants and children and older children are at risk of mortality through external or environmental dangers. Therefore at- risk ages in Johannesburg are neonates, three month and younger infants and one year of age and younger infants (Fig.3).

The highest prevalence of cause of death within the sample was that blunt force trauma and natural illness fatalities. In keeping with the above statements, external circumstances such as MVAs, PVAs, and falls from heights, plausible assault and homicide are associated with blunt force trauma. In a positive correlation with publications cited in the introduction chapter of this thesis, falls from heights and traffic accidents present with a high prevalence in hospital settings (Herbert et al, 2012); pre-schoolers are at a high risk to be involved in PVAs (Pretorius and Van Niekerk, 2014; Isaac et al., 2014). Natural circumstances include that of pneumonia, gastrointestinal complications, dehydration and malnutrition.

The most prevalent racial affinity was that of Black individuals. This prevalence can be explained and supported by the demographic makeup of the South Africa as Black individuals constitute of

the racial distribution in the country. A significant difference was equated for in the relationship of biological sex to regions of the body affected (Table 10), therefore suggesting that cause of death might be different between the sexes. A high consistency and accuracy of positive correlation between the police documentation (SAPS180) recorded cause of death and the official post mortem report was observed. This trend ceases in minority or rare causes of death where expert insight is needed to assign a cause of death. Incorrect SAPS180 assignment was found in natural/illness related fatalities (Table 11). There is a commonality or tendency for the police to assign cause of death to the category of 'other' or 'sudden'. A significant difference was observed between the recording of external findings in blunt force trauma and illness related deaths for the age groups of birth to five years of age and six to twelve years of age (Table 8). This is explained through the mechanism of death as trauma often presents with external findings, whereas the signs of natural deaths are noted during the internal examination of the body. In terms of racial affinity, there was a significant difference between White and Black paediatric patients who received therapeutic intervention or who were admitted to hospital prior to death (Table 9). Additionally, there was also a difference between White and Black paediatric patients who presented with external injuries at post mortem examination (Table 9). Could the conversation about the accessibility and service of health care to individuals of a lower socio-economic background be relevant here?

A topic related to the above is the residential area the patient resided in prior to death. This study found that risk suburbs for fatality include the northern suburbs. These suburbs constitute of a combination of low, intermediate and high socio-economic status. Therefore, it is problematic to suggest that decedents of a lower socio-economic background are at risk. The lack of specific data related to each individual case explains the impossibility of this deduction. To complicate this issue further, a large amount of the sample was recorded as originated from non-specific areas.

Without adequate and comprehensive recorded information about cases included in the sample, a discussion on the variable of socio-economic would be ill advised, uninformed and vague.

In terms of the region of injury variable in the study, within the category of blunt force trauma (BFT), multiple sites were recorded in 100% of cases. In 69.2% of the neck region being recorded with remarkable findings, signs of BFT were observed, followed by 40.9% of the head and chest. Natural fatalities were found to constitute 66.6% of all recorded practices of 'limited autopsy' as well as 50.6% of all chest region injuries or pathology. Drowning fatalities constituted 25.4% of head and chest region injuries and 13% of chest findings (Table 12).

Injury patterning within the prevalent categories of death was dominated by effects of injuries or physiological responses to trauma or asphyxia. Externally, in BFT cases 77% included contusions and 67.5% included fractures. With respects to internal findings in the sample, 93.5 % of BFT cases included findings of haemorrhage, 44.8% of natural illness fatalities included congestion of organs, and 41.7% included Bronchopneumonic changes in the lungs and 33.8% lung consolidation. In drowning fatalities, 93.9% included congestion of organs, 78% included oedema of the brain.

When comparing this population with the previous literature, the highlighted difference is that of a demographic nature. Differences of this sample to literature in paediatric pathology are based in the population components of age, sex and race. A discussion about these variables within the prevalent causes of death observed within the sample will follow.

5.4 Comparison of age ranges and causes of death with previous literature

The highest category of death encountered in the sample was that of blunt force trauma (BFT). BFT includes accidental injury fatalities of motor vehicle accidents, pedestrian vehicle accidents

and fall from heights. In positive correlation with global trends and publications in both underdeveloped and developed countries, the phenomenon of BFT indicates that infants and children are great risk of mortality (Imamura, 2012; Diamond et al., 2009; Hyder, 2008; Peclet et al., 1990 & Mason, 1989). Majority of cases observed in the sample fall within the range of two to three years. As this category constituted 33% of the sample, 11% was consequential of PVAs, 7% of MVAs and 6% of fall from heights. The circumstance of road traffic fatalities in the paediatric population being more prevalent in pedestrian scenarios claimed by Hyder (2008) coincides comfortably with the findings of the SAPS reported causes of death in this study (11% of sample) .

This positive correlation of this occurrence is possibly accounted for by density of numbers in the paediatric population prevalent in the inner city as well as the potential lack of parental supervision and care. The high concentration of drivers on South African roads adds a realistic risk for child mortality through the circumstance of motor vehicle collisions. In tentative agreement with these authors, the findings of this research indicate that accidental fatalities outweigh the potential of assault or homicide. Judging by the composition and nature of the JFPS sample, non-accidental injury isn't a common cause of fatalities received at the JFPS. However, 9% of this portion is unaccounted for. The assignment of 'other' constituted 26% of the sample on the police documentation. Perhaps a percentage of the 'other 'cases can be attributed to non-accidental injury?

The criteria by Knight in Mason (1989); Van As & Garach (2008); McDonald (2007); and Phillips & Van de Heyde (2006) on child abuse and suspected child murder provided instructive and diagnostic information on non-accidental injuries. A fair assumption would be to posit that some of the blunt force fatalities within the sample ranging under the age of two without valid

information or admitted to the facility as ‘sudden or other’ could be suspected intentional and inflicted injury. This assumption is loaded with potential pitfalls, as collateral information from the scene and involved parties is crucial to the medico-legal investigation. These ambiguities lead one to surmise that the conclusion that all blunt force trauma resulted from motor vehicle collisions and falls is unfounded. Because of this, age range comparisons are problematic as many circumstances could be resultant in BFT. Without vital information about circumstance of death, comparisons would not be reliable or valid and the investigator can only make assumptions or deductions on the data available. However, through a process of exclusion, 18 blunt force trauma fatalities were selected from the SAPS180 category of ‘other’ or ‘sudden’. These fatalities exhibited classic and suggestive features of NAIS. When examining the age category from this limited data set, the distribution was skewed in that majority of suspected NAIS cases fell within the under five years of age grouping (Table 14).

Within the same assumption as above and in accordance with Matschke et al., (2009) and Tzioumi and Oates (1998), subdural haematomas are indicative of non-accidental injury in infants younger than two years of life. The current sample revealed a prevalence of subdural bleeding in blunt force fatalities. The findings are in agreement with the above authors; however the median age for these fatalities was that of an older age group. This discrepancy could be attributed to the large amount of vehicle related deaths, however the similarities allow for the investigator to assume that a portion (namely cases assigned as ‘other’ or ‘sudden’) are most likely due to a suspected non-accidental manner of paediatric death and more specifically due to that of suspected child abuse. In such cases, comprehensive thorough post mortem examinations can clearly confirm suspicions of child abuse, when all the injurious findings are considered and correlated. Keeping within the manner of caution it needs to be noted that subdural bleeds aren’t exclusively associated with

trauma. Geddes and Whitwell (2004) claim that a physiological aetiology is entirely viable when examining pathology of the brain and surrounding structures as opposed to that of trauma. An isolated finding of subdural haematoma can thus never be used as a pathognomonic indicator of trauma or child abuse.

The study displayed a significant difference in age ranges within natural and unnatural deaths (Table 7). One can deduce that developmental and socio-economic constraints are operational to produce this result. The age range observed for natural fatalities received at the JFPS during the data collection period was six months to two years of age. As mandated in South African legislation, all unknown or sudden deaths are admitted to the facility for investigation. Natural causes of death represented the second highest occurrence of paediatric fatalities in the sample. As stressed by Andrews and colleagues (2008) as well Saloojee and Pettifor (2005), illness related fatalities in early development are common in the African countries. As a consequence of developing countries, poverty, low standard of clean water, sanitation and electricity utilities are dominant contributors to this relationship. The jurisdiction which the JFPS operates includes formal as well as informal settlements. These settlements are often directly adjacent to each other. An example of this can be observed through the close geographic proximity of Sandton (a high socio-economic area) and Alexandra (a low socio-economic area), both of which are situated in the northern suburbs. One of the prominent findings of this study was the high number of paediatric fatalities originating from the northern suburbs of Johannesburg. The findings by Guildea and colleagues (2005) are supported by the results of this study as neonates and infants in urbanized areas were found to be at greater risk of infection then that of their rural counterparts. The distribution of infants under the age of two being closely associated with natural fatalities in the current sample, adds weight to this argument.

The third most prevalent cause of death in the sample was that of drowning. The universal characteristics recognized by Shepherd and Simpson (2003) were found in the majority of drowning cases observed. The concerning realization in these figures and statistics is that despite legislation and interventions regarding the prevention of drowning fatalities, the circumstance of drowning in the paediatric population, remains prevalent globally. The age range noted in the sample was between one and two years. Developmental constraints and lack of parental supervision are main contributors here. Shkrum & Ramsay (2007) provided insight into why this age of development is vulnerable. Limited mobility and difficulty in eradicating oneself from a dangerous situation are reasons for this vulnerability. This reasoning is further supported by Salomez and Vincent (2004), as first world and developing countries experience numerous accidental paediatric drowning deaths, irrespective of political, social and cultural climate.

5.5 Comparison of sex and race with previous literature

When reviewing the results for the variables of sex and race within the study, significant differences were observed with relation to previous hospital admission (race) and the presence of external findings (sex and race). The difference was found in the presence of external findings at post mortem examination of black and white paediatric cases as well as in prior admission to a hospital before death (Table 9). Clearly, White children are admitted to hospital for medical intervention more frequently then Black children. These findings elicits questions about the accessibility of appropriate health care, economic cost for the medical intervention as well as the transport facilities available to arrive at the hospital for care. Additionally, the finding of external injury presentation being more prevalent in White children compared to that of Black, suggests that Black individuals are at far greater risk for fatality due to natural/communicable diseases than White individuals. Is this discrepancy due to limited health care services as suggested by Burgard

and Treiman (2006), whereby optimistic idealistic changes following South Africa's turbulent history haven't been afforded the support necessary to be made realistic? Or perhaps this finding is a consequence of policies not being implemented as suggested by Coovadia and colleagues (Coovadia et al., 2009)? Another suggestion would be the ideology and attitude of parents and caregivers following an accident or onset of disease, whereby medical intervention at a clinic or hospital is necessary for survival. Perhaps the constraints of one's socio-economic situation could produce seeking out medical care unlikely and impossible to some. However, is it fair to suggest that in many communities, the advice and 'treatments 'of the traditional healer far outweigh the opinions and recommendations of western interventions? This suggestion would certainly be supported by Colvin and colleagues (2013), where the belief systems of families are perceived as highly influential on the health of children within the family unit.

In terms of biological sex, several publications have reported that male children are at more risk for mortality than females (Colvin et al., 2013; Kanchan et al., 2009; Hyder et al., 2008; Brown et al., 2006; Salomez & Vincent, 2004; Declet et al., 1989). Balsara and colleagues are suggesting that males are more vulnerable to mortality across a variety of medical conditions. Thus implying that an investigation into genetic and hormonal mechanisms be conducted (Balsara et al., 2013). As head injury fatalities served as a prominent finding in the JFPS sample, it is prudent to examine any possible linkage with previous research. In Kotze and colleagues (2007) review of fatal child abuse cases within the South African context, there were significantly more females than males. An explanation for this discrepancy is once again focus of the study. Kotze and colleagues investigated child abuse cases. The mandate for the current study focused on the prevalence of all child fatalities within the data collection period. However, when examining the suspected NAIS cases within the sample, the female percentage is higher than that of males (Table 14) with respects

to head injuries. Could this finding be suggesting that accidental and natural fatalities are more common in males and child abuse or NAIS fatalities more prevalent in females within the Johannesburg jurisdiction?

5.6 Discussion on the police documentation and post mortem report

The admission of a deceased individual to the Johannesburg Forensic Pathology Service requires the accompanying police document (SAPS180). When one observes the results of the correlation of police documentation and post-mortem report findings (Table 11), a discussion can be explored about the possible deficiencies of the police documentation itself. An example of this can be observed in the prevalence of blunt force trauma fatalities in the sample. Thirty cases were admitted as 'other', five were assigned as 'sudden', one as drowning, one as anaesthetic and one as assault. Extrapolating from this, one can surmise that out of 156 blunt force trauma fatalities, only one allowed for a history indicating intentional harm resulting in a homicide. From an administrative perspective, categories of death which suggest neglect, abuse or intent of harm are not included on the current form. This therefore creates an obstacle in terms of the onset of investigation as well as future research studies. From an educational perspective, the question regarding the training of police services to ascertain the circumstance of death is also questionable. The results of this study indicate that police personnel utilize the category of 'other' or 'sudden' as a means when the death doesn't subscribe or fit with any of the other categories available on the form. This tendency can be seen in the negative correlations of natural illness fatalities. An added variable to consider is the question of the nature of death. Several of the options available on the form could be accidental, homicidal or potential murder. Therefore, due to the lack of options presented on the SAPS180 form, the suggestion of reformulation is prudent. Refining this form could also include the introduction of a child death form which is applicable to all children

under the age of 12. This would ensure that suspected cases of NAIS or child murder are identified timeously and judicial/ criminal investigation procedures can proceed. A template of the SAPS180 form can be examined in appendix D.

During the data collection and data analysis period, the investigator encountered a variety of cause of death descriptions on the post mortem report which were then categorized for statistical purposes. This variety in the method of reporting of cases by forensic medical practitioners hinders the data capturing processes. To successfully render the service of forensic pathological examination, which assists in the investigation process of potential criminal acts – a standard of reporting different causes of death on the official post mortem report is necessary. The proposal of a standard recording method or codes would ensure efficiency in data capturing and statistical record keeping for research purposes. The current study depended on the reliability and validity of these two official documents. The discrepancies and deficiencies observed therefore compromise the confidence of results expressed in the previous chapter. Thus, communication and collaboration between the different avenues of forensic investigation within the various police jurisdictions require improvement and streamlining. A further suggestion would be to facilitate a national service level agreement between Forensic Pathology Services and the South African Police Service.

5.7 Comparison of pathological findings and categories of death

The approach to a discussion about the biological findings and abnormalities present in the research sample would have to negate the non-specific findings (e.g. cerebral oedema and congestion of the organs), which outweigh that of the specific findings that lead to determination

of cause of death exponentially. Specific injuries or disease processes prevalent in the sample will be compared with that of previous publications. By introduction, the regions of the body prevalent in the sample will be discussed, followed by those directly related to the injuries recorded.

When one examines the correlation between the region of injury and the category of death (Table 12), the head and chest region of the body is found to be compatible with the prominent categories of death in the sample. The commonality of the head and chest regions in the cases of blunt force trauma fatalities, natural disease related deaths and drowning scenarios coincide with the injuries and the systemic response to injury or shock to the vital organs of these regions. Understandably, 40.9% of all head and chest injuries and 100% of multiple sites were attributed to blunt force trauma. This finding alludes to the fact that majority sample of fatal trauma is caused by head injuries as well as multiple injuries congruent with vehicle accident circumstances. Similarly, 50.6% of chest region findings were caused by natural illness disease processes. This finding explains the commonality of bronchopneumonia fatalities in the sample and highlights that young toddlers and infants within the Johannesburg area are extremely vulnerable to respiratory communicable diseases. Drowning fatalities contributed to 25.4% of head and chest findings. As with the above, this is explainable in terms of the mechanism of this type of asphyxia to the tissues and organs of these regions.

In an investigation into the patterns of injury and pathology which accompanies the fatality of road traffic deaths, one can surmise from the previous chapter that external injuries or findings synonymous with the above include abrasions, contusions, fractures and lacerations. This result is in agreement with Derlet et al., (1989), Shepherd and Simpson (2003). Due to this similarity, it wouldn't be unjustified to assume that the scenario consequences claimed by Serre et al., (2010) are viable in the South African context. Though the information regarding point of impact or

trajectory weren't known variables in this study; the above accuracies with international findings support the claim that the bonnet or hood of the vehicle is a common site for impact in child pedestrian vehicle accidents. However, do children suffer patterns which are exclusive to their developmental stage? Toro et al., (2005) disagree with this assumption as the extensive array of pedestrian injuries encountered in the author's adult sample included skull fractures, epidural haemorrhages, subdural haemorrhages, brain contusions and injuries to the extremities. These injuries were all prevalent in the patterns of blunt force trauma recorded in the post mortem examination reports examined for this study.

Majority of the injuries or effects of injuries in blunt force trauma fatalities found in the JFPS sample were the presence of haemorrhages, fractures of the skull, vertebral column and extremities, cerebral oedema, contusion and congestion and lacerations. The presence of therapeutic interventions provides evidence of prior hospital admission. This deduction is further emphasized by the equal distribution of prior hospital admissions in the sample, mirroring that of the top highest categories of deaths – blunt force trauma and illness related circumstances. The significant association of Black child fatalities and prior hospital admission as well as external injuries suggests that governmental clinics and hospitals admit a large number of individuals following road traffic accidents, where immediate intervention is undertaken. The negative correlation between the literatures found here could be accounted for by the difference in study designs and overall mandates in perspectives for research.

In agreement with Kanchan et al., (2009), older children are more at risk for road traffic accidents than their younger counterparts. Though the age range for blunt force trauma fatalities is two to three years (younger than illness related deaths), one can still concur with that of Saukko and Knight (2004) that seatbelts as well as car seats are a necessity for travel via motor vehicle.

Seatbelts also cause injuries which equate to 'seatbelt syndrome'. This condition comprises injuries to the abdominal organs (liver, spleen, kidneys and mesentery), as well as that of head, chest, vertebral column, pelvis and skeleton (Shkrum & Ramsay, 2007; Knight& Saukko, 2004; Shepherd & Simpson, 2003). From the findings in this study – abdominal injuries weren't in the majority and findings conclusive with the abdomen were attributed to autolysis and early decomposition. Could a lack of seat belt and paediatric car seat practices in South Africa account for this finding?

When a comparison is made with the results of the Crash Reconstruction Network (CIREN) and the findings of this study, a congruent trend of lateral impact directionality resulting in the majority of the blunt force trauma fatalities, was found. These were focused on the regions of the head and chest areas (Brown et al., 2006). Additionally the authors stress that front-impact direction is also plausible in motor vehicle accident scenarios and as such produce a higher injury severity level or possible demise. The work of Brown and colleagues is most instructive in delineating the relationship of seat position and impact direction. However due to the variety of factors which influence motor vehicle accident scenarios, the aim of comparison of the current sample with that of Brown's would be unfounded. As stressed before in the paper, investigations such as these highlight the importance for enquiry in not only the general patterns of injury from road traffic accidents but the consideration of variables of biomechanics, directionality and velocity, which should be included in research designs in the transportation of children.

Despite the limitations stated above, these research findings allude to the assumption that despite socio-economic, cultural and political discrepancies between affluent and developing counties, the prevalence of vehicle related mortality for the paediatric population is one of the leading categories of death in South Africa at this stage of human history.

Falling from a height was found to be a common form of blunt force trauma in children examined at the JFPS. The primary sites of impact from falls described by Saukko and Knight (2004) illustrate the variability as well as the similarity with fatalities of motor vehicle and pedestrian vehicle accidents observed in the sample. Similarities such as these indicate the importance for a through and comprehensive investigation into the circumstance of death, ideally prior to the medico-legal autopsy. This perspective is adopted by Shepherd and Simpson (2003) as skull fractures are challenging to assess in children in a forensic setting. This is primarily due the lack of universal opinion regarding the reaction of the skull to impact forces. This discrepancy is attributed the neurodevelopment and osteological properties the developing cranial vault. As fractures of the skull are prevalent in these circumstances, the types of fractures recorded during data collection agree with the previous authors with relation to blunt force trauma and falls from heights in particular. These included linear crack, ring, pond and hinge fractures.

The universal descriptions and criterion published in Mason (1989), Shepherd and Simpson (2003), Saukko and Knight (2004) and Spitz and Fisher (2006) served as invaluable references by which to compare cases of suspected NAIS within the blunt force trauma category. Table 14 illustrates the findings from the study and positively correlates to international literature on homicidal deaths in childhood. Similarly, journal publications related to the topic follow suit in this positive correlation and this fundamental knowledge and provide additional insight. As emphasized before in this paper, the distinction between accidental and intentional harm in cases observed within the study is problematic and prone to error and fault. However, the criterion of Bernard Knight cited in Mason (1989) as well as Spitz and Fisher (2006) proves a comprehensive consolidation of features and characteristics which are still relevant in a variety of sociological and cultural contexts. This criterion positively correlates with the research findings.

When one observes the findings of NAIS, externally, 50% of females and 83.3% of children in the over five years of age category presented with findings congruent with indicators of assault or neglect. Signs of dehydration, bruising in various stages of healing and healing or healed wounds of various ages were common findings. There were no recorded observations of scalding "wet "immersion burns, bites or cigarette burns. This is in positive correlation with Spitz and Fisher (2006), Shepherd and Simpson (2003), Carpenter (1999). Skull fractures were also prevalent in the cases evaluated. As with the external surface of the body, 50% of females, presented with skull fractures. In 60% of males and 83.3% of the over five years of age group exhibited with prevalent occipito-parietal fractures. These figures are in agreement with McDonald (2007), Saukko and Knight (2004), Shepherd and Simpson (2003). It is prudent to note that the cases evaluated documented new fractures and not that of old or healing. The importance of a full skeletal radiological survey has been emphasized by the authors such as Hughes-Roberts et al., (2012) and Saukko and Knight (2004). A possible reason for the lack of presentation of old fractures could be the limited documentation utilized to equate the statistical results as well as qualitative counterparts. The incorporation of radiological survey results such as that from 'baby-grams' in future research designs on the topic of child abuse could be highly informative and instructive. Alternatively, a plausible reason for this 'absence' of old fractures could be that consequence of chronic prolonged child abuse isn't common in the sample and that impulse homicidal intent or murder is far more likely.

Haemorrhages, contusions and lacerations of the intracranial contents were more common in suspected NAIS cases then the above mentioned skull fractures. All females included as well as 80% of the males displayed intracranial damage based on the post mortem report. Subdural haemorrhages and subarachnoid haemorrhages were prevalent indicators in this region. In all

children over the age of five, damage to the soft tissues of the brain was evident. Once again, this occurred in 100% of female individuals. The under-five age group is also vulnerable with 83.3% representation. The over representation of the older age group is not congruent with publications cited in this paper as authors have claimed the vulnerability of younger children and infants to child abuse fatalities resultant of head injury (Matschke et al., 2009; Tzioumi & Oates, 1998). It is however important to note that within the cases of NAIS examined, the younger age group (birth to five years) is double that of older children in number. The above described female distribution is in keeping with that of Kotze (2007).

Facial damage was evident in 75% of female fatalities. Within this grouping, laceration and abrasion to the cheeks, mouth and lips followed by haemorrhages of the conjunctivae and retinae were common. This is in compliance with Knight in Mason (1989) and Phillips and Van de Heyde (2006). However the recording of torn frenulum was not found in the cases included. In keeping with the caution advised by the literary authorities referred to when evaluating the suspected cases of NAIS in blunt force trauma, a combination of signs or characteristics need to be present for the suspicion of NAIS to be justified. Each case needs to be assessed in terms of the context and circumstance of death. Therefore the above statements and suggestions are made tentatively though due to our lack of data, however the one trend which is indicative of the current South African context is that of accidental or 'low adult supervision' deaths. These deaths are socio-economic in nature and not indicative of possible mental psychosis or criminal intent. Investigation into this suggestion is obviously necessary to substantiate this logic.

Remaining on the subject of murderous intent, the small number of asphyxia related deaths (Table 19) within the sample requires some consideration in terms of findings at autopsy. Through examination of these cases, the heart and lungs presented with the immediate effect of injury – sub

pleural haemorrhages of the lungs and sub-epicardial petechial haemorrhages of the heart as well as petechial haemorrhages of the conjunctivae. The work of Shepherd and Simpson (2003) as well as Gilliland and colleagues (1994) are supported through these findings. Two strangulation cases and two smothering cases were included in the sample. The work of Verma (2007) is in negative correlation with the study results as majority of asphyxia deaths were male and younger than eight years of age. This suggests a difference in perpetrator mode of operation or perhaps the current sample is too small to be indicative of general characteristics or guidelines.

Corresponding with the findings of this study and that of Du Toit - Prinsloo and Saayman (2014), the presentation of fatal NAIS in medico-legal settings is in the minority in terms of percentage. One case of NAIS and 6 cases of homicide were found in the Pretoria mortuary study which reviewed cases admitted to the mortuary from 2004 to 2008 whilst 18 cases where identified in this study. Homicide can be included under non-accidental injury. Despite the differences in terminology; the commonalities between statistics in these two jurisdictions are indicative of a regional and perhaps national trend. Therefore the researcher makes the statement that the occurrence of road traffic fatalities is far more likely than child abuse or homicide fatalities in paediatric mortality within South Africa.

Natural illness fatalities constituted a large portion of cases within the sample. From a sociological and cultural perspective, Colvin and colleagues (2013) identified themes which contribute to the risk assessment of infectious diseases in young children. South Africa is a multicultural country with a variety of religious and ethnic beliefs. This, coupled with low education levels and psychology deeply rooted in cultural frameworks, produces behavioural patterns which aren't always congruent with modern medicine or public health campaigns and awareness. For these reasons, the investigator proposes research into campaigning and interventions which operate in a

complementary fashion with cultural and ethnic norms. As assessed by Mckerrow and Mulaudzi (2010) pneumonia, septicaemia and diarrhoea are common culprits of child mortality in South Africa. The signs of infectious disease processes evident in the sample were bronchopneumonic changes (41.7% of cases) and lung consolidation (33.8% of cases). The commonality of practicing the protocol of a 'limited autopsy' in half the number of cases sampled debilitates insight into disease processes prevalent within natural fatalities. As stated before, the decision to perform a 'limited autopsy' is a confirmatory measure and not exploratory. Therefore, the sign of illness externally as well as the general condition of the deceased is important to note in these occurrences. The findings associated with natural deaths in the sample found that bronchopneumonia and dehydration (usually due to gastroenteritis) were prevalent categories of fatality. This positive correlation between previous literature and the research conducted at JFPS supports the need for social and economic change in Southern Africa.

Petechial haemorrhages were a major finding in the sample, particularly in the periorbital and conjunctival tissues. This coincides with the research by Somers et al., (2008) relating to the mechanism of drowning. However, this presentation is not exclusive to drowning scenarios as this publication is introduced by including the causes of death – hanging, strangulation, suffocation, electrocution and positional asphyxia as antagonists to the presentation of petechial haemorrhages in the periorbital and conjunctival tissues. This 'presentation' is due to the obstructed venous return from the head and neck structures as well as rise in pressure within the microvasculature in the early post-mortem period (Somers et al., 2008). Nonetheless, positive correlations such as these assist in diagnostic criteria for the assignment of drowning at post mortem examination.

5.8 Procedural efficiency of the South African Police Service and Johannesburg Forensic Pathology Service

A significant volume of identified potential cases which could have been included in this study, were omitted due to lack of information. This obstacle presented the foremost limitation to this research. The absent information pertaining to variables of the study included the age of individuals, sex, race, residential area and assignment of cause of death. This information is meant to be entered on the SAPS180 form. In several cases identified, the post mortem report was not available from the administration office for several months after the data collection period. Even after cases were included in the sample, missing information and a lack of finalised post mortem reports due to incomplete specialized investigations, obscured the research initiative of prevalence even further. Toxicological analysis in South Africa is extremely delayed and consequently post mortem examination reports in suspected poisoning cases cannot be finalised. There are only three National Department of Health (NDoH) Forensic Chemistry Laboratories (FCL's) in South Africa dealing with all the South African forensic toxicological specimens and the volume of cases in combination with the above limitations has resulted in significant delays in forensic toxicological services. Solutions are being worked on, inter alia including planning for a new Forensic Chemistry Laboratory in Kwazulu Natal, as well as increasing of FCL staffing, improving stakeholder competencies and streamlining of methods and protocols (Fenyvesi, pers. comm., 2013).

Due to the high crime rate in South Africa and large jurisdictional responsibility of police and forensic services alike, the investigator ascribes a lack of resources and SAPS training to the inconsistencies in important official documentation and consequently data collection for this study.

Ultimately, the death scene investigations as well as the collection of vital evidence and histories, enable the forensic investigators, forensic medical practitioners and analysts to support and clarify the circumstances which lead to the individual's demise. Without this foundation, the scaffolding JFPS role-players are at a disadvantage when performing their duties to adequately satisfy the requirements of the South African Department of Health and Department of Justice.

5.9 Recommendations for future research

When one assesses the current situation of medico-legal death investigations in Johannesburg, suggestions for future research leans towards an objective to ascertain procedural difficulties and pitfalls. Following the identification of these difficulties, experimental interventions and policies could be implemented within study designs to ascertain their potential success. Ideally, these policies if efficient and beneficial will eventually influence the operational systems of public service facilities such as that of the Johannesburg Forensic Pathology Service. An investigation is crucial into the implementations and practice of the National Health Regulations and Guides at FPS mortuaries in South Africa. The necessity for protocols which promote standardization and the efficiency of SAPS law enforcement is imperative. A prospective study design which includes the assessment of FPS mortuary procedures, both practical and administrative would provide greater insight, which is beyond the scope of the current study. A combined qualitative and quantitative design could evaluate proficiency and protocol implementation at every level. With respects to the South African Police Service, the procedural evaluation mentioned above is relevant here as well. As a component to this, a human behavioural or cognitive-attribution study would be insightful in the aspect of discerning how employees and personnel view their posts, duties and influence on the justice system. Thus these perspectives produce a radiating effect and influence on work ethic and satisfaction. Insight into these key influences on the current problem provides a

basis from which training initiatives, human resources and managerial staff can produce alterations and amendments to current policies and protocols. An inquiry into the Regulations governing crime/ death scene investigations, sampling of evidence and the interviewing of relevant parties privy to the crime, has the potential to influence governmental bodies, whose support is the backbone to these services' operational success.

In terms of paediatric forensic pathology and injuries, it is evident from the results of this study that accidental and natural deaths constitute the majority of fatalities in children. A possible suggestion for further research would be to evaluate the efficiency and pitfalls of emergency services in South Africa. It is the investigator's informed opinion that child mortality in the South African context is primarily due to psycho-social-economic constraints and a lack of education. In absolute agreement with previous authors who attribute paediatric mortality to low standards of living situations and a deficit of basic human needs, the investigator suggests that these aspects form an unstable foundation for children in crucial developmental stages. The added parental or caregiver influences of impaired psychological health, low education levels, life stresses, cultural constraints and conflicting belief systems, produce an inevitable risk environment for young children. Suggestions for future research would constitute of a framework which embodies cultural, psychological and social considerations. The utilization and common practice of safety measures employed for transportation and bodies of water, the delineation of circumstances of blunt force trauma i.e. differentiation of non-accidental and accidental fatalities and the education of public safety in informal settlements are paramount research initiatives which have the potential to influence change in child mortality. Evidence of execution and application of these initiatives is found wanting and therefore investigation into the procedural initiation of these interventions needs to be formulated.

However, it is imperative though to emphasize the challenge facing researchers, officials, social workers and preventative measures geared towards child welfare and health. As described before, the multicultural and varied ethnic dynamic of South Africa poses an obstacle in this feat. Our current socio-economic ‘bridging period’ allows for an awkward gait to manifest in terms of progress in this vein.

Chapter 6: Concluding remarks

To conclude the above findings and assumptions, the prevalence and nature of child mortality within the Johannesburg jurisdiction is not quantifiable or comprehensively explained by the current study, thus the validation of the hypothesis of this study was not possible. Discrepancies in the data consulted produces doubt in the researcher that a clarified and multidimensional understanding of paediatric mortality has been achieved. Credence can be found in the evaluated data with that of international publications from affluent and developing nations alike. The positive correlations of accidental death finding with that of countries such as the Americas and the United Kingdom add weight to the assumption that socio-economic constraints aren't dominant in this vein. However the high prevalence of natural death admission to the site of study alludes to a socio-economic and cultural influence. The legal framework by which the Forensic Pathology Service and the SAPS operate influences the case load as well as type of cases that would be processed. The difference in UK and USA legislation with respects to the definitions of "unnatural deaths" therefore influence the prevalence of paediatric cases received and processed within different jurisdictions. Patterns of injury documented in this study are congruent with global trends, supporting the premise that the manners and indicators of categories of death are universally accepted.

One of the main findings from this inquiry is the 'risk' allocation to certain age ranges. These are concisely described as infants younger than one being susceptible to infectious diseases and trauma being more prevalent in toddlers and young children. The variables of sex and race did not produce any significant trends. However, demographically South Africa's racial distribution is predominately that of Black individuals. As such, the significant number of prior hospital admissions and external injuries noted in Black children is plausible.

Future research of this important social dilemma requires the prospective data capturing of complete and reliable documentation as well as in-depth inquiry and consultation with health and police service personnel. This requires the development and implementation of new and existing procedures and protocols in the Forensic Pathology Service, health care facilities and public service clinics and hospitals.

Reference List

Adamsbaum, C., Grabar, S., Mejean, N., & Rey-Salmon, C. (2010) Abusive head trauma: judicial admissions highlight violent and repetitive shaking. *Pediatrics*, *126*, 546-555.

Adegoke, S. A., & Oginni, L. M. (2011). Predictors of paediatric injury mortality. *South African Journal of Child Health*, *5*(1), 15–18.

Andrews, K. M., Brouillette, D. B., & Brouillette, R. T. (2008). Mortality, infant. *Encyclopedia of Infant and Early Development*, 343–359.

Arslan, H., Subasi, M., Keseimenli, C., Kaphkaya, A., Necmioglu, S., & Kajikci, C.(2002). Problem fractures associated with gunshot wouldns in children. *Injury*, *33*(9), 743-749.

Atwal, G. S., Rutty, G. N., Carter, N., & Green, M. A. (1998). Bruising in non-accidental head injured children; a retrospective study of the prevalence, distribution and pathological associations in 24 cases. *Forensic Science International*, *96*(2-3), 215–30.

Bailey, B., Forget, S., & Gaudreault, P. (2001). Prevalence of potential risk factors in victims of electrocution. *Forensic Science International*, *123*(1), 58–62.

Balsara, S. L., Faerber, J. A., Spinner, N. B., & Feudtner, C. (2013). Pediatric Mortality in Males Versus Females in the United States , 1999 – 2008. *Pediatrics*, *132*, 631–638.

Banaschak, S., Schmidt, P., & Madea, B. (2003). Smothering of children older than 1 year of age — diagnostic significance of morphological findings. *Forensic Science International*, *134*, 163–168.

Bandyopadhyay, S., & Yen, K. (2002). Non-accidental fractures in child maltreatment syndrome. *Clinical Pediatric Emergency Medicine*, *3*(2), 145–152.

Bandak, F.A. (2005) Shaken baby syndrome: a biomechanics analysis of injury mechanisms. *Forensic Science International.151*, 71-79.

Baralic, I., Savic, S., Alempijevic, D. M., Jecmenica, D. S., Sbutega-Milosevic, G., & Obradovic, M. (2010). Child homicide on the territory of Belgrade. *Child abuse & neglect*, *34*(12), 935–42.

Barsness, K. A, Cha, E.-S., Bensard, D. D., Calkins, C. M., Partrick, D. A, Karrer, F. M., & Strain, J. D. (2003). The positive predictive value of rib fractures as an indicator of nonaccidental trauma in children. *The Journal of trauma*, *54*(6), 1107–10.

Bartolomeos K, Kipsaina C, Grills N, Ozanne-Smith J, Peden M (eds).(2012) *Fatal injury surveillance in mortuaries and hospitals: a manual for practitioners.* Geneva, World Health Organization.

Beaver, B. L., Moore, V. L., Peclet, M., Haller, J. A, Smialek, J., & Hill, J. L. (1990). Characteristics of pediatric firearm fatalities. *Journal of pediatric surgery*, *25*(1), 97–9; discussion 99–100.

Bennett, M., Hall, J., Frazier, L., Patel, N, Barker, L., & Shaw, K. (2006). Homicide of children aged 0-4 years, 2003-04: results from the national violent death reporting system. *Injury Prevention*, *12*, 1139-1143.

Births and Deaths Registration Act, No 51. In: 1992.

Blom, L., van Niekerk, A., & Laflamme, L. (2011). Epidemiology of fatal burns in rural South Africa: a mortuary register-based study from Mpumalanga Province. *Burns : journal of the International Society for Burn Injuries*, *37*(8), 1394–402.

Brown, J. K., Jing, Y., Wang, S., & Ehrlich, P. F. (2006). Patterns of severe injury in pediatric car crash victims: Crash Injury Research Engineering Network database. *Journal of pediatric surgery*, *41*(2), 362–7.

Burgard, S. A, & Treiman, D. J. (2006). Trends and racial differences in infant mortality in South Africa. *Social science & medicine (1982)*, *62*(5), 1126–37.

Carpenter, R.F. (1999). The Prevalence and distribution of bruising in babies. *Archives of Disease in childhood*, 80: 363-366.

Choit, R. L., Tredwell, S. J., Leblanc, J. G., Reilly, C. W., & Mulpuri, K. (2006). Abdominal aortic injuries associated with chance fractures in pediatric patients. *Journal of pediatric surgery*, *41*(6), 1184–90.

Colvin, C. J., Smith, H. J., Swartz, A., Ahs, J. W., Heer, J. De, Opiyo, N., George, A. (2013). Understanding careseeking for child illness in sub-Saharan Africa : A systematic review and conceptual framework based on qualitative research of household recognition and response to child diarrhoea , pneumonia and malaria. *Social Science & Medicine*, *86*, 66–78.

Coovadia, H., Jewkes, R., Barron, P., Sanders, D., & McIntyre, D. (2009). The health and health system of South Africa: historical roots of current public health challenges. *Lancet*, *374*, 817–34.

Decker, R. D.,& Hewitson, J.(2011). Congenital heart surgery : what we do to our patients. *Continuing Medical Education*, *29* (11), 467–470.

Derlet, R. W., Silva, J., & Holcroft, J. (1989). Pedestrian accidents: adult and pediatric injuries. *The Journal of emergency medicine*, *7*(1), 5–8.

Diamond, I. R., Parkin, P. C., Wales, P. W., Bohn, D., Kreller, M. A, Dykes, E. H., Wesson, D. E. (2009). Pediatric blunt and penetrating trauma deaths in Ontario: a population-based study. *Journal of pediatric surgery*, *44*(5), 981–6.

Du Toit-Prinsloo, L & Saayman, G.(2014). Fatal head injuries in children under the age of 5 years in Pretoria. *American Journal of Forensic Medicine and Pathology*.

Edelman, L. S. (2007). Social and economic factors associated with the risk of burn injury. *Burns : journal of the International Society for Burn Injuries*, *33*(8), 958–65.

Fujiward, T., Barber, C., Schaechter, J., & Hemenway, D. (2009). Characteristics of infant homicides: findings from a U.S. multisite reporting system. . *Pediatrics,* 124:e210-e217.

Geddes, J. F., & Whitwell, H. L. (2004). Inflicted head injury in infants. *Forensic Science International*, *146*(2-3), 83–8.

Greenbaum, A. R., Donne, J., Wilson, D., & Dunn, K. W. (2004). Intentional burn injury: an evidence-based, clinical and forensic review. *Burns : journal of the International Society for Burn Injuries*, *30*(7), 628–42.

Guildea, Z. E. S., Fone, D. L., Dunstan, F. D., Cartlidge, P. H. T., & Park, H. (2005). Differences in risk of mortality under 1 year of age between rural and urban areas : an ecological study,*119*(5), 442–447.

Gilliland, M.G.F., Luckenbach, M.W., Chenier, T.C. (1994). Systemic and ocular findings in 169 prospectively studied child deaths: retinal hemorrhages usually mean child abuse. *Forensic Science International, 68*: 117-132.

Hall, C. M., & Ng, C. S. (1998). Costochondral junction fractures and intra-abdominal trauma in non-accidental injury (child abuse). *Pediatric Radiology*, *12*(28), 671–676.

Hastings, L. A., & Bushman, G. (2006). The anesthesiologist and the perioperative environment for the patient with congenital heart disease *Pediatric Anesthesia*, *25*(3),149–158.

Health Professions Ammendment Act, No 29. In; 2007.

Herbert, H.K, Van As, A.B., Abdulgafoor, M., Mtambeka,D., Stevens, K.A., Millar, A.J.W& Hyder, A.A.(2012). Patterns of pediatric injury in south africa: an analysis of hospital data between 1997 and 2006. *Journal of Trauma and Acute Care Surgery*. 73 *(1): 168-174*.

Hewitson, J., & Zilla, P. (2010). Children's heart disease in sub-Saharan Africa : Challenging the burden of disease. *SA Heart*, *2*(7), 18–29.

Hon, K.-L. E., & Leung, A. K. C. (2010). Childhood accidents: injuries and poisoning. *Advances in pediatrics*, *57*(1), 33–62.

Hughes-Roberts, Y., Arthurs, O. J., Moss, H., & Set, P. A. K. (2012). Post-mortem skeletal surveys in suspected non-accidental injury. *Clinical radiology*, *67*(9), 868–76.

Hyder, A. A., Muzaffar, S. S. F., & Bachani, A. M. (2008). Road traffic injuries in urban Africa and Asia: a policy gap in child and adolescent health. *Public health*, *122*(10), 1104–10.

Ibrahim, N. G., Wood, J., Margulies, S. S., & Christian, C. W. (2012). Influence of age and fall type on head injuries in infants and toddlers. *International journal of developmental neuroscience*, *30*(3), 201–6.

Imamura, J., Troster, E., & Oliveira, C. (2012). What types of unintentional injuries kill our children? Do infants die of the same types of injuries? A systematic review. *Clinics*, *67*(9), 1107–1116.

Inquests Act, No 58. In; 1959

Isaac, K. N., Van Niekerk, A. & Van As, A.B. (2014): Child road traffic crash injuries at the Red Cross War Memorial Children's Hospital in Cape Town, South Africa in 1992, 2002 and 2012, *International Journal of Injury Control and Safety Promotion*.

Johnson, C. F., & Showers, J. (1985). Injury variables in child abuse. *Child abuse & neglect*, *9*(2), 207–15.

Kanchan, T., Menezes, R. G., & Monteiro, F. N. P. (2009). Fatal unintentional injuries among young children--a hospital based retrospective analysis. *Journal of forensic and legal medicine*, *16*(6), 307–11.

King, W. J., Mackay, M., Sirnick, A. (2003). Shaken baby syndrome in Canada: clinical characteristics and outcomes of hospital cases. *Canadian Medical Association Journal*, *168*(2), 9–13.

Kraft, J. K. (2011). Imaging of non-accidental injury. *Orthopaedics and Trauma*, *25*(2), 109–118.

Kotze, G.P.J., Jager, I., Van Schalkwyk, L., & Joubert, G. (2007). Fatal child abuse: a literature review and profile in the southern Free State (1995-2003). *South African Family Practice*, 49:15.

Lee, A. C., Ou, Y., & Fong, D. (2003). Depressed skull fractures: a pattern of abusive head injury in three older children. *Child Abuse & Neglect*, *27*(11), 1323–1329.

Leestma, J. E. (2005). Case Analysis of Brain-Injured Admittedly Shaken Infants. *The American Journal of Forensic Medicine and Pathology*, *26*(3), 199–212.

Lourens (2006) Procedure-related deaths - aspects to keep in mind. *Continuring Medical Education*, *24* (3), 140-141.

Gilliland, M.G.F., Luckenbachb, W., & Chenier, C. (1994). Systemic and ocular findings in 169 prospectively studied child deaths: retinal hemorrhages usually mean child abuse. *Forensic science international*, *68*, 117–132.

Mason, J.K.(Ed.).(1989) *Paediatric forensic medicine and pathology*. London: Chapman &Hall.

Marten, R., McIntyre, D., Travassos, C., Shishkin, S., Longde, W., Reddy, S., Vega, J.(2014). An assessment towards universal health coverage in Brazil, Russia, India, China and South Africa (BRICS). *The Lancet*, 1-8.

Matschke, J., Voss, J., Obi, N., Görndt, J., Sperhake, J.-P., Püschel, K., & Glatzel, M. (2009). Nonaccidental head injury is the most common cause of subdural bleeding in infants <1 year of age. *Pediatrics*, *124*(6), 1587–94.

McDonald, K.C. (2007). Child Abuse: Approach and management. *American Academy of Family Physicians*, 75:221-228.

Mckerrow, N., & Mulaudzi, M. (2010). Child mortality in South Africa: Using Existing Data, *South African Health Review*,59–71.

Moar, J. J. (1996). Anaesthetic-associated mortality and anaesthetic contributory death: the South African medicolegal approach. *Forensic science international*, *78*(3), 219–30.

Munang, L.A., Leonard, P.A., & Mok, J.Y.Q. (2002). Lack of agreement on colour description between clinicians examining childhood bruising. *Journal of Clinical Forensic Medicine*, 9: 171-174.

National Forensic Pathology Services Committee-Academic and Professional advisory sub-committee, 2007, in the National Health Act, No 61. In; 2003.

National Health Act, No 61. In; 2003.

Nieminen, H. P., Jokinen, E. V., & Sairanen, I. (2007). Causes of late deaths after pediatric cardiac surgery. *Journal of American College of Cardiology*, *50*(13), 1263-1271.

Ntuli, S.T., Malangu, N., & Alberts, M. (2013). Causes of death in children under five years old at a tertiary hospital in Limpopo province of South Africa. *Global Journal of Health Science.*Vol.5 (3), pp 95-100.

Overpeck, M. ., Brenner, R. ., Trumble, A. C., Trifeletti, L. B., & Berendes, H. W. (2006). Risk factors for infant homicide. *The New England Journal of Medicine*, *339*(17), 1211–1216.

Peck, M. D. (2011). Epidemiology of burns throughout the world. Part I: Distribution and risk factors. *Burns : journal of the International Society for Burn Injuries*, *37*(7), 1087–100.

Peclet, M. H., Newman, K. D., Eichelberger, M. R., Gotschall, C. S., Guzzetta, P. C., Anderson, K. D., Bowman, L. M. (1990). Patterns of injury in children. *Journal of Pediatric Surgery, 25*(1), 85–91.

Peltier, P.J., Purdue, G., Shepherd, J.R. (2001). Burn injuries in child abuse. *Office of Juvenile Justice and Delinquency Prevention*, 1-24.

Phillips, V.M., & Van Der Heyde, Y.(2006) Oro-facial trauma in child abuse fatalities. *South African Medical Journal,96* (3), 213-5.

Pieterse D, Groenewald P, Burger L, Kirk G, Bradshaw D. (2009).Cause of Death Certification: A Guide for completing the Death Notification Form (DNF) – BI-1663. Cape Town: *South African Medical Research Council*.

Pretorius, K & Van Niekerk, A. (2014). Childhood psychosocial development and fatal injuries in Gauteng, South Africa. *Child: Care, Health and Development*, 1-10.

Rao, P., & Carty, H. (1999). Review Injury : Review of the Radiology. *Clinical radiology*, *54*, 11–24.

Regulations Regarding the Rendering of Forensic Pathology Service, in the National Health Act, No 61. In; 2003.

Ross, A. H., Abel, S. M., & Radisch, D. (2009). Pattern of injury in child fatalities resulting from child abuse. *Forensic science international*, *188*(1-3), 99–102.

Salomez, F., & Vincent, J. L. (2004). Drowning: a review of epidemiology, pathophysiology, treatment and prevention. *Resuscitation*, *63*(3), 261–8.

Saloojee, H., & Pettifor, J. M. (2005). International child health: 10 years of democracy in South Africa; the challenges facing children today. *Current Paediatrics*, *15*(5), 429–436.

Salti, N. (2010). Relative deprivation and mortality in South Africa. *Social science & medicine (1982)*, *70*(5), 720–8.

Saukko, P., & Knight, B. (2004). *Knight's Forensic Pathology* (3rd ed.). London: Arnold.

Seedat, M., Van Niekerk, A., Jewkes, R., Suffla, S., & Ratele, K. (2009). Violence and injuries in South Africa: prioritising an agenda for prevention. *Lancet*, *374*, 1011–22.

Sep, D., & Thies, K. C. (2007). Strangulation injuries in children. *Resuscitation*, *74*(2), 386–91.

Serre, T., Lalys, L., Bartoli, C., Christia-Lotter, A., Leonetti, G., & Brunet, C. (2010). Child pedestrian anthropometry: evaluation of potential impact points during a crash. *Accident; analysis and prevention*, *42*(6), 1943–8.

Shepherd, R., & Simpson, K. (2003). *Simpson's Forensic Medicine* (12th ed.). London: Arnold.

Shkrum, M. J., & Ramsay, D. A. (2007). *Forensic Pathology of Trauma: Common Problems for the Pathologist*. Totowa, New Jersey: Humana Press.

Skellern, C. Y., Wood, D. O., Murphy, a, & Crawford, M. (2000). Non-accidental fractures in infants: risk of further abuse. *Journal of paediatrics and child health*, *36*(6), 590–2.

Somers, G. R., Chiasson, D. a, & Taylor, G. P. (2008). Presence of periorbital and conjunctival petechial hemorrhages in accidental pediatric drowning. *Forensic science international*, *175*(2-3), 198–201.

Spear, R. M. (1992).Anesthesia for premature and term infant: perioperative implications. *The Journal of Pediatrics*, *120* (2), 165-176.

Spinelli, M. G. (2001). A systematic investigation of 16 cases of neonaticide. *American Journal of Psychiatry*, *158*,811-813.

Spitz, W.U. (Ed.). (2006). *Spitz and Fisher's Medico legal Investigation of Death: guidelines for the application of pathology to crime investigation*. (4th ed.) USA: Charles C Thomas.

Steenekamp, J. (2010). General Aspects of the South African Legal System with Special Reference to the Medical Practitioner. *Forensic Medicine course notes*. University of the Witwatersrand.

Tooley, G. A., Karakis, M., Stokes, M., & Ozanne-Smith, J. (2006). Generalising the Cinderella Effect to unintentional childhood fatalities. *Evolution and Human Behavior*, *27*(3), 224–230.

Töro, K., Hubay, M., Sótonyi, P., & Keller, E. (2005). Fatal traffic injuries among pedestrians, bicyclists and motor vehicle occupants. *Forensic science international*, *151*(2-3), 151–6.

Tso, E. L., Beaver, B. L., & Haller, J. a. (1993). Abdominal injuries in restrained pediatric passengers. *Journal of pediatric surgery*, *28*(7), 915–9.

Tzioumi, D., & Oates, R. K. (1998). Subdural hematomas in children under 2 years. Accidental or inflicted? A 10-year experience. *Child abuse & neglect*, *22*(11), 1105–12.

Van As, A.B., & Garach, S.R.(2008) Femur fractures in infants. *South African Medical Journal*, *98*,(1), 23-24.

Verma, S. K. (2007). Pediatric and adolescent strangulation deaths. *Journal of Forensic and Legal Medicine*, *14*(2), 61–64.

Wang, H.(2014). Global, regional, and national levels of neonatal, infant and under 5 mortality during 1990-2013: a systematic analysis for the global burden of disease study. *The Lancet*, 1-20.

Weinberg, A. C., Huang, L., Jiang, H., Tinloy, B., Raskas, M. D., Penna, F. J., Nguyen, H. T. (2011). Perioperative Risk Factors for Major Complications in Pediatric Surgery : A Study in Surgical Risk Assessment for Children. *American College of Surgeons*, *212*(5), 768–778.

Williams, B. G., Gouws, E., Boschi-pinto, C., Bryce, J., & Dye, C. (2002). Estimates of world-wide distribution of child deaths from acute respiratory infections. *Lancet*, *2*, 25–32.

Appendices

A – Data sheet template

B – Ethics Clearance certificate

C – Post mortem examination report template

D – SAPS180 form template

DATA SHEET

Documentation of paediatric injuries (Thornton 2011 & FPS JHB)

Case Number: _____ Date of Autopsy: _____

Date of Death: _____ Age at Death: _____ (Estimated/Actual)

Ancestry: _____ (B/W/C/A/?) Sex: _____ (M/F) Stature: _____

Socio-economic status: _____

Name of Doctor: _____ Date of Analysis: _____

1. Description of "circumstance" of death

☐ MVA ☐ PVA ☐ Fall ☐ Drowning/asphyxia

☐ Hospital case ☐ SIDS ☐ Assault ☐ Illness

☐ Poisoning ☐ Burns ☐ Gunshot wounds

☐ Other:

_____

2. External appearance of affected area:

☐ No visible soft tissue injuries

☐ Visible soft tissue injuries:

☐ Contusions ☐ Abrasions ☐ Lacerations ☐ Incised wounds

3. Region of soft tissue/skeletal injuries:

☐ Head ( )

☐ Neck ( )

☐ Anterior Chest ( )

☐ Posterior Chest ( )

☐ Anterior Abdomen ( )

☐ Posterior Abdomen ( )

☐ Anterior Pelvis ( )

☐ Posterior Pelvis ( )

☐ Upper Extremity ( )

☐ Lower Extremity ( )

4. Description of soft tissue/skeletal injuries:

☐ Head ……..

……

.....

.....

☐ Neck ……...

……

☐ Anterior Chest ……..

…..……..

☐ Posterior Chest ……..

…..……..

☐ Anterior Abdomen ……..……..

…..……...

☐ Posterior Abdomen ……..……..

…..……...

☐ Anterior Pelvis ……..……

……..……...

☐ Posterior Pelvis ……..……..……

……..……..

.

☐ Upper Extremity ……..……

……..……...

☐ Lower Extremity ……..……

……..……...

5. Does admission (to morgue) cause of death = final postmortem cause of death:

……

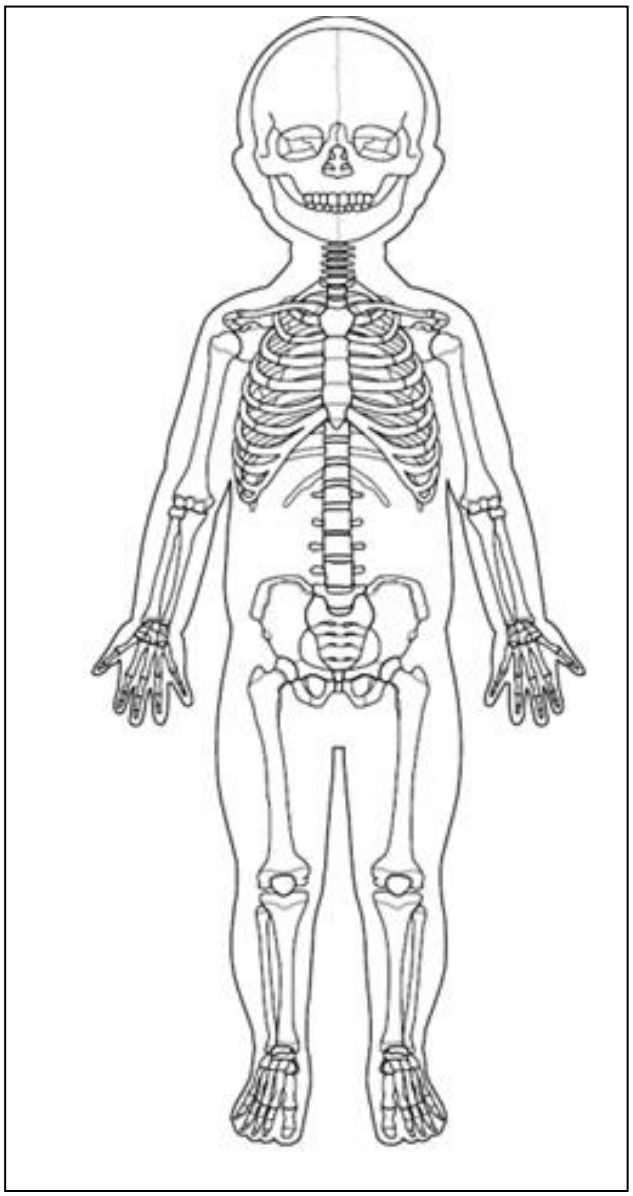
……

……

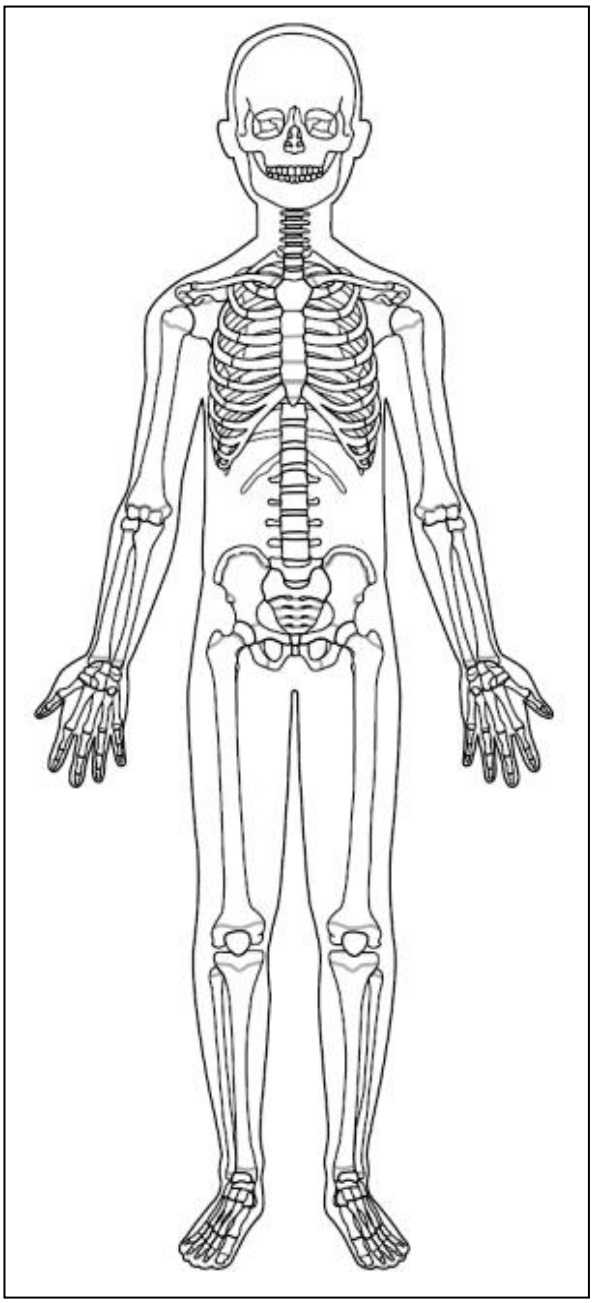
……

Additional notes:.....
.....
.....
.....
.....

Infant/ toddler sketch



Child sketch



M110520

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG
Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Ms Roxanne Thornton

CLEARANCE CERTIFICATE	**M110520**
PROJECT	Patterns of Injury and Pathology in Paediatric Deaths Gathered at the Johannesburg Forensic Pathology Service
INVESTIGATORS	Ms Roxanne Thornton.
DEPARTMENT	Division of Forensic Medicine and Pathology
DATE CONSIDERED	27/05/2011
DECISION OF THE COMMITTEE*	Approved unconditionally

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE **CHAIRPERSON** .....
(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable
cc: Supervisor : Mrs Guinevere Gordon

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...

Appendix C

REPUBLIC OF SOUTH AFRICA

GAUTENG PROVINCIAL GOVERNMENT: DEPARTMENT OF HEALTH
FORENSIC PATHOLOGY SERVICE JOHANNESBURG

REPORT ON A MEDICOLEGAL POST MORTEM EXAMINATION

AFFIDAVIT IN TERMS OF SECTION 212(4 & 8) ACT 51 OF 1977

I, **Dr XX Xxxxxxxxx** [Qualifications: MBBCh(XXXX), Dip For Med(SA) Path, FC For Path(SA) etc etc], attached to the Forensic Pathology Service Johannesburg, Private Bag X9, Braamfontein, 2017, declare under oath in English as follows:

I am in the employ of the Gauteng Provincial Government as a xxxxxx Specialist / Registrar / Medical Officer in Forensic Pathology, in Johannesburg.

On xx/xx/2013 a body bearing the number xxxx/2013 was pointed out and identified to me by F/O M Mabuto.

On xx/xx/2013 I conducted a post mortem examination on the said body and recorded my findings on attached schedule (GW7/15), which facts I ascertained through an examination as a medical practitioner, which required skills in biology, anatomy and pathology.

The content of this affidavit to the best of my knowledge and belief is true and correct.

I know and understand the contents of this affidavit.
I have no objection to taking the prescribed oath.
I consider the prescribed oath as binding on my conscience.

……..
DR XXXXXXXXX XXXXXXXXX
SPECIALIST / REGISTRAR / MEDICAL OFFICER

I certify that the deponent has acknowledged that he / she is fully cognizant with this affidavit and that he / she knows and understands the contents of this affidavit, signed and sworn before me at Johannesburg on the under mentioned date.

DATE: 2013 - xx - xx ……..
COMMISSIONER OF OATHS

PLACE: JOHANNESBURG
FULL NAMES & SURNAME: XXXXXXXXX
RANK / DESIGNATION: XXXXXXXXX
ADDRESS: Johannesburg Medicolegal Laboratory
Forensic Pathology Service: Johannesburg
25A Hospital Street, Braamfontein, 2001

CONFIDENTIAL

To the MAGISTRATE of JOHANNESBURG:

I, **Dr XXXXXXX XXXXXXXXXXXXXX** hereby certify:

(i) That I examined the body of a black / white / coloured / indian / other, male / female / unknown on the xx/xx/2013,
at the JOHANNESBURG MEDICOLEGAL LABORATORY, FPS JOHANNESBURG,
beginning at 08:30

(ii) That the body was identified to me:
(a) by F/O XXXXXX of the JOHANNESBURG MEDICOLEGAL LABORATORY
(b) as that of **CASE NO: XXXX / 2013**
(c) whose exact age was / was not available at the time of the autopsy – whose actual / estimated age was XXXXX years / months / weeks / days / hours

(iii) That the death occurred as informed, on xx/xx/2013

(iv) That the chief post mortem findings in this case were:

The body of a e.g. A black male toddler with features of multiple blunt force injuries to his head, trunk, arms and legs, in varying stages of healing and repair. These injuries were evidenced by extensive bruising of the skin in these regions, as well fractures of the skull and ribs and lacerations of the brain, lungs and liver with associated haemorrhage. A dense extradural haematoma was present over the right hemisphere of the brain. A number of small round burn wounds, consistent with those of cigarette burns were noted over the forearms, anterior chest and buttocks, in varying stages of healing. Etc. etc. ……
……
……

(v) That as a result of my observations in the schedule which follows, I concluded that the **CAUSE OF DEATH** was the following:

E.g. Extradural haematoma and lacerated brain, lungs and liver with associated haemorrhage, due to severe blunt force trauma to the head and trunk with associated fractures of the skull and ribs.

Dated at **JOHANNESBURG** on this **xxth day of xxxxxx 2013**

Signature: ……
Qualifications: MBBCh(Wits) &/ Dip For Med(SA) Path &/ FC For Path(SA)
Position: XXXXXX REGISTRAR / MEDICAL OFFICER / REGISTRAR
FORENSIC PATHOLOGY SERVICE: JOHANNESBURG
Postal address: Private Bag X9, Braamfontein 2017
Tel: 011 – XXXXXXXXX

SCHEDULE OF OBSERVATIONS

GENERAL

1 **HEIGHT:** XXX m **MASS:** XXX g / kg
PHYSIQUE: XXX **NUTRITION:** XXX

2 **SPECIAL IDENTIFYING FEATURES:**
XXX A Black / White / Coloured / Indian / Unknown e.g. male ……XXXX

3 **SECONDARY POST-MORTEM CHANGES:**
XXX

4 **EXTERNAL APPEARANCE OF THE BODY AND CONDITION OF THE LIMBS:**

E.G.
1. There is a 20mm X 60mm bruise over ……
2. There is a 10mm X 10mm healing burn wound over ……..
3.

HEAD AND NECK

5 **SCALP:** XXX

SKULL: XXX

6 **INTRACRANIAL CONTENTS:**
XXX

Brain mass: XXXg

7 **ORBITAL, NASAL AND AURAL CAVITIES:**
XXX

8 **MOUTH, TONGUE AND PHARYNX:**
XXX

9 **NECK STRUCTURES:**
XXX

CHEST

10 **THORACIC CAGE AND DIAPHRAGM:**
XXX

11 **OESOPHAGUS:**
XXX

12 **TRACHEA AND BRONCHI:**
XXX

13 **PLEURA AND LUNGS:**
XXX

Left lung mass: XXXg
Right lung mass: XXXg

14 **HEART AND PERICARDIUM:**
XXX

Heart mass: XXXg

15 **LARGE BLOOD VESSELS:**
XXX

ABDOMEN

16 **PERITONEAL CAVITY:**
XXX

17 **STOMACH AND CONTENTS:**
XXX

18 **INTESTINES AND MESENTERY:**
XXX

19 **LIVER, GALL BLADDER AND BILIARY PASSAGES:**
XXX

Liver mass: XXXg

20 **PANCREAS:**
XXX

21 **SPLEEN:**
XXX

Spleen mass: XXXg

22 **ADRENAL GLANDS:**
XXX

23 **KIDNEYS:**
XXX

Left kidney mass: XXXg
Right kidney mass: XXXg

24 **URINARY BLADDER AND URETHRA:**
XXX

25 **PELVIC WALLS:**
XXX

26 **GENITAL ORGANS:**
XXX

SPINE:

27 **SPINAL COLUMN:**
XXX

28 **SPINAL CORD:**
XXX

SPECIMENS RETAINED:

NATURE OF SPECIMEN	NATURE OF INVESTIGATION	DISPOSAL OF SPECIMEN
E.g. Blood (taken from right femoral vessels)	Alcohol seal no H/G B	Handed to xxxxxxxx
E.g. Tissues (taken from brain, heart, lungs, liver, spleen, kidneys, bowel, burn wounds and bruises)	Histology	Handed to xxxxxxxx

EXHIBITS:

DESCRIPTION		DISPOSAL OF ITEM
E.g. Electrical Cord from neck of deceased	SAPS Exhibit	Handed to xxxxxxxx
E.g. Spent, deformed copper-jacketed bullets	SAPS Exhibit – Comparison Microscopy	Handed to xxxxxxxx

ADDITIONAL OBSERVATIONS:

HISTORY OBTAINED (SAPS180): xxxx

SUMMARY OF HOSPITAL FINDINGS: xxxx

OTHERS: X-Ray screening: xxxx

HISTOLOGY REPORT: xxxx

RESULTS OF SPECIAL INVESTIGATIONS CONSIDERED WHEN FORMULATING THE CAUSE OF DEATH: xxxx

LABORATORY INVESTIGATIONS: Blood Alcohol Concentration = …. Grams per 100 Milliliters
Toxicological Investigations: ……
……

PHOTOGRAPHS AVAILABLE AND INCLUDED: Yes / No

DHA-1663 with number **AO XXXX** issued.

G.P.-S 002-0097

SAPD
SAPS 180

SUID-AFRIKAANSE POLISIEDIENS | SOUTH AFRICAN POLICE SERVICE

Appendix D

POLISIERAPPORT WAT LYK NA LYKSHUIS VERGESEL
POLICE REPORT ACCOMPANYING BODY TO MORTUARY

1/2

SAPD 13 No. / SAPS 13 No. ..... Lyk No. / Body No. .....

Naam van lid/persoon van wie lyk ontvang word
Name of member/person from whom body is received .....

Nommer, rang en naam van lid wat lyk ontvang
Number, rank and name of member receiving body .....

.....

Volle naam en adres van oorledene
Full names and address of deceased .....

.....

ID No. .....

Merk toepaslike blok met X / Mark applicable square with X:

Wit White	Swart Black	Bruin Brown	Asiër Asian

Manlik Male	Vroulik Female

In lewe bekend as (volle name)
Known as (full names) .....

Ouderdom / Age ..... Huwelikstatus / Marital status ..... Land gebore / Land born .....

BESONDERHEDE VAN STERFGEVAL • PARTICULARS OF DEATH

Datum en tyd van dood / Date and time of death ..... Plek van dood / Place of death .....

Merk toepaslike blok met X / Mark applicable square with X:

Motorbotsing Motor accident	Bestuurder Driver	Passasier Passenger	Voetganger Pedestrian	Fietsryer Cyclist	Motorfietsryer Motorcyclist

Selfmoord Suicide	Vuurwapen Firearm	Opgehang Hanging	Pille Pills	Vergas Gassed	Van gebou afgespring Jumped from building	Ander Other

Ander Other	Van gebou geval Fell from building	Met vuurwapen gedood Killed with firearm	Met mes/voorwerp gesteek Stabbed with knife/object	Vergiftig Poisened

Sterf onder narkose Died under anaesthetic	Skielike dood sonder mediese geskiedenis Sudden death without medical history	Sterf in aanhouding Died in custody

Volledige geskiedenis
Full history .....

Opmerkings
Remarks .....

.....

.....

.....

.....

.....

Items benodig vir verdere ondersoek
Items required for further investigation .....

EIENDOM VAN OORLEDENE • PROPERTY OF DECEASED

1. Kontant (meld nommers van note)
Cash (state note numbers).....

.....

.....

.....

.....

.....

.....

..... (R.....)

2. Ander besittings (spesifiseer)
Other property (specify).....

.....

.....

.....

.....

.....

.....

.....

Plek
Place.....

.....
HANDTEKENING VAN ONDERSOEKER
SIGNATURE OF INVESTIGATOR

Datum
Date.....

.....
HANDTEKENING VAN LID WAT LYK ONTVANG
SIGNATURE OF MEMBER RECEIVING BODY