

Patterns of death due to blunt force trauma in the West Metropole of the City of Cape Town, South Africa

by

COURTNEE CLARK

CLRCOU001

SUBMITTED TO THE UNIVERSITY OF CAPE TOWN

In partial fulfilment of the requirements for the degree

MPhil (Biomedical Forensic Science)

Faculty of Health Sciences

UNIVERSITY OF CAPE TOWN

November 2015

Supervisors: Calvin Mole, Dr. Marise Heyns

Department of Pathology

Division of Forensic Medicine and Toxicology

University of Cape Town

The copyright of this thesis vests in the author. No quotation from it or information derived from it is to be published without full acknowledgement of the source. The thesis is to be used for private study or non-commercial research purposes only.

Published by the University of Cape Town (UCT) in terms of the non-exclusive license granted to UCT by the author.

Declaration

I, Courtnee Clark, hereby declare that the work on which this dissertation/thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

I empower the university to reproduce for the purpose of research either the whole or any portion of the contents in any manner whatsoever.

Signature:

Signed by candidate

Date: November 2015

Abstract

There is currently a paucity of information regarding the prevalence and characteristics associated with blunt force trauma related homicides in South Africa. Information relating to the patterns of blunt force trauma could assist in the implementation of appropriate interventions targeted at specific areas or individuals. Furthermore it can direct research toward topics in blunt force trauma which are in need of investigation. As such the primary objective of this study was to determine the prevalence of blunt force trauma related homicides in the West Metropole of the City of Cape Town, South Africa. The secondary objective was to describe the characteristics associated with blunt force trauma related homicides in the West Metropole of the City of Cape Town, South Africa.

This thesis begins by defining blunt force wounds and comparing and contrasting the prevalence and documented characteristics associated with blunt force trauma nationally as well as internationally. Blunt force wounds occur when the body comes into contact with a blunt object at great force. Homicides by blunt force trauma are usually the result of assaults with fists, feet, bats or clubs, etc. Common wounds associated with blunt force assaults are contusions, lacerations and in some cases, bone fractures. In fatal blunt force assaults, these wounds tend to be located primarily on the head region.

Salt River Mortuary receives cases from the West Metropole of the City of Cape Town, hence the results of this thesis are considered in the context of this area. This region is comprised of areas with diverse socio-economic status' and heterogeneous crime rates. The study was a retrospective review of autopsy reports obtained from Salt River mortuary from 1 January 2013 to 31 December 2014. The prevalence of blunt force trauma was considered for unnatural deaths with a focus on homicide. The inclusion criteria were cases where the cause of death was blunt force trauma as determined by the pathologist. Cases in which the death was not caused solely by blunt force trauma were classified as combination deaths, and cases involving deaths due to blunt force trauma as a result of falling from a height, train-related, pedestrian or motor vehicle accidents were excluded.

A total of 3346 and 3461 cases of unnatural deaths occurred in the West Metropole of the City of Cape Town in 2013 and 2014 respectively. 247 (7.4%) cases in 2013 and 277 (8%) cases in 2014 involved blunt force injuries, and of these cases 183 (5.5%) in 2013 and 201 (5.8%) in 2014 were classified as homicides. The results of the characteristics of blunt force homicide analysed in this study broadly concur with previous studies undertaken in South Africa, with some areas of divergence. Additional features that have not been extensively covered in previous studies also emerged, which could possibly form the basis for future investigations.

Contents

Declaration.....	I
Abstract.....	II
List of Figures.....	VI
List of Tables.....	VII
Chapter One: Research Proposal.....	- 1 -
1.1. Purpose.....	- 2 -
1.2. Background.....	- 2 -
1.3. Methodology.....	- 4 -
1.3.1. Study design.....	- 4 -
1.3.2. Characteristics of the study population.....	- 4 -
1.3.3. Research procedures and data collection methods.....	- 5 -
1.3.4. Data analysis.....	- 5 -
1.3.5. Estimated costs.....	- 5 -
1.4. Description of Risks and Benefits.....	- 6 -
1.5. Reference List.....	- 7 -
1.6. Amendments to Proposal.....	- 8 -
1.6.1. Study Period.....	- 8 -
1.6.2. Characteristics.....	- 8 -
Chapter Two: Literature Review.....	- 9 -
2.1. Trauma Morphology.....	- 10 -
2.2. Epidemiology and Patterns of Blunt Force Trauma.....	- 13 -
2.2.1. Prevalence.....	- 14 -
2.2.2. Age.....	- 15 -
2.2.3. Gender.....	- 15 -
2.2.4. Day and month of death.....	- 16 -
2.2.5. Injuries.....	- 17 -
2.2.6. Physical crime scene location.....	- 17 -
2.2.7. Presence of alcohol in victim.....	- 18 -
2.3. Context of the Study.....	- 18 -
2.4. Relevance and Future Study.....	- 22 -
2.5. Reference List.....	- 24 -
Chapter Three: Publication Ready Manuscript.....	- 27 -
3.1. Abstract.....	- 29 -

3.2.	Introduction.....	- 30 -
3.3.	Methods.....	- 31 -
3.4.	Results and Discussion	- 32 -
3.4.1.	Prevalence	- 32 -
3.4.2.	Age of victim	- 33 -
3.4.3.	Gender	- 34 -
3.4.4.	Day and month of death.....	- 36 -
3.4.5.	Number and location of injuries	- 38 -
3.4.6.	Geographical crime scene area.....	- 39 -
3.4.7.	Physical crime scene location	- 40 -
3.4.8.	Presence of alcohol in victim.....	- 41 -
3.4.9.	Limitations	- 43 -
3.5.	Conclusion	- 44 -
3.6.	Reference List	- 45 -
	Chapter Four: Appendices.....	- 47 -
4.1.	Acknowledgments.....	- 48 -
4.2.	HREC Approval Letter.....	- 49 -
4.3.	Population Data for West Metropole of the City of Cape Town Suburbs.....	- 51 -
4.4.	Instructions to Authors	- 53 -

List of Figures

- Figure 2-1. Western Cape Metro Health District area map including West Metropole of the City of Cape Town areas. Catchment area for Salt River Mortuary is outlined in red. - 20 -
- Figure 2-2. A 2001 census map representing the socio-economic status of suburbs in the Cape Town area. The areas in red are indicative of poor socio-economic status while those in green represent high socio-economic status..... - 21 -
- Figure 3-1. Percentage age distribution of victims of blunt force trauma homicide during 2013 and 2014. Numbers above bars represent number of cases. - 34 -
- Figure 3-2. Percentage distribution of blunt force homicide cases during the days of the week in 2013 and 2014. Numbers above the bars represent number of cases.... - 37 -
- Figure 3-3. Percentage distribution of intoxication levels during the week as a percentage of the total cases for 2013 and 2014..... - 37 -
- Figure 3-4. Percentage of total number of cases with blunt force injuries involving the head during 2013 and 2014. Numbers in each segment represent number of cases with the corresponding percentage..... - 39 -
- Figure 3-5. Percentage distribution of total number of victims in physical crime scene context. Numbers above the bars represent number of cases. - 41 -
- Figure 3-6. Percentage of victims of each gender and the physical context of the crime scene..... - 41 -
- Figure 3-7. Percentage distribution of the blood alcohol concentration levels in victims of blunt force trauma. Numbers above the bars represent number of cases. - 43 -

List of Tables

Table 1-1. Variable types associated with the characteristics of blunt force trauma. ...	- 4 -
Table 3-1. Comparison of the age distribution between blunt force homicide cases and the overall intake from salt river mortuary for the years 2013 and 2014.	- 34 -
Table 3-2. Comparison of the gender distribution of blunt force trauma homicide cases for both years of study and the overall intake from salt river mortuary for both years of study.....	- 35 -
Table 3-3. Distribution of the number of blunt force injuries per case in 2013 and 2014 and the regional distribution of the blunt force injuries.	- 39 -

Chapter One: Research Proposal

1.1. Purpose

There is currently a paucity of information reported on the characteristics of blunt force trauma in South Africa, and as such the primary objective of this study is to determine the prevalence of blunt force trauma-related fatalities in the West Metropole of the City of Cape Town. The secondary objective is to describe the characteristics associated with blunt force trauma-related fatalities in the West Metropole of the City of Cape Town.

1.2. Background

Trauma can be divided into three main forms; namely blunt, sharp and ballistic. The second leading manner of death in Cape Town, South Africa, is murder (1) and blunt force trauma forms a considerable portion of these deaths (2). The most recent figure reported on the prevalence of deaths due to blunt force trauma in South Africa was 10.6%, based on data from the year 2000 (3). However, this analysis did not examine the characteristics of these cases. In South Africa there is currently a dearth of information regarding the features associated with deaths caused by blunt force trauma. Information relating to the features of blunt force trauma would allow us to focus resources and research toward particular aspects of blunt force trauma, which could help to better analyse or prevent such incidents from occurring in the future. Practically, this could include the proposal of interventions such as an increase in police presence at times of increased risk or in areas of high risk.

Fatal blunt force trauma injuries are usually the consequence of blows from fists and feet or a variety of blunt implements such as household hammers, pool cues or bats (4). Typically the manner of death associated with blunt force trauma is murder (other than in cases of motor vehicle collisions) however cases of suicide by blunt force trauma, although rare, have been noted (5). Literature on fatal blunt force trauma tends to focus on age and gender, location of injuries, number of body regions involved, defence injuries, weapon, assailant-victim relationship, location of the crime scene (6) and further toxicological analysis of the victim's tissue (7). The incidence of blunt force trauma varies widely among countries (4,6). There is currently a need for reliable information relating to the South African context. Retrospective studies conducted in Germany, India and

Scandinavia have reported that blunt force trauma constitutes respectively, 51%, 41% and 18% of homicide cases in the periods studied (6,8,9).

A broad age spectrum exists for victims of blunt force trauma (9), however, the largest group of victims are commonly seen in the 20 – 40 years age bracket (4,6,8,10). Males tend more frequently to be the victims of blunt force trauma compared to females (4,6,8,10). There is little focus in the literature on racial groups affected by fatal blunt force trauma, possibly because race depends heavily on the geographical area of investigation (4).

The literature varies in regard to the reported region of the body involved in blunt force trauma as well as the type and number of injuries described on the victims. In a 2003 study, multiple regions of the body were affected in blunt force injury (8), whereas another investigation found that the head was typically the principal region of the body involved in blunt force injury (11). It is not uncommon for victims of blunt force trauma to display defensive injuries in addition to those sustained during the attack; these injuries are often abraded and contused wounds to the forearm (6).

The relationship of the assailant and victim differs between countries and gender groups. Ambade and Godbole (2006) reported, in an Indian population, that the majority of victims had no familial connection to their assailant (6). However in the Scandinavian (8) and German populations (9) it was found that female victims were primarily attacked by their spouses while male victims had no prior relationship with their attacker(s). Consequently female victims are often killed in their domicile, while a large proportion of males are killed outdoors or away from their homes (4,8,9).

A number of weapons may be used to inflict blunt force trauma. Typically, a single known weapon is often the cause of injury (6). A retrospective study conducted in Ireland revealed that 66% of cases of blunt force head trauma a weapon of origin was known (11). However, a Scandinavian investigation discovered that there is often little substantial information regarding the weapon used (8). When the weapon(s) used are known, they are frequently common household objects (7,9) or the assailants' fists and/or shod feet (4,8).

1.3. Methodology

1.3.1. Study design

The study will be a retrospective review of autopsy reports obtained from Salt River mortuary for two years from 1 January 2012 to 31 December 2012 and 1 January 2013 to 31 December 2013. The prevalence of blunt force trauma-related fatalities in the West Metropole of the City of Cape Town will be calculated for each of the two years (2012 and 2013) and the study will focus on the following characteristics as shown in Table 1-1 below:

Table 1-1. Variable types associated with the characteristics of blunt force trauma.

Variable	Type
Age	Numerical continuous
Gender	Binary
Day and month of death	Categorical
Number of injuries	Numerical continuous
Location of injuries	Categorical
Number of body regions involved	Numerical continuous
Defence injuries	Binary
Assailant-victim relationship	Categorical
Physical crime scene location	Categorical
Geographical crime scene area	Categorical
Presence of alcohol in victim	Binary
Manner of death	Categorical
Suspected weapon	Categorical
Signs of medical intervention	Binary

1.3.2. Characteristics of the study population

The study will focus on cases of unnatural death from Salt River mortuary from the years 2012 and 2013. The inclusion criteria will be cases where the cause of death is blunt force trauma as determined by the pathologist; these cases will be isolated to calculate the prevalence of blunt force trauma in the West Metropole of the City of Cape Town. Cases in which the death was not caused solely by blunt force trauma will be included in the analysis and classified as mixed cases. Cases involving deaths due to blunt force trauma as a result of train-related, pedestrian or motor vehicle accidents will be excluded.

1.3.3. Research procedures and data collection methods

In order to accurately calculate the prevalence of blunt force trauma fatalities for each of the two years, all the autopsy reports pertaining to those respective years will be considered. Salt River mortuary serves the West Metropole of the City of Cape Town and receives approximately 3000 cases per year (12). Hence, the prevalence for blunt force trauma-related fatalities will be calculated for the years 2012 and 2013. Characteristic data for those cases will be collected as pertaining to the variables stated above in Table 1-1.

1.3.4. Data analysis

Forensic Pathology Services, Western Cape Government, Department of Health maintains a database of all autopsies conducted. Access to this database is restricted. This database will be used to determine the prevalence of blunt force trauma and to determine cases for further analysis. The information supplied by the database was originally collected under the auspices of the Inquest Act where no consent is necessary. Furthermore, all the information for this study was originally collected as part of routine operational processes of a database (13). In cases where data is missing or omitted in the database information will be obtained from the autopsy report of the case. Data will be captured at UCT in a secure room with restricted access. In order to protect the sensitive information contained in the autopsy reports the following precautions will be taken: the data used will not be freely available, and all names will be omitted and case numbers will be anonymised. In each case, the characteristic data (Table 1-1) will be collected and recorded into a Microsoft® Office Excel® 2013 (Microsoft, Redmond, Washington, US) database. Statistical calculations will be performed using Stata Ver 13.1 (StataCorp, TX, USA). Descriptive statistics will be used to identify the presence of patterns and commonalities for each characteristic.

1.3.5. Estimated costs

There are no foreseeable expenses involved in this study because it is retrospective in nature, hence no reagents or equipment are required. The software used to perform the

statistical analysis is freely available to UCT staff members and students and therefore adds no cost to the study.

1.4. Description of Risks and Benefits

The study is a retrospective review of the autopsy reports associated with blunt force trauma fatalities from Salt River mortuary, hence there are no physical risks involved. However, the information contained in the autopsy reports is highly sensitive and as such anonymity and confidentiality is critical and will be maintained as described in the data analysis section. The information gained from this study will provide current information regarding the prevalence and characteristics of blunt force trauma-related fatalities in the West Metropole of the City of Cape Town. This data will provide insight into the victims of blunt force trauma and highlight areas for further study.

1.5. Reference List

1. L. Gilbert, Urban violence and health – South Africa 1995, *Soc Sci Med* 43 (5) (1996) 873–886.
2. L. B. Lerer, R. G. Matzopoulos, R. Phillips, Violence and injury mortality in the Cape Town metropole, *S Afr Med J* 87 (3) (1997) 298–301.
3. P. Groenewald, D. Bradshaw, J. Daniels, R. Matzopoulos, D. Bourne, D. Blease, et al., Cause of death and premature mortality in Cape Town, 2001–2006, Cape Town: South African Medical Research Council, 2008 1-88.
4. J. P. Henderson, S.E. Morgan, F. Patel, M.E. Tiplady, Patterns of non-firearm homicide, *J Clin Forensic Med* 12 (3) (2005) 128–132.
5. A. Thierauf, S. Lutz-Bonengel, T. Sanger, S. Vogt, W. Rupp, M.G. Perdekamp, Suicide by multiple blunt head traumatisation using a stone, *Forensic Sci Int* 214 (2012) 47–50.
6. V. N. Ambade, H. V. Godbole, Comparison of wound patterns in homicide by sharp and blunt force, *Forensic Sci Int* 156 (2006) 166–170.
7. P. Wahlsten, V. Koironen, P. Saukko, Survey of medico-legal investigation of homicides in the city of Turku, Finland, *J Clin Forensic Med* 14 (5) (2007) 243–252.
8. S. Rogde, H. P. Hougen, K. Poulsen, Homicide by blunt force in 2 Scandinavian capitals, *Am J Forensic Med Pathol* 24 (3) (2003) 288–291.
9. J. Fischer, W. J. Kleemann, H. D. Troger, Types of trauma in cases of homicide, *Forensic Sci Int* 68 (1994) 161–167.
10. C. S. Byun, I. H. Park, J. H. Oh, K. S. Bae, K. H. Lee, E. Lee, Epidemiology of trauma patients and analysis of 268 mortality cases: trends of a single center in Korea, *Yonsei Med J* 56 (1) (2015) 220–226.
11. E. Sharkey, M. Cassidy, J. Brady, M. Gilchrist, N. NicDaeid, Investigation of the force associated with the formation of lacerations and skull fractures, *Int J Legal Med* 126 (2011) 834–835.
12. Forensic Pathology Services: Our Facilities [Internet], (2014) Available from: <https://www.westerncape.gov.za/general-publication/our-facilities> (accessed 8 March 2015).
13. Department of Justice, Inquests Act No. 58 of 1959, Statutes of the Republic of South Africa [Internet], Available from: <http://www.justice.gov.za/legislation/acts/1959-58.pdf> (accessed 18 May 2015).

1.6. Amendments to Proposal

The following amendments were made to the research proposal:

1.6.1. Study Period

The period of study was shifted from 2012-2013 to 2013-2014 in order to cover the most recent available data. It was originally thought that blood alcohol toxicology results would not be available for the year 2014. However, on investigation it was discovered that these results were available for 2014.

1.6.2. Characteristics

The assailant-victim relationship and suspected weapon were excluded from the analysis due to inconsistent reporting. An analysis of the presence of signs of medical intervention was excluded from the dissertation because there was insufficient information available on the extent of medical intervention for each case. Whilst this information is valuable, further study which exceeds the bounds of a mini-thesis is required in order to provide valuable information relating to this characteristic.

Chapter Two: Literature Review

2.1. Trauma Morphology

Trauma is commonly categorised into three groups according to the mechanisms of trauma, namely, blunt, sharp and ballistic trauma. Extensive research on wound pathology has been conducted to better differentiate between blunt, sharp and ballistic trauma in order to contribute to the determination of the cause and manner of death as well as to provide information pertaining to the weapon type so as to clarify the events surrounding death (1,2). However, wound morphology is governed by the interaction of variables such as force, tissue structure and surface area resulting in wound pathology being more effectively viewed as a continuum, rather than mutually exclusive categories (3).

Typical blunt trauma injuries include abrasions, contusions and lacerations. The most superficial of these wounds are abrasions which are described as shallow wounding of the skin such as scratches and grazes. Scratches are linear in appearance whilst grazes typically affect a wider surface area. In an assault with a blunt object these wounds can be created when the victim receives a glancing blow from a rough weapon such as a brick or falling or being dragged on the ground. Cases where the skin receives vertical impact can result in crush abrasions whereby the epidermis is crushed leaving an imprint of the impacting object. If the force of the object is concentrated on a small surface area, the skin can be perforated resulting in a puncture abrasion. Artefactual abrasions can confuse determination of the cause of death and may occur as a result of the body being handled after death or by insect activity.

Contusions are commonly seen in conjunction with abrasions and can be visible during external examination on the skin or visible on internal examination affecting internal tissues. Blunt force attacks commonly result in contused injuries because the blunt object is not sharp enough to pierce the skin resulting in blood from damaged vessels collecting under the skin or internally (4). Patterned bruises can provide information regarding the object used in the attack, tramline bruises are often present on victims of attacks with cylindrical objects or straps as are commonly utilised in impromptu fights and assaults (4-6).

Lacerations are the third major type of blunt force injury that result in the full thickness of the skin being penetrated. They can be distinguished from sharp force incisions because of rough edges, crushed margins, and tissue bridges forming when the skin tears, all of which are not seen in cleanly sliced incision wounds. Tear and crush forces are associated with laceration wounds but the degree to which this is seen depends on the angle and body location of injury, as well as the force and object with which it was inflicted. Lacerations are commonly located in areas with a firm underlying base such as the skull or shoulder blade, and it is rare to find lacerations on softer areas such as the abdomen or buttocks where there is no underlying bone immediately beneath the skin's surface which compresses the skin against the object (4). However, "flaying injuries" are common to motor vehicle accident victims when the rotary action of the wheel rolls a large area of tissue and skin off a limb. If the deeper underlying tissue is separated from the skin, and the skin remains unbroken the injury will be classified as decollement. If utilised with sufficient force, some objects such as a hammer or steel capped boots will produce patterned laceration injuries which are commonly associated with bruises of similar patterns. Blunt penetration injuries, such as hook lacerations, can occur as a result of injury from metal spikes, garden forks, screwdrivers are a cross between incisions and lacerations, although they commonly show more features of the former (4).

In contrast to blunt trauma, ballistic trauma often results in injury patterns that are usually characterised by rounded entrance wounds and stellate exit wounds (7), but in exceptional cases there can be an absence of a definitive site of impact making classification challenging. In these cases wounds can be distinguished from blunt force trauma by studying the dissimilar fracture pattern of the underlying bone (1). The presence of cut marks on bone can be indicative of sharp force trauma as well as provide information that links the injury to the weapon type (1), however, these wounds can be misleading because similar wounds can be the result of injury by blunt objects meaning sharp objects can create wounds that resemble blunt trauma depending on the location of injury (8,9). Examples of such injuries include chop wounds due to an axe as well as injuries due to motorboat propellers. Furthermore, sharp objects can also be responsible for inflicting blunt trauma such as tear or crush wounds associated with underlying bone fractures (8,9). These similarities in wound morphology pose a challenge to pathologists

when commenting on weapon types and peri-mortem activities and there can be a lack of consistency in the description of the trauma analyses (8).

The wound morphology in blunt force trauma cases varies, based on the weapon used and the force with which it was applied (1,10). Therefore, it is possible for blunt force trauma to occasionally leave no visible trace on the exterior of the body, resulting in the diagnosis of the mechanism of injury only becoming apparent after an internal examination of the tissue and bones (9). Further investigative complications can arise because blunt force attacks do not always result in immediate death. In some cases death may occur days, weeks or even months after an attack, causing difficulty in determining if an individual is at fault. The delayed onset of death from blunt force injuries can be due to thromboembolisms, subarachnoid haemorrhages and/or diffuse axonal injuries depending on the nature of the attack. A severe beating can result in fatal thromboembolisms which can occur between 2 to 90 days after injury (11). Furthermore, mechanical disintegration of the underlying adipose tissue or embolization of marrow fat from the long bones in cases of fracture, could lead to potentially fatal fat embolisms (12). Some cases of blunt force head injury result in subarachnoid haemorrhages with no external signs of trauma, hence the victim does not seek medical help after the incident but will succumb to headaches, vomiting, unconsciousness and eventually death at a variable time after the incident (13). Diffuse axonal injury can also manifest sometime after a mild or severe head injury with no visible signs of trauma making diagnosis of death difficult without a medical history (13).

Bone is a viscoelastic material exhibiting different responses dependant on the load applied. The fracture mechanics of bone under different loading conditions may therefore be used to further differentiate between blunt and ballistic trauma. Under high rates of loading such as those seen in ballistic trauma, bone behaves as a brittle material and fracture quickly under a load (14). Bone is stronger under compression than tension and therefore will first fail under tension. It has also been noted that the type of bevelling seen in concentric fractures differs between blunt and ballistic trauma. Internal bevelling is associated with concentric fracture in blunt trauma, whilst ballistic trauma produces concentric fractures that demonstrate external bevelling. However, the production of

bone fractures is complex and depends largely on the interaction of extrinsic and intrinsic factors, often making interpretation difficult (15,16).

2.2. Epidemiology and Patterns of Blunt Force Trauma

Fatal blunt force trauma injuries are usually the consequence of blows from fists and feet or a variety of blunt implements such as household hammers, pool cues or bats (17). A number of weapons may be used to inflict blunt force trauma. Often, a single known weapon is the cause of injury (18). A retrospective study conducted in Ireland revealed that in 66% of cases of blunt force head trauma, a weapon of origin was known (9). However, a Scandinavian investigation discovered that there was often little substantial information regarding the weapon used (19). When the weapon(s) used are known, they are frequently common household objects (20,21) or the assailants' fists and/or shod feet (17,19).

The typical manners of death associated with blunt force trauma are murder (by means of assault), suicide by jumping from a height and accidents by way of falling or motor vehicle collisions. Rare cases of suicide by multiple blows to the head have however been recorded in which the victim was mentally unstable (22). Literature on fatal blunt force trauma tends to focus on age, gender, location of injuries, number of body regions involved, defence injuries, weapon, assailant-victim relationship, location of the crime scene and further toxicological analysis of the victim's tissue (18,21). However, direct comparison of reported results is not always possible because in South Africa there is a dearth of centralised information pertaining to blunt force deaths, hence research is frequently compiled from a variety of data sources such as police dockets, hospital records and autopsy reports (23). Even with the use of multiple data sources, there is still a lack of consistent reporting for some characteristics such as the location of an attack versus the location of death, assailant-victim relationship and weapon type used. To positively identify weapon types, extensive DNA testing of the weapon and victim is required. As it stands, without such tests, a pathologist can only comment on whether the injuries are in accordance with a certain weapon or the weapon found at the scene (24). Furthermore, very few studies report the statistical significance of their results and

proportions are generally not compared to population data to determine whether the distribution observed in the study is merely due to population proportions.

2.2.1. Prevalence

The incidence of blunt force trauma varies widely among countries (17,18). Retrospective studies conducted in Germany, India and Scandinavia have reported that blunt force trauma constitutes 51%, 41% and 18% respectively, of homicide cases in the periods studied (18–20). There is currently a need for reliable centralised information relating to blunt force trauma in a South African context. From a global perspective South Africa has an exceptionally high rate of inter-personal violence (25). The second leading manner of death in Cape Town, South Africa, is murder (26,27) and blunt force trauma forms a considerable portion of these deaths (28).

There is a dearth of consolidated data regarding the prevalence and characteristics of blunt force trauma in South Africa because many studies that report the prevalence of homicide rely on information from a variety of record sources as stated above (27). A 1994 cross-sectional study compiling data from death registers, autopsy reports, police dockets and laboratory documents from Salt River and Tygerberg mortuaries, in Cape Town, South Africa found an overall homicide rate of 46% with blunt force trauma accounting for 13% of homicide related deaths (28). A further study conducted in 2003 investigated violence and mortality across 36 mortuaries in 7 of the 9 provinces in South Africa (23). This study reported the prevalence of deaths due to blunt force trauma in South Africa to be 14% (23). A more recent study conducted in Pretoria, South Africa in 2014, produced a figure of 6.19% of unnatural deaths caused by blunt force trauma (29). This study performed an analysis of non-natural deaths for which alcohol analysis was performed, in which approximately 62% of cases had samples taken for alcohol analysis.

While the above results are useful for studying the impact of blunt force trauma in South Africa there is a notable lack in centralised data on the prevalence and characteristics of blunt force trauma homicide and relatively few studies investigate homicidal blunt force trauma as a unique entity (26). Information relating to the features of blunt force trauma would allow for the focus of resources and research toward particular aspects of blunt

force trauma, which could help to better analyse or prevent such incidents from occurring in the future.

2.2.2. Age

A broad age spectrum exists for victims of blunt force trauma (20). However, the largest group of victims are commonly seen in the 20 – 40 years age bracket (17–19,30). In a 1994 South African study by Lerer et al. (28) the blunt force trauma homicide victims had a wide age range from 0 – >75 years with 30% of the victims falling within the 25 – 34 years age category. A similar pattern was seen nationally with most homicide victims falling within the 25 – 29 years age group (23). In accordance with the South African studies, wide age ranges were present in India and England but dissimilarly the majority of victims were slightly older than those seen in South Africa (23,28). The majority being between 31– 40 and 30 – 39 years of age in India and England respectively (17,18). A conceivable explanation for this could be the involvement of younger people in gang activity and violence in South Africa, and particularly in the Western Cape (5,6,31).

2.2.3. Gender

Globally, males tend more frequently to be the victims of blunt force trauma than females (17–19,30). In the Cape Metropole in 1994, 13% of the homicide victims were female with 87% being male (28). This was mirrored in an Indian study which reported the same male to female ratio for blunt force homicide victims (18). Similarly a study of non-firearm homicides in England showed more male than female victims however, with a ratio of 2:1 it is to a lesser extent than the Indian and South African studies (17). There is a wide array of research on this global trend and the explanations are often multidimensional and grounded on complex socio-biological interactions (32).

A United States study used the evolutionary theory of sexual selection to explain the overrepresentation of young, unemployed, single male homicide victims and offenders (33). They use the term hegemonic masculinity to describe young men tending to be more aggressive and competitive, hence more likely to be victims or perpetrators of violence, because of the evolutionary context of reproductive competition (31). Evolutionary

theory was also included in a model developed using data from 18 developed democracies whereby the gender-gap associated with homicide was attributed to gender differences in societal roles and status (32). The model included the degree of exposure to potential offenders and the prevalence of conflict amongst the population. In the South African context there are high levels of conflict associated with male dominance within populations (31).

These explanations are applicable to homicide in general on a global scale, hence could be used to explain the high numbers of South African men killed by blunt force trauma as opposed to women. Despite the overrepresentation of male victims, the circumstances surrounding death often differ between men and women. When studying the crime scene location on a national scale in South Africa, a much greater proportion of female victims were murdered in private homes than male victims (42% versus 32%) (23). This could be indicative of signs of domestic violence which is affected by issues of under-reporting and is often difficult to identify retrospectively due to the lack of information regarding victim-perpetrator relationship in homicide data (25).

2.2.4. Day and month of death

According to the most recent data there is a peak in the number of homicides during the weekend days of Saturday and Sunday, with this being particularly noticeable in Cape Town (23). These results are contradictory to those of non-firearm related homicides in England which saw no association between homicide and the day of the week (17). From a seasonal perspective in Cape Town the homicide rate was at its highest early in the year between January and March (23). However, most of the non-firearm homicides in England occurred during summer which they suggest could be attributed to increased hours of daylight and temperature which possibly encourages social drinking and the potential for drunken encounters (17). The period of the year is difficult to compare due to seasonal differences between South Africa and England as well as the moderate climate in South Africa and overall much higher crime rate than that of Britain (23,28).

2.2.5. Injuries

In South Africa there is a severe lack of injury-related information pertaining to homicide and more specifically blunt force homicide. International literature discussing injury characteristics is also scarce, however, Ambade et al. (18) recorded that there is usually only one body region affected in blunt force homicides with the head region being most often affected. This study compared blunt and sharp force trauma using autopsy records from a total 241 homicide cases that were autopsied at the Forensic Medicine Department of Nagpur University during 1998 to 2000. An investigation at the Irish State Pathologist's Office from 2000 to 2009 which was conducted using 377 autopsy cases of head trauma also found that blunt force injuries are principally located on the head (9). These results were mirrored by Henderson et al. (17) in a British study reporting 26% of non-firearm related homicide cases from a London state mortuary, involving blunt force trauma of which 88% showed multiple head injuries.

2.2.6. Physical crime scene location

The physical crime scene location refers to the context in which a victim was killed. It is often classified as indoors, outdoors and at home or away from home and in some instances can be indicative of the nature of the attack (17,18). An Indian study recorded that 36% of blunt force homicide victims were killed in an outdoor context and 35% in their own domicile (18). South African literature relating to the physical crime scene location is uncommon but inferences can sometimes be made by studying the victim-perpetrator relationship if it is known. In a 2003 study performed in South Africa, 42% of women were murdered in private homes compared to 32% of men (23). Henderson et al. (17) recorded that men tend more often to be killed by a stranger in a public place than women who are more often killed by a known assailant in their homes. Consequently, female victims are often killed in their domicile, while a large proportion of males are killed outdoors or away from their homes (17,19,20).

2.2.7. Presence of alcohol in victim

In South Africa alcohol abuse is a significant public health challenge with a well-recognised relationship between alcohol intoxication and interpersonal violence thereby also affecting the criminal justice system (34,35). Alcohol is a common drug detected in post mortem specimens from medico-legal autopsy cases and a recent South African study found a positive correlation between alcohol use and the occurrence of unnatural deaths (29). From the 1455 cases of unnatural death tested for alcohol, 686 (47%) tested positive with a blood alcohol level of greater than 0g/100ml. Of the 90 cases of blunt force death, 34 (38%) had a positive blood alcohol concentration (BAC) (29).

In addition to the high levels of drinking in South Africa, of greater concern is the high amount of binge drinking which is more closely associated with the risk of violence than moderate drinking patterns (36). Cape Town is one of the areas worst affected by alcohol use in South Africa with 53% of homicide cases testing positive for alcohol in 2003 (23). High levels of social drinking amongst men and women are accepted as the norm in South Africa, particularly in Cape Town, and this combined with high rates of gender violence leaves women especially vulnerable (37). In a 2006 study in Cape Town, female blunt force homicide victims were found to have high blood alcohol concentration showing 12% of female victims being mildly intoxicated (0.01-0.04g/100ml), 15% intoxicated (0.05-0.14g/100ml) and 56% severely intoxicated (>0.15g/100ml) (37). This highlights the risks involved, specifically for women, in heavy episodic drinking.

2.3. Context of the Study

Salt River Mortuary is an M6 Academic facility which processes an average of 3000 cases a year. It services the West Metropole of the City of Cape Town (38) and is comprised of the Western, Southern, Klipfontein and Mitchells Plain districts (Figure 2-1). The Western district includes the City Bowl and West Coast areas, the Southern district is made up of the Atlantic Seaboard, Southern Peninsula and Southern Suburb areas and the Cape Flats is partially represented and covers the Klipfontein and Mitchells Plain districts. The Cape Flats is a geographical area that is serviced by both Salt River and Tygerberg Forensic

Pathology Mortuaries. The Klipfontein and Mitchells Plain districts fall within the catchment area of Salt River Mortuary and are collectively referred to as the Cape Flats in this study (Figure 2-1). There is a wide disparity of homicide rates amongst the areas of the West Metropole of the City of Cape Town, where the Southern peninsula usually has relatively low levels of homicide compared the Cape Flats, which is the area most severely affected by homicide (27,28). Poor socioeconomic status has been shown to be correlated with high rates of homicide (36,39). The Salt River Mortuary services areas of both high and low socioeconomic status as depicted in the map in Figure 2-2. Areas of low economic status typically correlate to areas with a high crime rate. This is especially true for the informal settlements within the West Metropole of the City of Cape Town, many of which are located in the Cape Flats area, which has high rates of homicide victimisation particularly in young men (40). These differences may be attributed to differences in socioeconomic status as well as relative population sizes. A possible explanation for this is the staggeringly high levels of gang activity that are endemic to this area (6).



Figure 2-1. Western Cape Metro Health District area map including West Metropole of the City of Cape Town areas. Catchment area for Salt River mortuary is outlined in red.

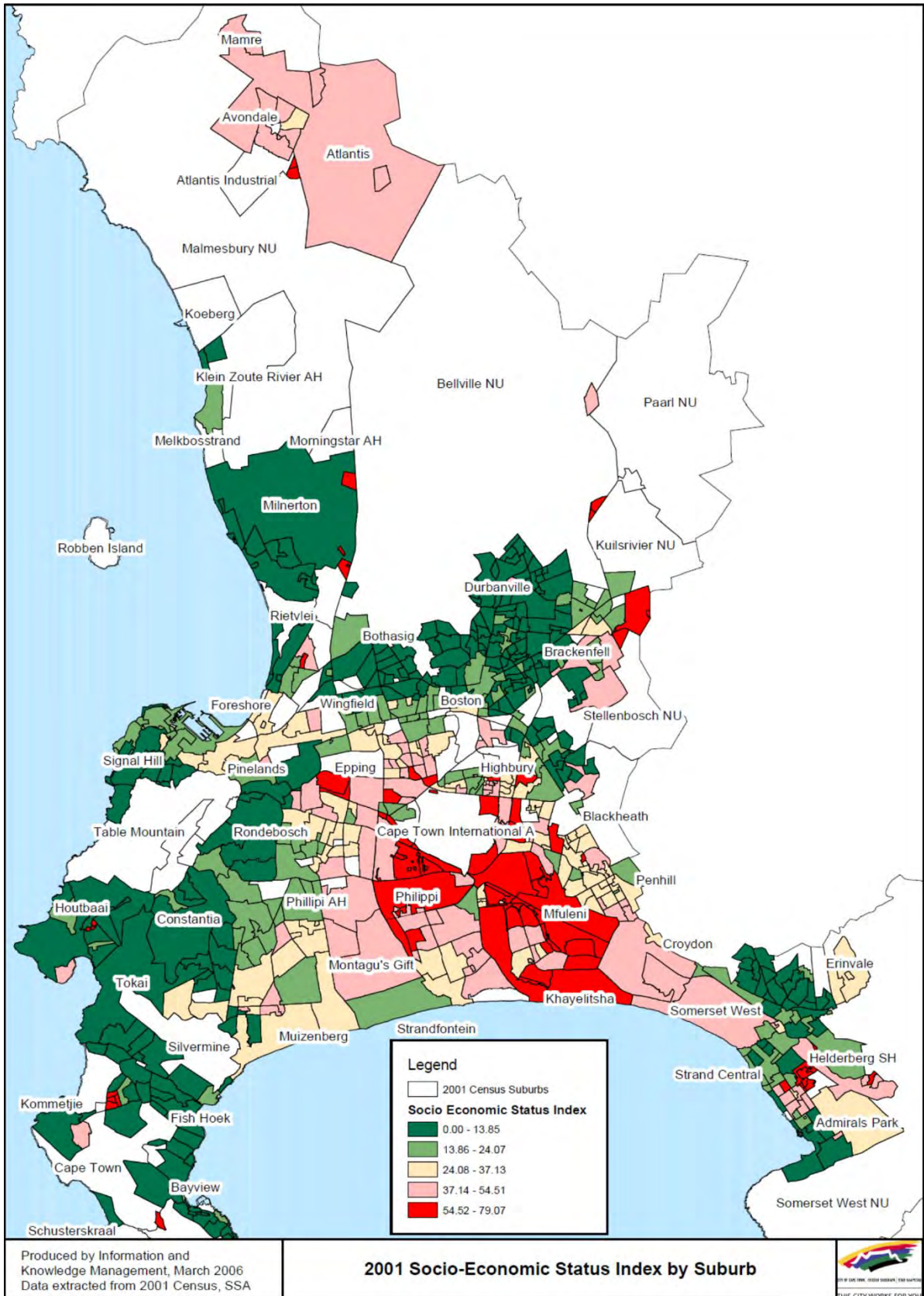


Figure 2-2. A 2001 Census Map representing the socio-economic status of suburbs in the Cape Town area. The areas in red are indicative of poor socio-economic status while those in green represent high socio-economic status.

2.4. Relevance and Future Study

South Africa is a country where violence is rife, especially in Cape Town where murder is the second highest contributor to unnatural deaths (23,25), a portion of which are caused by blunt force trauma (28). It is evident that in the South African context, violence reduction is a health priority that requires inter-sectoral interventions by the judicial system, police and the health sectors (26). To this end an increase in the availability of accurate and timely data is required for the effective response to the high injury and violence burden on the community (25,39). Mortuary data is able to provide a complete and accurate record of mortality to increase the understanding of the circumstances surrounding death and better reduce or cope with them. Due to the statutory requirement in South Africa for a post-mortem examination in cases of non-natural mortality (41), there is scope for a detailed database on unnatural deaths, provided the collected medico legal data is shared with health information systems on a provincial and/or national level (28).

South African homicide and injury literature tends to focus on age and gender, body regions involved, assailant-victim relationship, location of the crime scene and further toxicological analysis of the victim's tissue (18,20,21). However, not all literature on fatal blunt force trauma is directly comparable because nationally there is a lack of centralised information pertaining to blunt force deaths. Hence research is gathered from a variety of data sources such as police dockets, hospital records and autopsy reports (23). There are also gaps in the investigation reports with regards to the location of an attack versus the location of death, the specific weapon/s used to inflict the injuries and the extent of the injuries, especially as these characteristics pertain to blunt force trauma. Furthermore, very few studies report the statistical significance of the recorded proportions and proportions which are generally not compared to population data to determine whether the distribution seen in the study is merely due to population proportions.

The exploration and analysis of further characteristics and prevalence associated with blunt force trauma could assist in the implementation of appropriate interventions targeted at specific areas or individuals. Additionally it can direct research toward topics in blunt force trauma which are in need of investigation such as locality of the crime

scene, extent of the injuries sustained, weapons commonly used, and the victim-assailant relationship.

2.5. Reference List

1. G. O. Hart, Fracture pattern interpretation in the skull: differentiating blunt force from ballistics trauma using concentric fractures, *J Forensic Sci* 50 (6) (2005) 1276–1281.
2. T. Ohshima, Forensic wound examination, *Forensic Sci Int* 113 (2000) 153–164.
3. M. Kroman, A dissertation presented for the doctor of philosophy degree, The University of Tennessee, 2007, 1-165.
4. P. Saukko, B. Knight, The pathology of wounds, in: *Knight's Forensic Pathology*, 3rd Ed., Arnold, London, 2004, pp. 136-140.
5. L. Buur, S. Jensen, Introduction: vigilantism and the policing of everyday life in South Africa, *Afr Stud* 63 (2) (2004) 139–152.
6. B. Van Wyk, W. Theron, Fighting gangsterism in South Africa: a contextual review of gang and anti- gang movements in the Western Cape, *Acta Crim* 18 (3) (2005) 51–60.
7. J. J. Hollerman, M. L. Fackler, D. M. Coldwell, Y. Ben-Menachem, Gunshot wounds: bullets, ballistics and mechanisms of injury, *AJR* 155 (1990) 685–690.
8. D. Semeraro, N. V. Passalacqua, S. Symes, T. Gilson, Patterns of trauma induced by motorboat and ferry propellers as illustrated by three known cases from Rhode Island, *J Forensic Sci* 57 (6) (2012) 1625–1629.
9. E. Sharkey, M. Cassidy, J. Brady, M. Gilchrist, N. NicDaeid, Investigation of the force associated with the formation of lacerations and skull fractures, *Int J Legal Med* 126 (2011) 834–835.
10. C. G. Mole, M. Heyns, T. Cloete, How hard is hard enough? An investigation of the force associated with lateral blunt force trauma to the porcine cranium, *Leg Med* 17 (1) (2015) 1-8.
11. P. Saukko, B. Knight, The pathology of sudden death, in: *Knight's Forensic Pathology*, 3rd Ed., Arnold, London, 2004, pp. 518-520.
12. A. Mellor, N. Soni, Fat embolism, *Anaesthesia* 56 (2001) 145–154.
13. P. Saukko, B. Knight, Head and spinal injuries, in: *Knight's Forensic Pathology*, 3rd Ed., Arnold, London, 2004, pp. 198-200.
14. M. Nordin, V. H. Frankel, *Basic biomechanics of the musculoskeletal system*, 4th Ed., Lippincott Williams and Wilkins, Philadelphia, 2012.
15. H. E. Berryman, S. J. Haun, Applying forensic techniques to interpret cranial fracture patterns in an archaeological specimen, *Int J Osteoarchaeol* 6 (1996) 2–9.

16. D. C. Dirkmaat, L. L. Cabo, S. D. Ousley, S. A. Symes, New perspectives in forensic anthropology, *Yearb Phys Anthropol* 51 (2008) 33–52.
17. J. P. Henderson, S.E. Morgan, F. Patel, M.E. Tiplady, Patterns of non-firearm homicide, *J Clin Forensic Med* 12 (3) (2005) 128–132.
18. V. N. Ambade, H. V. Godbole, Comparison of wound patterns in homicide by sharp and blunt force, *Forensic Sci Int* 156 (2006) 166–170.
19. S. Rogde, H. P. Hougen, K. Poulsen, Homicide by blunt force in 2 Scandinavian capitals, *Am J Forensic Med Pathol* 24 (3) (2003) 288–291.
20. J. Fischer, W. J. Kleemann, H. D. Tröger, Types of trauma in cases of homicide, *Forensic Sci Int* 68 (1994) 161–167.
21. P. Wahlsten, V. Koiranen, P. Saukko, Survey of medico-legal investigation of homicides in the city of Turku, Finland, *J Clin Forensic Med* 14 (5) (2007) 243–252.
22. A. Thierauf, S. Lutz-Bonengel, T. Sängler, S. Vogt, W. Rupp, M.G. Perdekamp, Suicide by multiple blunt head traumatization using a stone, *Forensic Sci Int* 214 (2012) 47–50.
23. R. Matzopoulos, Violent Deaths in SA: The 2003 National Injury Mortality Surveillance System, *SA Crime Q* 13 (2005) 29–36.
24. F. T. Zugibe, J. T. Costello, Identification of a murder weapon by a peculiar blunt force injury pattern and histochemical analysis, *J Forensic Sci* 30 (1) (1985) 239–242.
25. R. Norman, R. Matzopoulos, P. Groenewald, D. Bradshaw, The high burden of injuries in South Africa, *Bull World Health Organ* 85 (9) (2007) 695–702.
26. L. Gilbert, Urban violence and health – South Africa 1995, *Soc Sci Med* 43 (5) (1996) 873–886.
27. P. Groenewald, D. Bradshaw, J. Daniels, R. Matzopoulos, D. Bourne, D. Blease, et al., Cause of death and premature mortality in Cape Town, 2001–2006, Cape Town: South African Medical Research Council (2008) 1-88.
28. L. B. Lerer, R. G. Matzopoulos, R. Phillips, Violence and injury mortality in the Cape Town metropole. *S Afr Med J* 87 (3) (1997) 298–301.
29. U. Ehmke, L. du Toit-Prinsloo, G. Saayman, A retrospective analysis of alcohol in medico-legal autopsied deaths in Pretoria over a 1 year period, *Forensic Sci Int* 245 (2014) 7–11.
30. C. S. Byun, I. H. Park, J. H. Oh, K. S. Bae, K. H. Lee, E. Lee, Epidemiology of trauma patients and analysis of 268 mortality cases: trends of a single center in Korea, *Yonsei Med J* 56 (1) (2015) 220–226.
31. R. Morrell, R. Jewkes, G. Lindegger, Hegemonic masculinity/masculinities in South Africa: culture, power, and gender politics, *Men Masc* (2012) 1-20.

32. R. Gartner, K. Baker, F. C. Pampel, Gender stratification and the gender gap in homicide victimization, *Soc Probl* 37 (4) (1990) 593–612.
33. M. Wilson, M. Daly, Competitiveness, risk taking, and violence: the young male syndrome, *Ethol Sociobiol* 6 (1985) 59–73.
34. M. Bellis, K. Hughes, S. Hughes, Alcohol and interpersonal violence: policy briefing, *Geneva World Heal Organ* (2005) 1–22.
35. R. Room, T. Babor, J. Rehm, Review alcohol and public health, *Lancet* 365 (2005) 519–530.
36. World Health Organisation, Global status report on alcohol and health, *World Health Organ* (2011) 1–286.
37. S. Mathews, N. Abrahams, R. Jewkes, L. J. Martin, C. Lombard, Alcohol use and its role in female homicides in the Western Cape, South Africa, *J Stud Alcohol Drugs* (2009) 321–327.
38. Forensic Pathology Services: Our Facilities [Internet], (2014) Available from: <https://www.westerncape.gov.za/general-publication/our-facilities> (accessed 8 March 2015).
39. N. Schuurman, J. Cinnamon, R. Matzopoulos, V. Fawcett, A. Nicol, S. M. Hameed, Collecting injury surveillance data in low- and middle-income countries: The Cape Town Trauma Registry pilot, *Glob Public Health* 6 (8) (2011) 874–889.
40. M. Seedat, A. Van Niekerk, R. Jewkes, S. Suffla, K. Ratele, Violence and injuries in South Africa: prioritising an agenda for prevention, *Lancet* 374 (2009) 1011–1022.
41. Department of Justice, Inquests Act No. 58 of 1959, Statutes of the Republic of South Africa [Internet], Available from: <http://www.justice.gov.za/legislation/acts/1959-58.pdf> (accessed 18 May 2015).

Chapter Three: Publication Ready Manuscript

Patterns of blunt force homicide in the West Metropole of the City of Cape Town, South Africa

Courtnee Clark^{1*}, Calvin Gerald Mole¹, Marise Heyns¹

¹Department of Pathology, Division of Forensic Medicine and Toxicology, Faculty of Health Sciences, University of Cape Town.

*Correspondence to: Miss Courtnee Clark, Department of Pathology, Division of Forensic Medicine and Toxicology, Faculty of Health Sciences, University of Cape Town, P.O. Box 13914, Mowbray, 7705, South Africa. E-mail: courtneeclark@gmail.com

3.1. Abstract

There is currently a paucity of information regarding the prevalence and characteristics associated with blunt force trauma related homicides in South Africa. Information relating to the patterns of blunt force trauma could assist in the implementation of appropriate interventions targeted at specific areas or individuals. Furthermore it can direct research toward topics in blunt force trauma which are in need of investigation. As such the primary objective of this study was to determine the prevalence of blunt force trauma related homicides in the West Metropole of the City of Cape Town, South Africa. The secondary objective was to describe the characteristics associated with blunt force trauma related homicides in the West Metropole of the City of Cape Town, South Africa.

The study was a retrospective review of autopsy reports obtained from Salt River mortuary from 1 January 2013 to 31 December 2014. The prevalence of blunt force trauma was considered for unnatural deaths with a focus on homicide. The inclusion criteria were cases where the cause of death was blunt force trauma as determined by the pathologist. Cases in which the death was not caused solely by blunt force trauma were classified as combination deaths, and cases involving deaths due to blunt force trauma as a result of falling from a height, train-related, pedestrian or motor vehicle accidents have been excluded.

A total of 3346 and 3461 cases of unnatural deaths occurred in the West Metropole of the City of Cape Town in 2013 and 2014 respectively. 247 (7.4%) cases in 2013 and 277 (8%) cases in 2014 involved blunt force injuries, and of these cases 183 (5.5%) in 2013 and 201 (5.8%) in 2014 were classified as homicides. The results of the characteristics of blunt force homicide analysed in this study broadly concur with previous studies undertaken in South Africa, with some areas of divergence. Additional features that have not been covered in previous studies also emerged, which could possibly form the basis for future investigations.

Keywords: Blunt force trauma, homicide, Cape Metropole

3.2. Introduction

Globally trauma is considered one of the most common forms of homicide and is frequently categorised into three main groups according to the mechanisms of trauma, namely: blunt, sharp and ballistic trauma. Extensive research on wound pathology has been conducted to better distinguish between the trauma mechanisms in order to provide information pertaining to the weapon type so as to clarify the events surrounding death (1,2). The wound morphology in blunt force trauma cases varies based on the weapon used, the force with which it was applied and the affected body region (1,3). Fatal blunt force trauma injuries are usually the consequence of blows from fists and feet or a variety of blunt implements such as household hammers, wooden clubs or bats (4). Some cases of blunt force trauma may not lead to instantaneous death but rather death after a delayed period of days, weeks or months in which case difficulties may arise in the determination of whether an individual is at fault (5).

In the South African context, violence is rife. This is especially the case in Cape Town where homicide is the second highest contributor to unnatural deaths (6,7). Previous research has suggested that the largest proportion of homicide deaths in Cape Town are due to sharp force and firearms, however blunt force trauma forms a significant portion of unnatural deaths (8). In some cases of homicide a combination of injuries are present, especially if the assault was carried out by multiple aggressors as is frequently seen in cases of mob violence which is prevalent in the Western Cape (8).

Literature tends to focus on age and gender, location of injuries, number of body regions involved, defence injuries, weapon, assailant-victim relationship, location of the crime scene and further toxicological analysis of the victim's tissue (9-11). However, not all literature on fatal blunt force trauma is directly comparable because nationally there is a dearth of centralised information pertaining to blunt force deaths, hence research is based on data gathered from a variety of resources such as police dockets, hospital records and autopsy reports (6). Furthermore, very few studies report the statistical significance of the recorded proportions and proportions are generally not compared to population data to determine whether the distribution seen in the study is merely due to regional population proportions. Information relating to the patterns of blunt force

trauma could assist in the implementation of appropriate interventions targeted at specific areas or individuals. Additionally it can direct research toward topics in blunt force trauma which are in need of investigation.

In South Africa, there is currently a paucity of information regarding the prevalence and characteristics associated with blunt force trauma related homicides. Therefore, the principal objective of this study was to determine the prevalence of blunt force trauma related deaths and homicides in the West Metropole of the City of Cape Town, South Africa. The secondary objective was to describe the characteristics associated with blunt force trauma related homicides in the West Metropole of the City of Cape Town, South Africa.

3.3. Methods

The study is a retrospective review of autopsy reports obtained from Salt River mortuary during the years 2013 and 2014, from 1 January 2013 to 31 December 2014. Salt River Mortuary is an M6 Academic facility which processes an average of 3000 cases a year. It services the West Metropole of the City of Cape Town which is comprised of the Western, Southern, Klipfontein and Mitchells Plain districts (12). The Western district includes the City Bowl and West Coast areas, the Southern district is made up of the Atlantic Seaboard, Southern Peninsula and Southern Suburb areas and part of the Cape Flats covers the Klipfontein and Mitchells Plain districts.

The prevalence of blunt force trauma was considered for unnatural deaths with a focus on homicide. The inclusion criteria were cases where the cause of death was blunt force trauma as determined by the pathologist. Cases in which the death was not caused solely by blunt force trauma were classified as combination deaths. Cases involving deaths due to blunt force trauma as a result of falling from a height, train-related, pedestrian and motor vehicle accidents were excluded.

In each case, the characteristic data was collected and recorded into a Microsoft® Office Excel® 2013 (Microsoft, Redmond, Washington, US) database. Stata Ver 13.1 (StataCorp, TX, USA) was used to perform descriptive statistics to identify the presence of patterns

and commonalities for each characteristic. Pearson's goodness of fit test was used to assess whether individual proportions were equal and Pearson's Chi-squared (χ^2) tests were used to assess the association among groups of characteristics. Population data for the relevant drainage area was obtained from the 2011 Census data compiled by StatsSA (13).

Ethics Committee approval for this study was obtained from the Human Research Ethics Committee (HREC) of the Faculty of Health Sciences at the University of Cape Town (HREC Ref: 313/2015).

3.4. Results and Discussion

3.4.1. Prevalence

A total of 3346 and 3461 cases of unnatural deaths occurred in the West Metropole of the City of Cape Town in 2013 and 2014 respectively, of which 247 (7.4%) cases in 2013 and 277 (8%) cases in 2014 involved blunt force injuries. In total, 183 (5.5%) and 201 (5.8%) deaths due to blunt force trauma were classified as homicides in 2013 and 2014 respectively. The mean prevalence over the two year period was 13.53/100 000 population for unnatural blunt force trauma deaths and 9.91/100 000 for blunt force trauma homicides. There was no significant difference in the prevalence of blunt force trauma nor blunt force trauma homicides between the years (blunt force trauma: $P=0.336$; blunt force trauma homicide: $P=0.545$). Between 2013 and 2014 there was no significant difference in the 56 (30.6%) and 58 (28.9%) homicides that were a consequence of a combination of blunt and sharp force trauma ($P=0.707$). Due to the lack of centralised data focusing on blunt force trauma homicides, it was difficult to make comparison of these results to previous results in the country. These figures of 5.5% and 5.8% prevalence are less than the 14% reported by Matzopoulos in 2003 (6). This could be due to the Matzopoulos study having considered all blunt force trauma related deaths in South Africa as a whole with no specific focus on homicide (6). It is understood that motor vehicle collisions are a major burden on health services world-wide, particularly in developing countries (14–16). The difference between these results and those reported by Matzopoulos et al. (6) may therefore primarily be due to the inclusion of

injuries seen in motor vehicle collisions. A more recent study in Pretoria in 2014 reported that 6.19% of unnatural deaths were caused by blunt force trauma (17). This study performed an analysis of non-natural deaths for which alcohol analysis was performed, in which approximately 62% of the total cases had samples taken for alcohol analysis (17).

3.4.2. Age of victim

In this study the mean age of the victims in 2013 was 31.75 years with a standard deviation of 12.44 years, the principal age group being 20 – 29 years (35%). In 2014 the mean age was 29.76 years associated with a standard deviation of 10.55 years, the principal age group also being 20 – 29 years (43%). There was no significant difference in the proportion of cases falling within the principal age group between 2013 and 2014 ($P=0.145$). The distribution of cases across age groups for both years can be seen in Figure 3-1. Both years reflect widely distributed victim ages ranging from 0 to 81 years in 2013 and 0 to 74 years in 2014.

The overall age distribution of the victims of blunt force trauma homicide is significantly different to the age distribution of the overall intake from Salt River Mortuary. The overall intake at Salt River Mortuary is composed primarily of cases of unnatural death with a portion of natural death cases. Individual differences can be seen in Table 3-1 with the most at risk group being the 20 – 29 year age group. The results of the current study are analogous with those from South Africa in 2003 and 1994 where the age group 25 – 29 and 25 - 34 years had the highest number of recorded homicides respectively (6,15). The predominant age group of homicide victims recorded in South African studies (6,15) is slightly younger than those reported in British (30-39 years) (4) and Indian (31-40 years) (10) studies, a conceivable explanation for this is the involvement of younger people in gang activity and violence, as is often the case in the Western Cape (8,18,19).

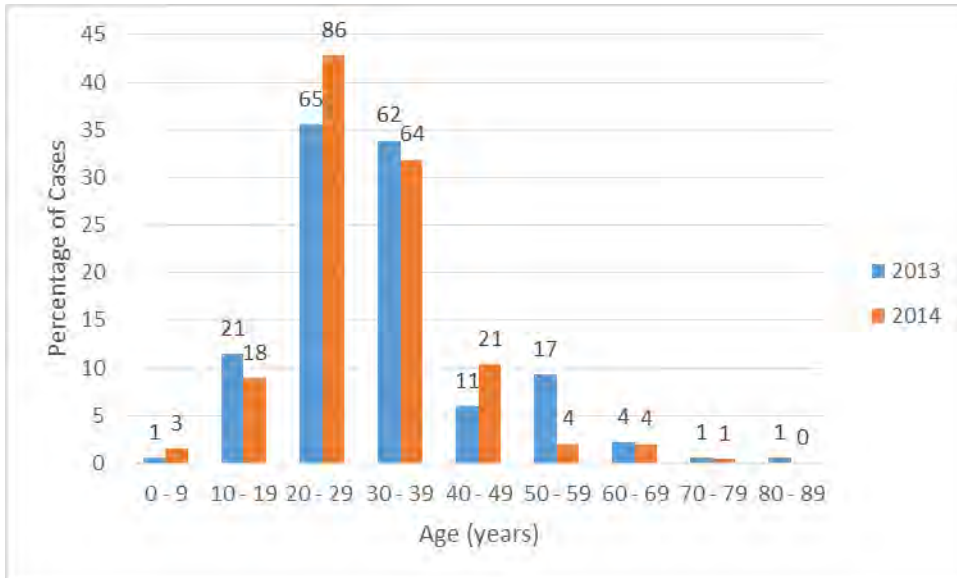


Figure 3-1. Percentage age distribution of victims of blunt force trauma homicide during 2013 and 2014. Numbers above bars represent number of cases.

Table 3-1. Comparison of the age distribution between blunt force homicide cases and the overall intake from Salt River Mortuary for the years 2013 and 2014.

Age Category	Blunt Force Trauma Homicide %	Salt River Mortuary Intake %	P-value
0 - 9	1,04	12,84	< 0,001
10 - 19	10,16	6,75	0,0106
20 - 29	39,32	24,62	<0,001
30 - 39	32,81	19,85	<0,001
40 - 49	8,33	12,23	0,0225
50 - 59	5,47	9,90	0,0043
60 - 69	2,08	7,28	<0,001
70 - 79	0,52	3,87	0,0007
80 - 89	0,26	2,31	0,0077
89 - 90	0,00	0,36	0,2389

3.4.3. Gender

It is accepted that there are a greater number of male compared to female homicide victims (4). The results of previous studies show the male to female ratio for all homicides in the city of Cape Town was reported as 8.5:1 in 2003(6). Similarly, a study conducted on blunt force homicide in India noted a male to female ratio 6.6:1 (10). The explanation for this is multifaceted and based on complex socio-biological interactions (20). A study in the United States used “sexual selection evolutionary theory” to explain

the overrepresentation of young, unemployed, single male homicide victims and offenders (21). This trend has subsequently been referred to as hegemonic masculinity and can be interpreted as young men tending to be more aggressive and competitive. Hence more likely to be victims or perpetrators of violence, because of the evolutionary context of reproductive competition (18). Evolutionary theory was included in a model developed using data from 18 developed democracies, whereby the gender-gap associated with homicide is attributed to gender differences in roles and status (20). This model included the degree of exposure to potential offenders and the prevalence of conflict amongst the population. In the South African context, there are high levels of conflict within a population associated with male dominance (18).

The current study showed that there were significantly more male victims than female victims of blunt force homicide for both years ($P < 0.001$), with no significant difference in the gender ratios of 2013 and 2014 ($P=0.298$). In 2013, 93% of victims were male and 7% female, a ratio of 14.25:1 and in 2014, 91% of victims were male and 9% female, a ratio of 9.58:1. In comparison the reported ratio of male to female victims of blunt force homicide in the Cape Metropole during the year 1994 was 6.6:1. (15).

The results of the current study show a significant overrepresentation of male victims of blunt force trauma homicide when compared to the overall intake at Salt River Mortuary for the respective years which was comprised of 78% males and 22% females. This suggests that males are more at risk from blunt force homicide than females (Table 3-2). The high levels of males involved in blunt force trauma, as well as homicide in general, in the West Metropole of the City of Cape Town could be due to the high levels of gang violence in which men are usually more heavily involved than women (8,18).

Table 3-2. Comparison of the gender distribution of blunt force trauma homicide cases for both years of study and the overall intake from Salt River Mortuary for both years of study.

Gender	Blunt Force Trauma Homicide %	Salt River Mortuary Intake %	P-value
Male	91,93	78,05	<0,001
Female	8,07	21,95	<0,001

3.4.4. Day and month of death

On examination of the blunt force homicides on the days of the week it was found that there was an association for both years between the distribution of cases and the days of the week (2013: $P= 0.002$; 2014: $P=0.008$). The highest number of blunt force homicides occurred on Sundays with 42 (23%) and 43 (21%) cases occurring on Sundays in 2013 and 2014 respectively (Figure 3-2). The number of homicides that occurred during the weekend accounted for 42% of the total number of blunt force homicide cases in 2013 and 38% in 2014. These results resemble that of 49% of all homicides taking place during the weekend in Cape Town in 2003 (6). It is thought that this trend could possibly be attributed to people spending more time taking part in social drinking over the weekend (4). Evidence of this pattern can be seen in Figure 3-3, which demonstrates that Sundays had the highest number of cases with mild to severe intoxication. In addition to research suggesting a correlation between the homicide rate and days of the week there is also a possible association between certain months or seasons of the year. A British study found the homicide rate increases during the warmer summer months (4) which is contrary to the results produced in this study which showed no recognisable pattern between 2013 or 2014 for the distribution of blunt force homicides over the course of the year. A possible explanation for this may be the moderate climate in South Africa and overall much higher crime rate in comparison with Britain (6,15).

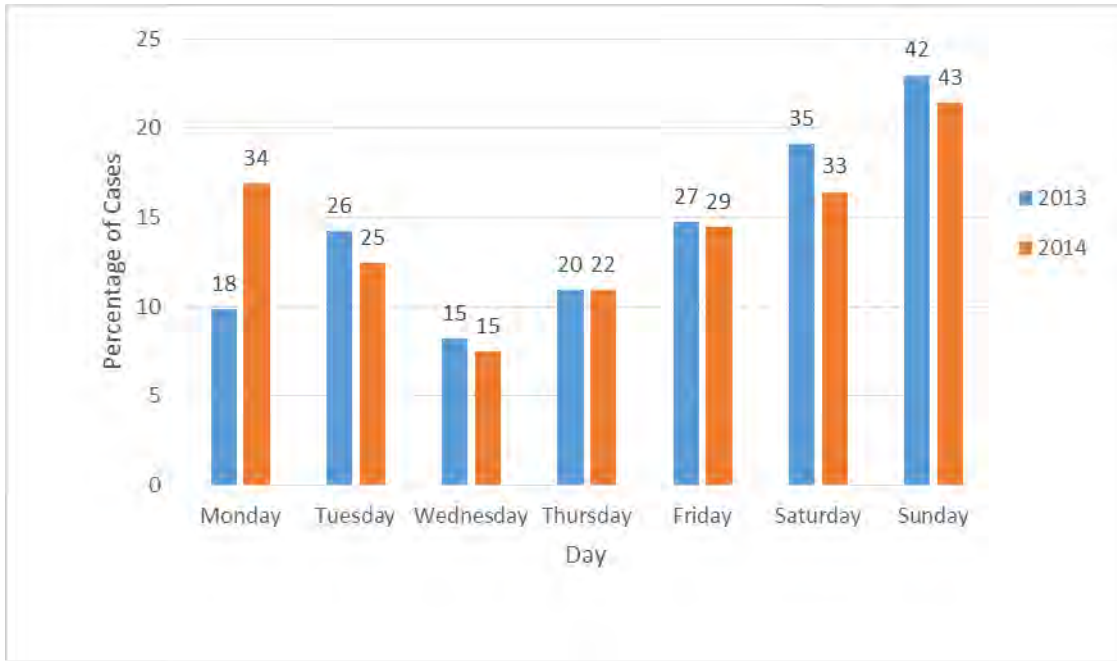


Figure 3-2. Percentage distribution of blunt force homicide cases during the days of the week in 2013 and 2014. Numbers above the bars represent number of cases.

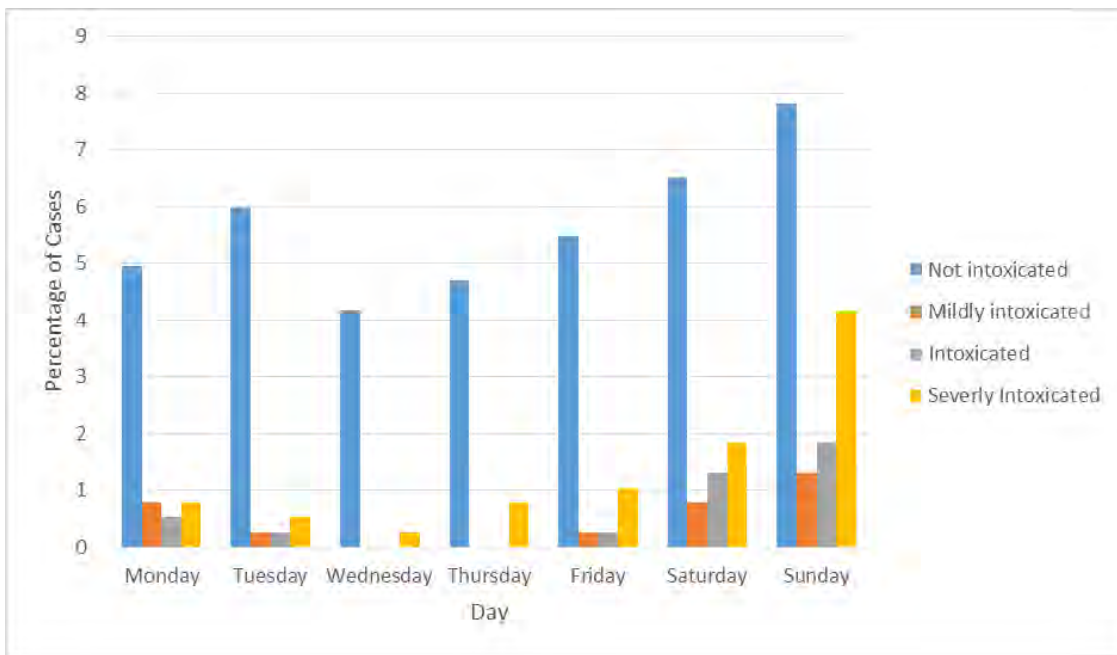


Figure 3-3. Percentage distribution of intoxication levels during the week as a percentage of the total cases for 2013 and 2014.

3.4.5. Number and location of injuries

Similar injury profiles were evident for both years of study. There was an average number of 10 injuries per case for both 2013 and 2014 and the mean number of injuries per case was 12.58 in 2013 and 12.83 in 2014 which was associated with standard deviations of 11.11 and 11.44 respectively (Table 3-3). The minimum and maximum number of blunt force injuries was 0 and 66 respectively in 2013 and 0 and 58 respectively in 2014 (Table 3-3). The cases with no injuries were indicative of cases where no visible signs of blunt force trauma were present externally. Very high numbers of injuries were mostly in cases with extensive areas of abrasion. Cases where the number of injuries was unknown refers to cases where the victim was severely burned post-mortem. In cases where sharp force trauma was also present fewer sharp force injuries were generally evident as compared to blunt force injuries. A possible reason for this could be that the study focused primarily on blunt force attacks so sharp force injuries may have been incidental in nature and seen to a lesser extent. Information pertaining to the number of assailants and weapons used was not uniformly reported or available but cases showing multiple combination injuries are thought to possibly be associated with multiple aggressors as in cases of community assault which is common in the Western Cape (8,22).

During the period of investigation, many victims sustained a high number of injuries, the location of which tended to be spread over the body. The head was the body region most often showing signs of blunt force trauma with over 90% of cases for both years involving the head (Table 3-3). This trend was demonstrated over both years of study as a total of 29 (16%) cases in 2013 and 32 (16%) cases in 2014 showed the head to be the only injured body region whilst 137 (75%) cases in 2013 and 152 (76%) cases in 2014 demonstrated injury to the head in addition to other regions (Figure 3-4).

Defensive injuries could contribute to the large number of wounds located on the arms which accounted for the arms being the second most affected body region in blunt force attacks. The high number of cases involving the head echoes Ambade et al. (2006) who recorded 81% of cases of blunt force homicide involved the head (10). Of the cases that also demonstrated sharp force trauma the head was involved to a lesser degree as 23 (41%) cases in 2013 and 31 (53%) cases in 2014 did not affect the head at all as opposed to the 17 (9%) and 17 (8%) cases that did not affect the head at all for the blunt force

injuries in the corresponding years. A more complete injury profile of blunt force attacks would be possible if hospital records and autopsy reports were combined in order to capture injury information of victims who survive blunt force attacks.

Table 3-3. Distribution of the number of blunt force injuries per case in 2013 and 2014 and the regional distribution of the blunt force injuries.

Year	Number of Injuries/Case				Regional Distribution N (%)						
	Mean	SD	Min	Max	Head	Neck	Chest	Back	Legs	Arms	Abdomen
2013 N=183	12,58	11,01	0	66	166 (91%)	41 (22%)	74 (40%)	61 (33%)	106 (58%)	109 (60%)	34 (19%)
2014 N=201	12,83	11,45	0	58	184 (92%)	53 (26%)	79 (39%)	74 (37%)	104 (52%)	130 (65%)	43 (21%)

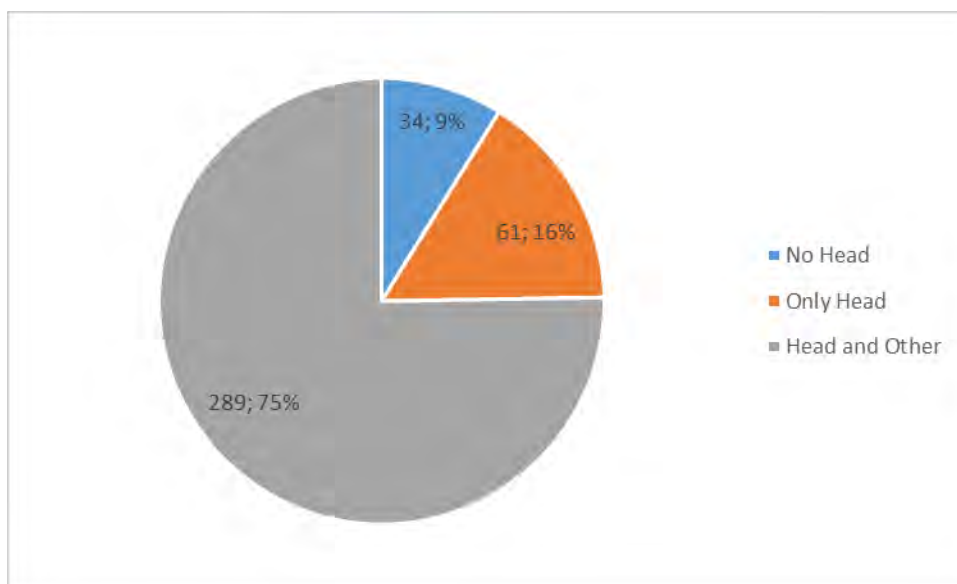


Figure 3-4. Percentage of total number of cases with blunt force injuries involving the head during 2013 and 2014. Numbers in each segment represent number of cases with the corresponding percentage.

3.4.6. Geographical crime scene area

In the West Metropole of the City of Cape Town, the Cape Flats was the most heavily affected geographical area in both years of study contributing 122 (66.67%) and 141 (70%) homicide cases in 2013 and 2014 respectively ($P < 0.001$), with no significant difference between the years ($P = 0.463$). These figures are in accordance with the high

reported rates of homicide in the Western Cape (23). Poor socio-economic status has been shown to be correlated with high rates of homicide (16,24). The current study therefore concurs with the finding of elevated levels of homicide in poor socio-economic areas.

A couple of cases indicate crimes occurring in the Boland (1 case) and Winelands (1 case) areas. These areas do not typically form part of the catchment area for Salt River mortuary, however in these cases the individuals were transferred to hospitals within the catchment area where they subsequently died.

3.4.7. Physical crime scene location

The physical location of the crime scene refers to the physical context of the crime scene and was categorised as formal housing (indoors), informal housing (indoors), outdoors, other (medical facilities, bars and shops) and unknown. There was no significant difference between the years of study for the physical crime scene location of blunt force homicides ($P=0.421$). As seen in Figure 3-5, a significant proportion of victims were killed in an outdoor context, compared to those killed at other locations (51% in 2013, 47% in 2014; $P<0.001$). Although there was a much higher proportion of male than female victims, when the number of cases per physical crime scene location was analysed separately for each gender a difference in the proportional distribution of female and male victims was noted. Although the association was not significant, in 2013 a greater proportion of female victims (41.67%) were killed indoors in formal or informal housing compared to 11.69% of male victims ($P=0.054$) (Figure 3-6). In 2014 a significant proportion of female victims (26.32%) were killed indoors in formal housing compared to 4.95% of male victims ($P=0.038$) (Figure 3-6). These results correspond to English and South African studies which conclude that a greater percentage of women than men are killed in their domiciles (4,6). A reason put forward for this global trend is the difference in the interaction of sociobiological factors and gender roles within society, leading to men being more likely than women to interact aggressively, especially with strangers away from their homes (20).

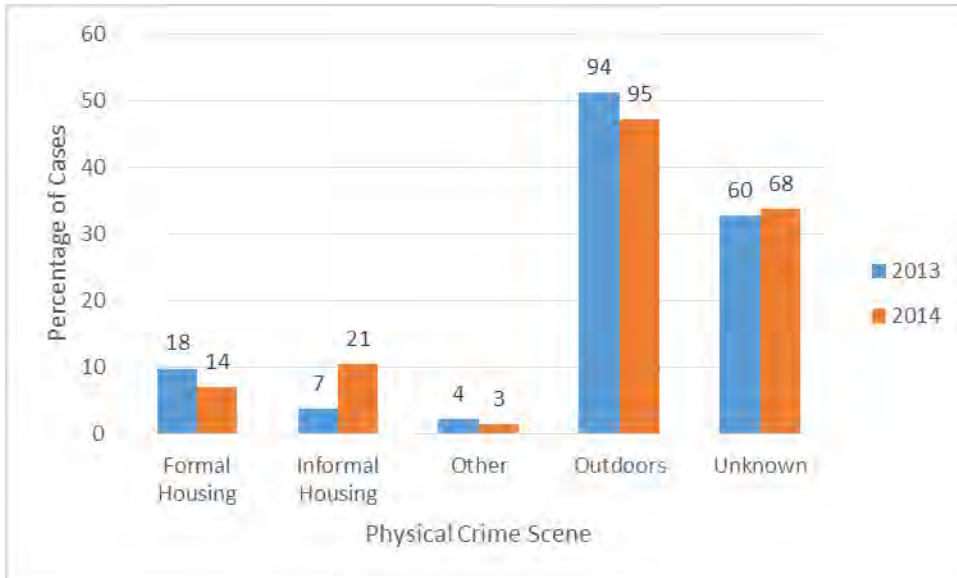


Figure 3-5. Percentage distribution of total number of victims in physical crime scene context. Numbers above the bars represent number of cases.

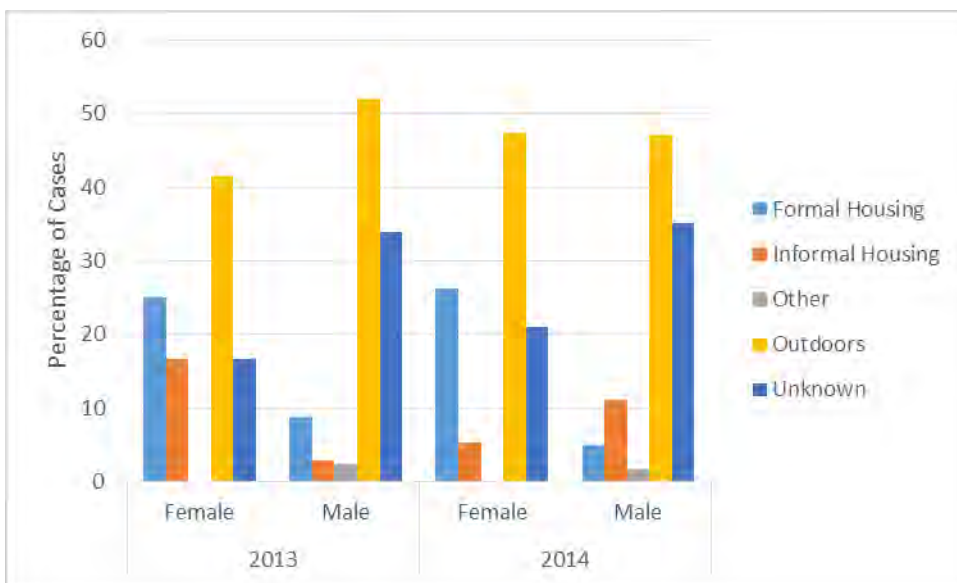


Figure 3-6. Percentage of victims of each gender and the physical context of the crime scene.

3.4.8. Presence of alcohol in victim

It is accepted that alcohol use and intoxication is a key risk factor for homicide, with Cape Town having a larger number of alcohol positive cases compared to other areas in South Africa (6). The blood alcohol concentration (BAC) of victims of blunt force trauma was expressed in grams per 100 millilitres of blood (g/100ml) and was classified into four

groups based on the South African legal driving blood alcohol level, namely: not intoxicated (0g/100ml), mildly intoxicated ($0 < 0.05\text{g}/100\text{ml}$), intoxicated ($0.05 < 0.15\text{g}/100\text{ml}$) and severely intoxicated ($0.15 < 0.4\text{g}/100\text{ml}$). In 2013 the blood alcohol concentration was unknown for 78 (43%) cases due to no alcohol analysis having been conducted. However, out of the 105 cases with a known BAC, 72 (39%) victims were not intoxicated, the 33 (31%) victims who were intoxicated had a mean BAC of 0.16g/100ml ranging from 0.01 – 0.37g/ 100ml of which 20 (11%) showed signs of severe intoxication (Figure 3-7). The 2014 data followed the same trend as that of 2013 with the largest number of cases (89; 44%) having unknown BAC, the second largest group was 80 (40%) cases where the victims were not intoxicated, the 32 (16%) intoxicated victims had a mean BAC of 0.15g/100ml ranging from 0.01 – 0.3g/ 100ml of which 16 (8%) showed signs of severe intoxication (Figure 3-7). In a 2014 study in Pretoria 38% of blunt force trauma cases had positive BAC with a mean BAC of 0.13g/100ml (17).

Whilst there was no significant association between age and BAC, the highest levels of intoxication were in the 30 – 39 years age category in 2013 and in the 20 – 29 years age category in 2014 with severe intoxication occurring more frequently than mild intoxication and intoxication within these age groups. Male victims showed BAC across all the intoxication levels, whilst females did not. Due to the small number of female blunt force trauma victims in this study it was difficult to make associations between female victims and alcohol use, however the 33% of severely intoxicated females is less than the results seen by Mathews et al. in which 56% of female blunt force trauma victims in the Western Cape were severely intoxicated (25). Differences between these results could be due to the specific nature of inclusion factors in this study which only included victims of blunt force homicide as opposed to all types of homicide.

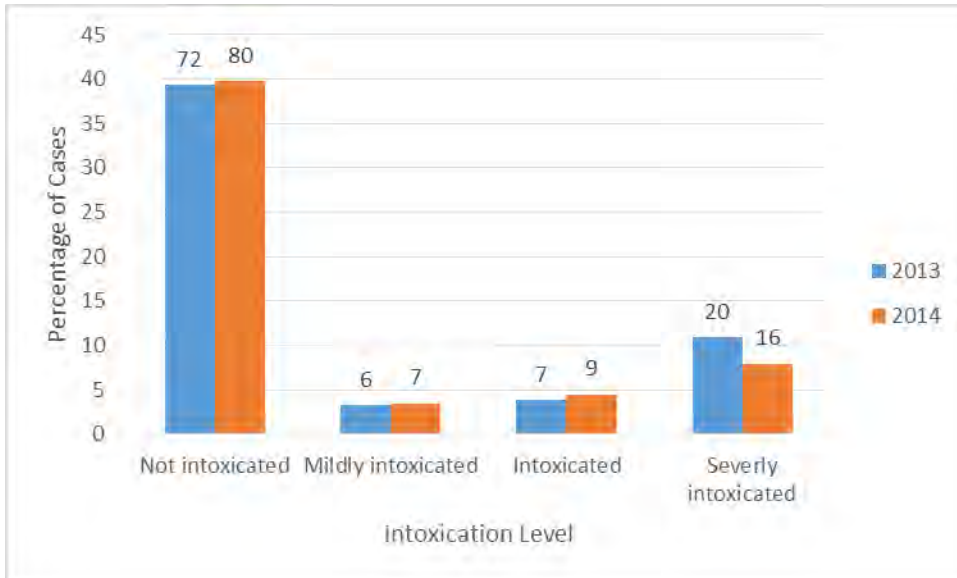


Figure 3-7. Percentage distribution of the blood alcohol concentration levels in victims of blunt force trauma. Numbers above the bars represent number of cases.

3.4.9. Limitations

The current study is limited to a two year period from 2013 to 2014. These years were selected for retrospective review in order to cover as recent a time period as possible while allowing enough time for the return of toxicological analysis. Whilst the results of each analysed characteristic are statistically similar, extending the period of study would allow for increased confidence in the observed patterns.

The population data was based on the 2011 Census data for the District municipality of the City of Cape Town because it was the most accurate and recent estimate of the population included in the study. However, this area is larger than the catchment area of Salt River Mortuary from where the analysed cases were obtained. To address this issue in future studies, autopsy reports from Tygerberg Mortuary can be included in the analysis in order to extend the area of study to cover the area of the District municipality of Cape Town.

The current study did not report on offender-victim relationship. However, such information may provide further insights to the events surrounding death and should be considered in future research by investigating police dockets in association with autopsy reports. Examining police dockets may also provide more information relating to the type

of weapon(s) used which are not typically available in autopsy reports. Furthermore, a more complete injury profile of blunt force trauma will be possible if autopsy reports were analysed in conjunction with hospital records. This will provide better understanding of fatal and non-fatal blunt force trauma injuries because some of the victims of blunt force trauma attacks do not die from their injuries.

3.5. Conclusion

The results of this study broadly concur with previous studies undertaken in South Africa. There were some areas of divergence, but also the emergence of features not covered in previous studies which could possibly form the basis for future investigation or intervention (6,15,17). In the West Metropole of the City of Cape Town the prevalence of blunt force trauma was 7.4% in 2013 and 8% in 2014 and the prevalence of blunt force trauma homicide was 5.5% in 2013 and 5.8% in 2014. The majority of the victims were young males from the Cape Flats. This area has poor socio-economic status and could be in need of interventions, especially for young men. Interventions could include increased police presence during the weekend. There was a high number of injuries associated with blunt force homicides especially located on the head, which highlights the importance of focusing resources and research on cranial trauma. Valuable insight can be gained from further analysis into the role of alcohol intoxication in blunt force trauma related deaths as well as the physical crime scene location which could narrow down high risk areas most in need of intervention. In relation to this the presence of medical intervention can be included in future investigations to determine the role it has on the survival of victims of blunt force attacks.

3.6. Reference List

1. G. O. Hart, Fracture pattern interpretation in the skull: differentiating blunt force from ballistics trauma using concentric fractures, *J Forensic Sci* 50 (6) (2005) 1276–1281.
2. T. Ohshima, Forensic wound examination, *Forensic Sci Int* 113 (2000) 153–164.
3. C. G. Mole, M. Heyns, T. Cloete, How hard is hard enough? An investigation of the force associated with lateral blunt force trauma to the porcine cranium, *Leg Med* 17 (1) (2015) 1-8.
4. J. P. Henderson, S.E. Morgan, F. Patel, M.E. Tiplady, Patterns of non-firearm homicide, *J Clin Forensic Med* 12 (3) (2005) 128–132.
5. P. Saukko, B. Knight, Chest and abdominal injuries, in: *Knight's Forensic Pathology*, 3rd Ed., Arnold, London, 2004, pp. 229–230.
6. R. Matzopoulos, Violent Deaths in SA: The 2003 National Injury Mortality Surveillance System, *SA Crime Q* 13 (2005) 29–36.
7. R. Norman, R. Matzopoulos, P. Groenewald, D. Bradshaw, The high burden of injuries in South Africa, *Bull World Health Organ* 85 (9) (2007) 695–702.
8. L. Buur, S. Jensen, Introduction: vigilantism and the policing of everyday life in South Africa, *Afr Stud* 63 (2) (2004) 139–152.
9. P. Wahlsten, V. Koironen, P. Saukko, Survey of medico-legal investigation of homicides in the city of Turku, Finland, *J Clin Forensic Med* 14 (5) (2007) 243–252.
10. V. N. Ambade, H. V. Godbole, Comparison of wound patterns in homicide by sharp and blunt force, *Forensic Sci Int* 156 (2006) 166–170.
11. J. Fischer, W. J. Kleemann, H. D. Tröger, Types of trauma in cases of homicide, *Forensic Sci Int* 68 (1994) 161–167.
12. Forensic Pathology Services: Our Facilities [Internet], (2014) Available from: <https://www.westerncape.gov.za/general-publication/our-facilities> (accessed 8 March 2015).
13. City of Cape Town: 2011 Census Suburb Profiles [Internet], (2015) Available from: <http://www.capetown.gov.za/en/stats/Pages/2011-Census-Suburb-Profiles-land.aspx> (accessed 9 November 2015).
14. C. S. Byun, I. H. Park, J. H. Oh, K. S. Bae, K. H. Lee, E. Lee, Epidemiology of trauma patients and analysis of 268 mortality cases: trends of a single center in Korea, *Yonsei Med J* 56 (1) (2015) 220–226.

15. L. B. Lerer, R. G. Matzopoulos, R. Phillips, Violence and injury mortality in the Cape Town Metropole. *S Afr Med J* 87 (3) (1997) 298–301.
16. N. Schuurman, J. Cinnamon, R. Matzopoulos, V. Fawcett, A. Nicol, S. M. Hameed, Collecting injury surveillance data in low- and middle-income countries: The Cape Town Trauma Registry pilot, *Glob Public Health* 6 (8) (2011) 874–889.
17. U. Ehmke, L. du Toit-Prinsloo, G. Saayman, A retrospective analysis of alcohol in medico-legal autopsied deaths in Pretoria over a 1 year period, *Forensic Sci Int* 245 (2014) 7–11.
18. R. Morrell, R. Jewkes, G. Lindegger, Hegemonic masculinity/masculinities in South Africa: culture, power, and gender politics, *Men Masc* (2012) 1-20.
19. B. Van Wyk, W. Theron, Fighting gangsterism in South Africa: a contextual review of gang and anti- gang movements in the Western Cape, *Acta Crim* 18 (3) (2005) 51–60.
20. R. Gartner, K. Baker, F. C. Pampel, Gender stratification and the gender gap in homicide victimization, *Soc Probl* 37 (4) (1990) 593–612.
21. M. Wilson, M. Daly, Competitiveness, risk taking, and violence: the young male syndrome, *Ethol Sociobiol* 6 (1985) 59–73.
22. N. Shields, K. Nadasen, L. Pierce, The effects of community violence on children in Cape Town, South Africa, *Child Abuse Negl* 32 (2008) 589–601.
23. Crime Situation in South Africa: South African Police Service [Internet], (2014) Available from:
http://www.saps.gov.za/resource_centre/publications/statistics/crimestats/2014/crime_stats.php (accessed 20 May 2015).
24. World Health Organisation, Global status report on alcohol and health, World Health Organ (2011) 1–286.
25. S. Mathews, N. Abrahams, R. Jewkes, L. J. Martin, C. Lombard, Alcohol use and its role in female homicides in the Western Cape, South Africa, *J Stud Alcohol Drugs* (2009) 321–327.

Chapter Four: Appendices

4.1. Acknowledgments

I would like to acknowledge the National Research Foundation (NRF) for awarding me the NRF Freestanding Masters Scholarship for the year in which I completed this project.

I have been fortunate to have supportive and encouraging supervisors who have made the compiling of this mini-thesis an interesting and exciting process.

Mr. Calvin Mole and Dr. Marise Heyns played a supervisory role in the compilation of this mini-thesis. I would like to acknowledge Mr. Calvin Mole for his availability, advice and encouragement throughout the research, analysing and writing of this thesis. His enthusiasm was contagious and I am grateful to have had the chance to learn from him.

I would also like to thank Dr. Marise Heyns for her contextual thinking and backing of all my academic pursuits. The people in the Forensic Medicine and Toxicology department have been generous with their time and their constructive comments have been much appreciated.

Finally, the support of my family and friends has been much appreciated, especially Wes who has endured more unsavoury dinner talk than is probably appropriate.

4.2. HREC Approval Letter



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



Room E52-24 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6338 • Facsimile [021] 406 6411
Email: nosi.tsama@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

04 June 2015

HREC REF: 313/2015

Mr C Mole
Forensic Medicine & Toxicology
Falmouth Building
Entrance 2, Level 5

Dear Mr Mole

PROJECT TITLE: PATTERNS OF DEATH DUE TO BLUNT FORCE TRAUMA (MPhil-candidate-C Clark)

Thank you for your response to the Faculty of Health Sciences Human Research Ethics Committee dated 26th May 2015.

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

Approval is granted for one year until the 30th June 2016.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.

(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

Please quote the HREC REF in all your correspondence.

We acknowledge that the student, Courtney Clark will also be involved in this study.

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

Yours sincerely

PROFESSOR M. BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE

Federal Wide Assurance Number: FWA00001637.

Institutional Review Board (IRB) number: IRB00001938

This serves to confirm that the University of Cape Town Human Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Convention on Harmonisation Good Clinical Practice (ICH GCP), South African Good Clinical Practice Guidelines (DoH

2006), based on the Association of the British Pharmaceutical Industry Guidelines (ABPI), and Declaration of Helsinki guidelines.

The Human Research Ethics Committee granting this approval is in compliance with the ICH Harmonised Tripartite Guidelines E6: Note for Guidance on Good Clinical Practice (CPMP/ICH/135/95) and FDA Code Federal Regulation Part 50, 56 and 312.

4.3. Population Data for West Metropole of the City of Cape Town Suburbs

This population data from the City of Cape Town was based on the StatsSA population data from the 2011 Census and provides population data for the suburbs within the West Metropole of the City of Cape Town. The data can be accessed via the following url: <http://www.capetown.gov.za/en/stats/Pages/2011-Census-Suburb-Profiles-land.aspx>

Suburb	Population
Acacia Park	817
Athlone	45 048
Atlantis Non-Urban	2479
Atlantis	67491
Bergvliet	4428
Bishopscourt	1603
Bloubergstrand	11179
Bonteheuvel	52956
Bothasig	11790
Brooklyn	10941
Camps Bay	4982
Cape Peninsula National Park	286
Cape Town CBD	5647
Capri	3061
Capricorn	4458
Castle Rock	5595
Century City	4239
Claremont	17198
Clifton	507
Clovelly	559
Coniston Park	1833
Constantia	12454
Crossroads	36043
Da Gama Park	2346
Diep River	2515
Dreyersdal	2130
Edgemead	9884
Epping Industria	50
Fairways	2952
Fish Hoek	9052
Foreshore	762
Gardens	7960
Glencairn	1574

Grassy Park	19212
Green Point	9301
Gugulethu	98468
Hanover Park	45497
Hazendal	4995
Heathfield	7226
Heideveld	21288
Hout Bay	17329
Imizamo Yethu	15538
Joe Slovo Park	12629
Kalk Bay	700
Kennilworth	10872
Kensington	24161
Kirstenhof	4515
Kleine Zout Rivier Small Holdings	283
Knole Park	2961
Kommetjie	3341
Lakeside	3801
Langa	52401
Lansdowne	18650
Lavenderhill	32598
Llandudno	571
Lotus River	38143
Maitland Garden Village	1834
Maitland	9782
Mamre	9048
Manenberg	61615
Marconi Beam	37
Marina da Gama	3390
Masiphumelele	21904
Meadowridge	3194
Melkbosstrand	11303
Milnerton Non-Urban	3293

Milnerton	14306
Mitchells Plain	310485
Montague Gardens	22
Monte Vista	7023
Mowbray	4726
Muizenberg	5537
Ndabeni	1014
Newlands	5100
Noordhoek	4424
Nyanga	57996
Observatory	9207
Ocean View	13569
Oranjezicht	3580
Ottery	17942
Oude Molen Village	530
Paarden Eiland	11
Parklands	24614
Parkwood	11870
Pelikan Park	12552
Pella	1681
Philippi	191025
Philippi Small Holdings	6618
Phoenix	4219
Pinelands	14198
Plumstead	20178
Pollsmoor	2161
Red Hill	1016
Retreat	35709
Robben Island	116
Rondebosch/Rosebank	19554
Rugby	4431
Ruyterwacht	10773
Salt River	6577
Scarborough	1075
Schotschekloof	3203

Sea Point	16164
Sheraton Park	3111
Silvertown	27146
Simons Town	2649
Southfield	7106
St James	491
Steenberg Estate	796
Steenberg	4168
Stonehurst Mountain Estate	678
Summer Greens	6275
Sun Valley	4869
Sunningdale	5299
Sybrand Park	1613
Table Mountain Nature Reserve	114
Table View	25977
Tamboerskloof	2984
Thornton	5862
Tijgerhof/Sanddrift	6178
Tokai	3664
University of Cape Town	471
V & A Waterfront	1570
Vissershok	323
Vredehoek	5415
Vrygrond	18498
Westlake	6452
Wingfield	3129
Woodstock	12656
Wynberg	14472
Youngsfield	887
Ysterplaat Airbase	838
Zeekoei Vlei	421
Zonnebloem	5122
Total	1937139

4.4. Instructions to Authors



FORENSIC SCIENCE INTERNATIONAL

An international journal dedicated to the applications of medicine and science in the administration of justice.

AUTHOR INFORMATION PACK

Description

Forensic Science International publishes original contributions in the many different scientific disciplines pertaining to the forensic sciences. Fields include forensic pathology and histochemistry, chemistry, biochemistry and toxicology (including drugs, alcohol, etc.), biology (including the identification of hairs and fibres), serology, odontology, psychiatry, anthropology, the physical sciences, firearms, and document examination, as well as investigations of value to public health in its broadest sense, and the important marginal area where science and medicine interact with the law.



Forensic Science International publishes: Original Research Papers Review Articles Preliminary Communications Letters to the Editor Book Reviews Case Reports. The journal covers all legal aspects of the general disciplines listed above, as well as specialist topics of forensic interest that are included in, or are related to, these disciplines, e.g.: Biochemical and chemical analyses, and the forensic application of advanced analytical, physical, chemical and instrumental techniques, Bitemark evidence, Battered child syndrome, Questioned documents Ballistics, projectiles and wounds, Fingerprints and identification Tool marks, Contact traces, Poisoning Breath analysers, Accident investigation and mass disasters.

AUDIENCE

Pathologists, Anthropologists, Psychiatrists, Biologists, Serologists, Odontologists, Physical Scientists, Toxicologists, Scientists in Legal and Social Medicine, Questioned Documents and Jurisprudence.

IMPACT FACTOR

2014: 2.140 © Thomson Reuters Journal Citation Reports 2015

ABSTRACTING AND INDEXING

Bulletin Signalétique

Cambridge Scientific Abstracts

Chemical Abstracts

Criminology, Penology and Police Science Abstracts

Current Contents

MEDLINE®

EMBASE

National Criminal Justice Reference Service

Science Citation Index

Biological Abstracts

Current Awareness in Biological Sciences

Scopus

EDITORIAL BOARD

Editor-in-Chief

P. Saukko, (Experimental Forensic Pathology, Traffic Medicine and subjects not listed elsewhere), Department of Forensic Medicine, University of Turku, SF-20520 Turku, Finland, Fax: (+358) 2 3337600

Associate Editors

A. Carracedo, (Forensic Genetics), Institute of Legal Medicine, Universidade de Santiago de Compostela, C/ Pedrueca, 1., 39003 Santander - Cantabria, Spain, Fax: (+34) 981 580336

C. Cattaneo, (Anthropology, Osteology and Odontology), Istituto de Medicina Legal, Università degli Studi, Università degli Studi di Milano, Via Mangiagalli 7, 20133 Milano, Italy

O.H. Drummer, (Toxicology), Victorian Institute of Forensic Medicine, 57-83 Kavanagh Street, Southbank, 3006, Australia, Fax: +61 3 9682 7353

C. Jackowski, (Forensic Imaging), Institut für Rechtsmedizin; Medizinische Fakultät, Medizinische Fakultät, Universität Bern, Bülhstrasse 20, 3012 Bern, Fax: +41 (0)31 631 38 33

P. Margot, (for: Questioned Documents, with the assistance of A. Khanmy and W. Mazzela; and for Physical Science: ballistics, tool marks, contact traces, drugs analysis, fingerprints and identification etc.), Ecole des Sciences criminelles (School of Criminal Science), Université de Lausanne, bâtiment BCH, CH - 1015 Lausanne, Switzerland, Fax: +41 21 692 4605

S. Matuszewski, (for: Forensic Entomology), Adam Mickiewicz University of Poznan, Św. Marcin 90, Poznań, Poland

Assistant Editors

D. Deangelis, Milan, Italy

P. Esseiva, (for P. Margot), Lausanne, Switzerland

M.A. LeBeau, (for O.H. Drummer), Quantico, VA, USA

Z. Obertova, Milan, Italy

Editorial Board

J. Amendt, Frankfurt, Germany

P. Beh, Hong Kong, China

P. Buzzini, Morgantown, WV, USA

C. Campobasso, Campobasso, Italy

H. Chung, Seoul, South Korea

J.G. Clement, Melbourne, VIC, Australia

S.D. Cohle, Grand Rapids, MI, USA

S. Cordner, South Melbourne, VIC, Australia

G.L. de la Grandmaison, Garches, France

P. Dickens, Buxton, UK

H. Druid, Stockholm, Sweden

A. Eriksson, Umea, Sweden

J.A.J. Ferris, Auckland, New Zealand

M.C. Fishbein, Los Angeles, CA, USA

C. Henssge, Essen, Germany

M.A. Huestis, Baltimore, MD, USA

A.W. Jones, Stockholm, Sweden

H. Kalimo, Helsinki, Finland

Y. Katsumata, Chiba, Japan

B. Kneubuehl, Thun, Switzerland
G. Lau, Singapore
S. Leadbeatter, Cardiff, Wales, UK
C. Lennard, Canberra, NSW, Australia
A. Luna Maldonado, Murcia, Spain
B. Madea, Bonn, Germany
H. Maeda, Osaka, Japan
D. Meuwly, The Hague, Netherlands
C. Neumann, University Park, PA, USA
S. Pollak, Freiburg, Germany
M.S. Pollanen, Toronto, ONT, Canada
D.J. Pounder, Dundee, Scotland, UK
K. Püschel, Hamburg, Germany
G. Quatrehomme, Nice, France
R. Ramotowski, Washington, DC, USA
J. Robertson, Canberra, New South Wales, Australia
C. Roux, Sydney, NSW, Australia
I.E. Sääksjärvi, Turku, Finland
J. Stevens, Exeter, UK
M. Steyn, Hatfield, South Africa
F. Tagliaro, Verona, Italy
T. Takatori, Chiba, Japan
A. Thierauf, Freiburg, Germany
D. Ubelaker, Washington, DC, USA
D.N. Vieira, Coimbra, Portugal
J. Wells, Miami, FL, USA
P. Wiltshire, Surrey, Scotland, UK
X. Xu, Shantou, Guandong Province, China
J. Zieba-Palus, Kracow, Poland

GUIDE FOR AUTHORS

.

Your Paper Your Way

We now differentiate between the requirements for new and revised submissions. You may choose to submit your manuscript as a single Word or PDF file to be used in the refereeing process. Only when your paper is at the revision stage, will you be requested to put your paper in to a 'correct format' for acceptance and provide the items required for the publication of your article.

To find out more, please visit the Preparation section below.

INTRODUCTION

Forensic Science International is a peer-reviewed, international journal for the publication of original contributions in the many different scientific disciplines comprising the forensic sciences. These fields include, but are not limited to, forensic pathology and histochemistry, toxicology (including drugs, alcohol, etc.), serology, chemistry, biochemistry, biology (including the identification of hairs and fibres), odontology, psychiatry, anthropology, the physical sciences, firearms, and document examination, as well as the many other disciplines where science and medicine interact with the law.

Types of paper

1. Original Research Articles (Regular Papers)
2. Review Articles
3. Forensic Anthropology Population Data
3. Preliminary Communications
4. Letters to the Editor
5. Case Reports
6. Book Reviews
7. Rapid Communications
8. Technical Notes

Please note that all contributions of type 4 to 7 will be published as e-only articles. Their citation details, including e-page numbers, will continue to be listed in the relevant print issue of the journal's Table of Contents.

Announcement of Population Data: these types of articles will be published in Forensic Science International: Genetics, only. Please submit these articles via <http://www.ees.elsevier.com/fsigen/>.

Review Articles and Preliminary Communications (where brief accounts of important new work may be announced with less delay than is inevitable with major papers) may be accepted after correspondence with the appropriate Associate Editor.

Forensic Anthropology Population Data: Although the main focus of the anthropology section of the journal remains on the publication of original research, authors are invited to submit their forensic anthropology population data articles by selecting the "Forensic Anthropology Population Data" article type on the online submission system. When submitting a Forensic Anthropology Population data article, please assure that "Forensic Anthropology Population Data" is included as one of the keywords. These forensic anthropology population data articles involve the application of already published and standardised methods of aging, sexing, determination of ancestry and stature and other well-known diagnoses on different populations. This is at the heart of applied forensic anthropology. For example, in order to correctly assess age, stature or even sex of individuals of different ancestry or from different populations, it is fundamental that the method be tested on the specific population one is working on. In building the biological profile of a skeleton in order to aid identification, one needs to calibrate such techniques on the population of interest before applying them. The same may be true in a completely different scenario of anthropology, for example identifying criminals taped on video surveillance systems and aging victims of juvenile pornography. This section is dedicated to forensic anthropological population data and other types of updates (state of the art of particular issues, etc.), particularly concerning the following:

- Sexing
- Aging sub adult skeletal remains
- Aging adult skeletal remains
- Aging living sub adults and adults
- Determining ancestry
- Stature estimation
- Facial reconstruction

- Non metric trait distribution, pathology and trauma
- Positive identification of human skeletal remains
- Positive identification of the living

Forensic Anthropology Population Data articles will be published in abridged form in print (a clear, descriptive summary taken from the abstract), and the full length article will be published online only.

Full citation details and a reference to the online article, including e-page numbers, will be published in the relevant print issue of the journal. All submitted manuscripts will be evaluated by a strict peer review process.

Case Reports will be accepted only if they contain some important new information for the readers.

Rapid Communications should describe work of significant interest, whose impact would suffer if publication were not expedited. They should not be longer than 5 printed journal pages (about 10 submitted pages). Authors may suggest that their work is treated as a Rapid Communication, but the final decision on whether it is suitable as such will be taken by the handling Editor. Rapid Communications requiring revision should be resubmitted as a new submission.

Technical Notes report new developments, significant advances and novel aspects of experimental and theoretical methods and techniques which are relevant for scientific investigations within the journal scope. Manuscripts of this type should be short (a few pages only). Highly detailed and specific technical information such as computer programme code or user manuals can be included as electronic supplements. The manuscript title must start with "Technical Note:".

Revisions deadline

Please note that articles that are sent to the author for revision need to be returned within 60 days (and within 20 days for subsequent revisions). A reminder will be sent in the second month. Any articles that are sent after the two month period of revision will be considered a re-submission.

Contact details for submission

Papers for consideration should be submitted by topic. Editors and their topic specialty are listed below.

P. Saukko (Editor-in-Chief): Experimental Forensic Pathology, Traffic Medicine, and subjects not listed elsewhere

Tel: +358 2 3337543

Fax: +358 2 3337600

E-mail: psaukko@utu.fi

A. Carracedo: Forensic Genetics. Please note only review articles on this topic should be submitted to FSI. All non-review papers should be submitted to the FSI daughter journal devoted to this subject

Forensic Science International: Genetics, via <http://ees.elsevier.com/fsigen/>

Fax: +34 981 580336

E-mail: angel.carrafsi@usc.es

C. Cattaneo: Osteology, Anthropology and Odontology

Tel: +39 2 5031 5678

Fax: +39 2 5031 5724

E-mail: cristina.cattaneo@unimi.it

P. Margot: Questioned Documents and Physical Science: ballistics, tool marks, contact traces, drugs analysis, fingerprints and identification, etc.

Tel: +41 21 692 4605

Fax: +41 21 692 4605

E-mail: pierre.margot@unil.ch

O.H. Drummer: Toxicology

Tel: +61 3 9684 4334

Fax: +61 3 9682 7353

E-mail: olaf.drummer@vifm.org

S. Matuszewski: Entymology

Tel: +48 61 82 94 292

E-Mail: szymmat@amu.edu.pl

BEFORE YOU BEGIN

Ethics in publishing

For information on Ethics in publishing and Ethical guidelines for journal publication see <http://www.elsevier.com/publishingethics> and <http://www.elsevier.com/journal-authors/ethics>.

Conflict of interest

All authors are requested to disclose any actual or potential conflict of interest including any financial, personal or other relationships with other people or organizations within three years of beginning the submitted work that could inappropriately influence, or be perceived to influence, their work. See also <http://www.elsevier.com/conflictsofinterest>. Further information and an example of a Conflict of Interest form can be found at: http://help.elsevier.com/app/answers/detail/a_id/286/p/7923.

Additional information

Multiple submissions is not acceptable to the Editor, and any such papers, together with future submissions from the authors, will be rejected outright. Submission also implies that all authors have approved the paper for release and are in agreement with its content.

Submission declaration and verification

Submission of an article implies that the work described has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis or as an electronic preprint, see <http://www.elsevier.com/sharingpolicy>), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in

English or in any other language, including electronically without the written consent of the copyright-holder. To verify originality, your article may be checked by the originality detection service CrossCheck <http://www.elsevier.com/editors/plagdetect>.

Contributors

Each author is required to declare his or her individual contribution to the article: all authors must have materially participated in the research and/or article preparation, so roles for all authors should be described. The statement that all authors have approved the final article should be true and included in the disclosure.

Changes to authorship

This policy concerns the addition, deletion, or rearrangement of author names in the authorship of accepted manuscripts:

Before the accepted manuscript is published in an online issue: Requests to add or remove an author, or to rearrange the author names, must be sent to the Journal Manager from the corresponding author of the accepted manuscript and must include: (a) the reason the name should be added or removed, or the author names rearranged and (b) written confirmation (e-mail, fax, letter) from all authors that they agree with the addition, removal or rearrangement. In the case of addition or removal of authors, this includes confirmation from the author being added or removed. Requests that are not sent by the corresponding author will be forwarded by the Journal Manager to the corresponding author, who must follow the procedure as described above. Note that: (1) Journal Managers will inform the Journal Editors of any such requests and (2) publication of the accepted manuscript in an online issue is suspended until authorship has been agreed.

After the accepted manuscript is published in an online issue: Any requests to add, delete, or rearrange author names in an article published in an online issue will follow the same policies as noted above and result in a corrigendum.

Article transfer service

This journal is part of our Article Transfer Service. This means that if the Editor feels your article is more suitable in one of our other participating journals, then you may be asked

to consider transferring the article to one of those. If you agree, your article will be transferred automatically on your behalf with no need to reformat. Please note that your article will be reviewed again by the new journal. More information about this can be found here: <http://www.elsevier.com/authors/article-transfer-service>.

Copyright

Upon acceptance of an article, authors will be asked to complete a 'Journal Publishing Agreement' (for more information on this and copyright, see <http://www.elsevier.com/copyright>). An e-mail will be sent to the corresponding author confirming receipt of the manuscript together with a 'Journal Publishing Agreement' form or a link to the online version of this agreement. Subscribers may reproduce tables of contents or prepare lists of articles including abstracts for internal circulation within their institutions. Permission of the Publisher is required for resale or distribution outside the institution and for all other derivative works, including compilations and translations (please consult <http://www.elsevier.com/permissions>). If excerpts from other copyrighted works are included, the author(s) must obtain written permission from the copyright owners and credit the source(s) in the article. Elsevier has preprinted forms for use by authors in these cases: please consult <http://www.elsevier.com/permissions>. For open access articles: Upon acceptance of an article, authors will be asked to complete an 'Exclusive License Agreement' (for more information see <http://www.elsevier.com/OAauthoragreement>). Permitted third party reuse of open access articles is determined by the author's choice of user license (see <http://www.elsevier.com/openaccesslicenses>).

Author rights

As an author you (or your employer or institution) have certain rights to reuse your work. For more information see <http://www.elsevier.com/copyright>.

Role of the funding source

You are requested to identify who provided financial support for the conduct of the research and/or preparation of the article and to briefly describe the role of the sponsor(s), if any, in study design; in the collection, analysis and interpretation of data;

in the writing of the report; and in the decision to submit the article for publication. If the funding source(s) had no such involvement then this should be stated.

Funding body agreements and policies

Elsevier has established a number of agreements with funding bodies which allow authors to comply with their funder's open access policies. Some authors may also be reimbursed for associated publication fees. To learn more about existing agreements please visit <http://www.elsevier.com/fundingbodies>. After acceptance, open access papers will be published under a noncommercial license. For authors requiring a commercial CC BY license, you can apply after your manuscript is accepted for publication.

Open access

This journal offers authors a choice in publishing their research:

Open access

- Articles are freely available to both subscribers and the wider public with permitted reuse
- An open access publication fee is payable by authors or on their behalf e.g. by their research funder or institution

Subscription

- Articles are made available to subscribers as well as developing countries and patient groups through our universal access programs (<http://www.elsevier.com/access>).
- No open access publication fee payable by authors.

Regardless of how you choose to publish your article, the journal will apply the same peer review criteria and acceptance standards.

For open access articles, permitted third party (re)use is defined by the following Creative Commons user licenses:

Creative Commons Attribution-NonCommercial-NoDerivs (CC BY-NC-ND)

For non-commercial purposes, lets others distribute and copy the article, and to include in a collective work (such as an anthology), as long as they credit the author(s) and provided they do not alter or modify the article.

The open access publication fee for this journal is **USD 2500**, excluding taxes. Learn more about Elsevier's pricing policy: <http://www.elsevier.com/openaccesspricing>.

Green open access

Authors can share their research in a variety of different ways and Elsevier has a number of green open access options available. We recommend authors see our green open access page for further information (<http://elsevier.com/greenopenaccess>). Authors can also self-archive their manuscripts immediately and enable public access from their institution's repository after an embargo period. This is the version that has been accepted for publication and which typically includes author-incorporated changes suggested during submission, peer review and in editor-author communications. Embargo period: For subscription articles, an appropriate amount of time is needed for journals to deliver value to subscribing customers before an article becomes freely available to the public. This is the embargo period and begins from the publication date of the issue your article appears in.

This journal has an embargo period of 12 months.

Language (usage and editing services)

Please write your text in good English (American or British usage is accepted, but not a mixture of these). Authors who feel their English language manuscript may require editing to eliminate possible grammatical or spelling errors and to conform to correct scientific English may wish to use the English Language Editing service available from Elsevier's WebShop (<http://webshop.elsevier.com/languageediting/>) or visit our customer support site (<http://support.elsevier.com>) for more information.

Submission

Our online submission system guides you stepwise through the process of entering your article details and uploading your files. The system converts your article files to a single PDF file used in the peer-review process. Editable files (e.g., Word, LaTeX) are required

to typeset your article for final publication. All correspondence, including notification of the Editor's decision and requests for revision, is sent by e-mail.

Submit your article

Please submit your article via <http://ees.elsevier.com/fsi>.

PREPARATION

NEW SUBMISSIONS

Submission to this journal proceeds totally online and you will be guided stepwise through the creation and uploading of your files. The system automatically converts your files to a single PDF file, which is used in the peer-review process.

As part of the Your Paper Your Way service, you may choose to submit your manuscript as a single file to be used in the refereeing process. This can be a PDF file or a Word document, in any format or layout that can be used by referees to evaluate your manuscript. It should contain high enough quality figures for refereeing. If you prefer to do so, you may still provide all or some of the source files at the initial submission. Please note that individual figure files larger than 10 MB must be uploaded separately.

References

There are no strict requirements on reference formatting at submission. References can be in any style or format as long as the style is consistent. Where applicable, author(s) name(s), journal title/book title, chapter title/article title, year of publication, volume number/book chapter and the pagination must be present. Use of DOI is highly encouraged. The reference style used by the journal will be applied to the accepted article by Elsevier at the proof stage. Note that missing data will be highlighted at proof stage for the author to correct.

Formatting requirements

There are no strict formatting requirements but all manuscripts must contain the essential elements needed to convey your manuscript, for example Abstract, Keywords, Introduction, Materials and Methods, Results, Conclusions, Artwork and Tables with Captions. If your article includes any Videos and/or other Supplementary material, this

should be included in your initial submission for peer review purposes. Divide the article into clearly defined sections.

Figures and tables embedded in text

Please ensure the figures and the tables included in the single file are placed next to the relevant text in the manuscript, rather than at the bottom or the top of the file.

Double-blind review

This journal uses double-blind review, which means that both the reviewer and author name(s) are not allowed to be revealed to one another for a manuscript under review. The identities of the authors are concealed from the reviewers, and vice versa. For more information please refer to <http://www.elsevier.com/reviewers/peer-review>. To facilitate this, please include the following separately:

Title page (with author details): This should include the title, authors' names and affiliations, and a complete address for the corresponding author including an e-mail address.

Blinded manuscript (no author details): The main body of the paper (including the references, figures, tables and any Acknowledgements) should not include any identifying information, such as the authors' names or affiliations.

REVISED SUBMISSIONS

Use of word processing software

Regardless of the file format of the original submission, at revision you must provide us with an editable file of the entire article. Keep the layout of the text as simple as possible. Most formatting codes will be removed and replaced on processing the article. The electronic text should be prepared in a way very similar to that of conventional manuscripts (see also the Guide to Publishing with Elsevier:

<http://www.elsevier.com/guidepublication>). See also the section on Electronic artwork.

To avoid unnecessary errors you are strongly advised to use the 'spell-check' and 'grammar-check' functions of your word processor.

Article structure

Introduction

State the objectives of the work and provide an adequate background, avoiding a detailed literature survey or a summary of the results.

Material and methods

Provide sufficient detail to allow the work to be reproduced. Methods already published should be indicated by a reference: only relevant modifications should be described.

Results

Results should be clear and concise.

Discussion

This should explore the significance of the results of the work, not repeat them. A combined Results and Discussion section is often appropriate. Avoid extensive citations and discussion of published literature.

Conclusions

The main conclusions of the study may be presented in a short Conclusions section, which may stand alone or form a subsection of a Discussion or Results and Discussion section.

Essential title page information

- **Title.** Concise and informative. Titles are often used in information-retrieval systems. Avoid abbreviations and formulae where possible.

- **Author names and affiliations.** Please clearly indicate the given name(s) and family name(s) of each author and check that all names are accurately spelled. Present the authors' affiliation addresses (where the actual work was done) below the names. Indicate all affiliations with a lowercase superscript letter immediately after the author's name and in front of the appropriate address.

Provide the full postal address of each affiliation, including the country name and, if available, the e-mail address of each author.

- **Corresponding author.** Clearly indicate who will handle correspondence at all stages of refereeing and publication, also post-publication. **Ensure that the e-mail address is given and that contact details are kept up to date by the corresponding author.**

- **Present/permanent address.** If an author has moved since the work described in the article was done, or was visiting at the time, a 'Present address' (or 'Permanent address') may be indicated as a footnote to that author's name. The address at which the author actually did the work must be retained as the main, affiliation address. Superscript Arabic numerals are used for such footnotes.

Abstract

A concise and factual abstract is required. The abstract should state briefly the purpose of the research, the principal results and major conclusions. An abstract is often presented separately from the article, so it must be able to stand alone. For this reason, References should be avoided, but if essential, then cite the author(s) and year(s). Also, non-standard or uncommon abbreviations should be avoided, but if essential they must be defined at their first mention in the abstract itself.

Graphical abstract

Although a graphical abstract is optional, its use is encouraged as it draws more attention to the online article. The graphical abstract should summarize the contents of the article in a concise, pictorial form designed to capture the attention of a wide readership. Graphical abstracts should be submitted as a separate file in the online submission system. Image size: Please provide an image with a minimum of 531 × 1328 pixels (h × w) or proportionally more. The image should be readable at a size of 5 × 13 cm using a regular screen resolution of 96 dpi. Preferred file types: TIFF, EPS, PDF or MS Office files. See <http://www.elsevier.com/graphicalabstracts> for examples.

Authors can make use of Elsevier's Illustration and Enhancement service to ensure the best presentation of their images and in accordance with all technical requirements:

[Illustration Service.](#)

Highlights

Highlights are mandatory for this journal. They consist of a short collection of bullet points that convey the core findings of the article and should be submitted in a separate

editable file in the online submission system. Please use 'Highlights' in the file name and include 3 to 5 bullet points (maximum 85 characters, including spaces, per bullet point). See <http://www.elsevier.com/highlights> for examples.

Keywords

Immediately after the abstract, provide a maximum of 6 keywords, using American spelling and avoiding general and plural terms and multiple concepts (avoid, for example, 'and', 'of'). Be sparing with abbreviations: only abbreviations firmly established in the field may be eligible. These keywords will be used for indexing purposes.

Acknowledgements

Please provide Acknowledgements as a separate file and remove this from the manuscript. List here those individuals who provided help during the research (e.g., providing language help, writing assistance or proof reading the article, etc.).

Footnotes

Footnotes should be used sparingly. Number them consecutively throughout the article. Many word processors build footnotes into the text, and this feature may be used. Should this not be the case, indicate the position of footnotes in the text and present the footnotes themselves separately at the end of the article.

Artwork

Electronic artwork

General points

- Make sure you use uniform lettering and sizing of your original artwork.
- Preferred fonts: Arial (or Helvetica), Times New Roman (or Times), Symbol, Courier.
- Number the illustrations according to their sequence in the text.
- Use a logical naming convention for your artwork files.
- Indicate per figure if it is a single, 1.5 or 2-column fitting image.
- For Word submissions only, you may still provide figures and their captions, and tables within a single file at the revision stage.

- Please note that individual figure files larger than 10 MB must be provided in separate source files. A detailed guide on electronic artwork is available on our website:

<http://www.elsevier.com/artworkinstructions>.

You are urged to visit this site; some excerpts from the detailed information are given here.

Formats

Regardless of the application used, when your electronic artwork is finalized, please 'save as' or convert the images to one of the following formats (note the resolution requirements for line drawings, halftones, and line/halftone combinations given below): EPS (or PDF): Vector drawings. Embed the font or save the text as 'graphics'. TIFF (or JPG): Color or grayscale photographs (halftones): always use a minimum of 300 dpi. TIFF (or JPG): Bitmapped line drawings: use a minimum of 1000 dpi. TIFF (or JPG): Combinations bitmapped line/half-tone (color or grayscale): a minimum of 500 dpi is required.

Please do not:

- Supply files that are optimized for screen use (e.g., GIF, BMP, PICT, WPG); the resolution is too low.
- Supply files that are too low in resolution.
- Submit graphics that are disproportionately large for the content.

Color artwork

Please make sure that artwork files are in an acceptable format (TIFF (or JPEG), EPS (or PDF), or MS Office files) and with the correct resolution. If, together with your accepted article, you submit usable color figures then Elsevier will ensure, at no additional charge, that these figures will appear in color online (e.g., ScienceDirect and other sites) regardless of whether or not these illustrations are reproduced in color in the printed version. **For color reproduction in print, you will receive information regarding the costs from Elsevier after receipt of your accepted article.** Please indicate your preference for color: in print or online only. For further information on the preparation of electronic artwork, please see <http://www.elsevier.com/artworkinstructions>.

Please note: Because of technical complications that can arise by converting color figures to 'gray scale' (for the printed version should you not opt for color in print) please submit in addition usable black and white versions of all the color illustrations.

Figure captions

Ensure that each illustration has a caption. A caption should comprise a brief title (**not** on the figure itself) and a description of the illustration. Keep text in the illustrations themselves to a minimum but explain all symbols and abbreviations used.

Tables

Please submit tables as editable text and not as images. Tables can be placed either next to the relevant text in the article, or on separate page(s) at the end. Number tables consecutively in accordance with their appearance in the text and place any table notes below the table body. Be sparing in the use of tables and ensure that the data presented in them do not duplicate results described elsewhere in the article. Please avoid using vertical rules.

References

Citation in text

Please ensure that every reference cited in the text is also present in the reference list (and vice versa). Any references cited in the abstract must be given in full. Unpublished results and personal communications are not recommended in the reference list, but may be mentioned in the text. If these references are included in the reference list they should follow the standard reference style of the journal and should include a substitution of the publication date with either 'Unpublished results' or 'Personal communication'. Citation of a reference as 'in press' implies that the item has been accepted for publication.

Reference links

Increased discoverability of research and high quality peer review are ensured by online links to the sources cited. In order to allow us to create links to abstracting and indexing services, such as Scopus, CrossRef and PubMed, please ensure that data provided in the references are correct. Please note that incorrect surnames, journal/book titles,

publication year and pagination may prevent link creation. When copying references, please be careful as they may already contain errors. Use of the DOI is encouraged.

Reference management software

Most Elsevier journals have a standard template available in key reference management packages. This covers packages using the Citation Style Language, such as Mendeley (<http://www.mendeley.com/features/reference-manager>) and also others like EndNote (<http://www.endnote.com/support/enstyles.asp>) and Reference Manager (<http://refman.com/support/rmstyles.asp>). Using plug-ins to word processing packages which are available from the above sites, authors only need to select the appropriate journal template when preparing their article and the list of references and citations to these will be formatted according to the journal style as described in this Guide. The process of including templates in these packages is constantly ongoing. If the journal you are looking for does not have a template available yet, please see the list of sample references and citations provided in this Guide to help you format these according to the journal style. If you manage your research with Mendeley Desktop, you can easily install the reference style for this journal by clicking the link below:

<http://open.mendeley.com/use-citation-style/forensic-science-international>

When preparing your manuscript, you will then be able to select this style using the Mendeley plugins for Microsoft Word or LibreOffice. For more information about the Citation Style Language, visit <http://citationstyles.org>.

Reference formatting¹

There are no strict requirements on reference formatting at submission. References can be in any style or format as long as the style is consistent. Where applicable, author(s) name(s), journal title/book title, chapter title/article title, year of publication, volume number/book chapter and the pagination must be present. Use of DOI is highly encouraged. The reference style used by the journal will be applied to the accepted article by Elsevier at the proof stage. Note that missing data will be highlighted at proof stage for

¹ No specific style is suggested, hence the referencing style utilised was selected based on previous *Forensic Science International* publications.

the author to correct. If you do wish to format the references yourself they should be arranged according to the following examples:

Reference style

Text: Indicate references by number(s) in square brackets in line with the text. The actual authors can be referred to, but the reference number(s) must always be given.

Example: '..... as demonstrated [3,6]. Barnaby and Jones [8] obtained a different result'

List: Number the references (numbers in square brackets) in the list in the order in which they appear in the text.

Examples:

Reference to a journal publication:

[1] J. van der Geer, J.A.J. Hanraads, R.A. Lupton, The art of writing a scientific article, *J. Sci. Commun.* 163 (2010) 51–59.

Reference to a book:

[2] W. Strunk Jr., E.B. White, *The Elements of Style*, fourth ed., Longman, New York, 2000.

Reference to a chapter in an edited book:

[3] G.R. Mettam, L.B. Adams, How to prepare an electronic version of your article, in: B.S. Jones, R.Z. Smith (Eds.), *Introduction to the Electronic Age*, E-Publishing Inc., New York, 2009, pp. 281–304.

Video data

Elsevier accepts video material and animation sequences to support and enhance your scientific research. Authors who have video or animation files that they wish to submit with their article are strongly encouraged to include links to these within the body of the article. This can be done in the same way as a figure or table by referring to the video or animation content and noting in the body text where it should be placed. All submitted files should be properly labeled so that they directly relate to the video file's content. In order to ensure that your video or animation material is directly usable, please provide the files in one of our recommended file formats with a preferred maximum size of 150 MB. Video and animation files supplied will be published online in the electronic version of your article in Elsevier Web products, including ScienceDirect: <http://www.sciencedirect.com>. Please supply 'stills' with your files: you can choose any frame from the video or animation or make a separate image. These will be used instead

of standard icons and will personalize the link to your video data. For more detailed instructions please visit our video instruction pages at <http://www.elsevier.com/artworkinstructions>. Note: since video and animation cannot be embedded in the print version of the journal, please provide text for both the electronic and the print version for the portions of the article that refer to this content.

AudioSlides

The journal encourages authors to create an AudioSlides presentation with their published article. AudioSlides are brief, webinar-style presentations that are shown next to the online article on ScienceDirect. This gives authors the opportunity to summarize their research in their own words and to help readers understand what the paper is about. More information and examples are available at <http://www.elsevier.com/audioslides>. Authors of this journal will automatically receive an invitation e-mail to create an AudioSlides presentation after acceptance of their paper.

Supplementary material

Elsevier accepts electronic supplementary material to support and enhance your scientific research. Supplementary files offer the author additional possibilities to publish supporting applications, high resolution images, background datasets, sound clips and more. Supplementary files supplied will be published online alongside the electronic version of your article in Elsevier Web products, including ScienceDirect: <http://www.sciencedirect.com>. In order to ensure that your submitted material is directly usable, please provide the data in one of our recommended file formats. Authors should submit the material in electronic format together with the article and supply a concise and descriptive caption for each file. For more detailed instructions please visit our artwork instruction pages at <http://www.elsevier.com/artworkinstructions>.

Submission checklist

The following list will be useful during the final checking of an article prior to sending it to the journal for review. Please consult this Guide for Authors for further details of any item.

Ensure that the following items are present:

One author has been designated as the corresponding author with contact details:

- E-mail address
- Full postal address

All necessary files have been uploaded, and contain:

- Keywords
- All figure captions
- All tables (including title, description, footnotes)

Further considerations

- Manuscript has been 'spell-checked' and 'grammar-checked'
- All references mentioned in the Reference list are cited in the text, and vice versa
- Permission has been obtained for use of copyrighted material from other sources (including the Internet)

Printed version of figures (if applicable) in color or black-and-white

- Indicate clearly whether or not color or black-and-white in print is required.
- For reproduction in black-and-white, please supply black-and-white versions of the figures for printing purposes.

For any further information please visit our customer support site at <http://support.elsevier.com>.

AFTER ACCEPTANCE

Availability of accepted article

This journal makes articles available online as soon as possible after acceptance. This concerns the accepted article (both in HTML and PDF format), which has not yet been copyedited, typeset or proofread. A Digital Object Identifier (DOI) is allocated, thereby making it fully citable and searchable by title, author name(s) and the full text. The article's PDF also carries a disclaimer stating that it is an unedited article. Subsequent production stages will simply replace this version.

Use of the Digital Object Identifier

The Digital Object Identifier (DOI) may be used to cite and link to electronic documents. The DOI consists of a unique alpha-numeric character string which is assigned to a document by the publisher upon the initial electronic publication. The assigned DOI never

changes. Therefore, it is an ideal medium for citing a document, particularly 'Articles in press' because they have not yet received their full bibliographic information. Example of a correctly given DOI (in URL format; here an article in the journal *Physics Letters B*): <http://dx.doi.org/10.1016/j.physletb.2010.09.059>

When you use a DOI to create links to documents on the web, the DOIs are guaranteed never to change.

Online proof correction

Corresponding authors will receive an e-mail with a link to our online proofing system, allowing annotation and correction of proofs online. The environment is similar to MS Word: in addition to editing text, you can also comment on figures/tables and answer questions from the Copy Editor. Web-based proofing provides a faster and less error-prone process by allowing you to directly type your corrections, eliminating the potential introduction of errors. If preferred, you can still choose to annotate and upload your edits on the PDF version. All instructions for proofing will be given in the e-mail we send to authors, including alternative methods to the online version and PDF.

We will do everything possible to get your article published quickly and accurately. Please use this proof only for checking the typesetting, editing, completeness and correctness of the text, tables and figures. Significant changes to the article as accepted for publication will only be considered at this stage with permission from the Editor. It is important to ensure that all corrections are sent back to us in one communication. Please check carefully before replying, as inclusion of any subsequent corrections cannot be guaranteed. Proofreading is solely your responsibility.

Offprints

The corresponding author, at no cost, will be provided with 25 free paper offprints, or, alternatively, a personalized link providing 50 days free access to the final published version of the article on [ScienceDirect](#). This link can also be used for sharing via email and social networks. For an extra charge, more paper offprints can be ordered via the offprint order form which is sent once the article is accepted for publication.

Both corresponding and co-authors may order offprints at any time via Elsevier's WebShop (<http://webshop.elsevier.com/myarticleservices/offprints>). Authors

requiring printed copies of multiple articles may use Elsevier WebShop's 'Create Your Own Book' service to collate multiple articles within a single cover (<http://webshop.elsevier.com/myarticleservices/booklets>).

Author orders

When your article is published, you can commemorate your publication with printed author copies of the journal issue, customized full-color posters, extra offprints, and more. Please visit <http://webshop.elsevier.com> to learn more.

AUTHOR INQUIRIES

You can track your submitted article at <http://www.elsevier.com/track-submission>. You can track your accepted article at <http://www.elsevier.com/trackarticle>. You are also welcome to contact Customer Support via <http://support.elsevier.com>.

© Copyright 2014 Elsevier | <http://www.elsevier.com>