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Patterns of interpersonal violence presenting to a level one trauma centre in Johannesburg

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Patterns of interpersonal violence presenting to a Level One trauma centre in Johannesburg

Dr Sarah Louise Asbury

A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Medicine in the branch of Surgery

Johannesburg, 2011

I, Sarah Asbury, declare that this research report is my own work. It is being submitted for the degree of Master of Medicine (Surgery) in the University of the Witswatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

Signed:

Date: Friday, November 25, 2011

To the staff of the Johannesburg Hospital Trauma Unit,

without whom this work could not have been done,
and without whom the medical landscape of Johannesburg would be
a far bleaker place..

Publications and presentations arising from this study

Published Abstracts

1. **SL Asbury**, C Lownie, J Goosen, KD Boffard
   Patterns of Interpersonal Violence at an Urban South African Trauma Unit
   South African Journal of Surgery 2009; **00(0)**: 000 (Abstract)

2. **SL Asbury**, J Goosen, KD Boffard
   Patterns of Interpersonal Violence at an Urban South African Trauma Unit
   Annals of Emergency Medicine 2008; **51(4)**: 490 (Abstract)

3. **SL Asbury**, KD Boffard
   The hidden cost of alcohol: a study of bottle-based weapon violence
   Annals of Emergency Medicine 2008; **51(4)**: 494 (Abstract)

Presentations

1. Patterns of Interpersonal Violence at an Urban South African Trauma Unit
   Trauma Society of South Africa Biennial Congress, Cape Town, August 2009
   Second Prize for oral presentations

2. Patterns of Interpersonal Violence at an Urban South African Trauma Unit
   Bert Myburgh Research Forum, University of the Witswatersrand, November 2007

Poster Presentations

1. **SL Asbury**, KD Boffard
   Enjoy responsibly? The cost of bottle-based weapon violence in Johannesburg
   Public Health Association of South Africa Congress, Cape Town, June 2008

2. **SL Asbury**, J Goosen, KD Boffard
   Patterns of Interpersonal Violence at an Urban South African Trauma Unit
   International Conference in Emergency Medicine, San Francisco, April 2008

3. **SL Asbury**, KD Boffard
   The hidden cost of alcohol: a study of bottle-based weapon violence
   International Conference in Emergency Medicine, San Francisco, April 2008

Abstract

Trauma and intentional injury form a major burden of disease in South Africa. This study examines the patterns of injury resulting from interpersonal violence presenting at a Level One trauma centre serving an urban population.

This was a cross-sectional analysis of patients attending the Johannesburg Hospital Trauma Unit, over a period of forty-one consecutive days.

In keeping with the worldwide experience of trauma care, the study showed the burden of trauma rests heavily upon young males. A majority of the incidents involved a weapon, used for penetrating or blunt injury. In cases where the weapon was documented, it was more commonly a weapon carried by one of the individuals involved such as a firearm or knife, than an item obtained spontaneously during the conflict.

Patients subjected to weapon-based violence were significantly more likely to require advanced or invasive radiology, admission and operation. Weapon type influenced the pattern of injury sustained and the need for specialist consultation. It did not significantly affect admission or operation rates. Although blunt assault without a weapon may cause multiple injuries, they tended to be superficial injuries either allowing for discharge from the emergency room immediately or following a period of observation.

This study showed the presence of a weapon greatly increases the morbidity resulting from the event for the patient and increases the subsequent cost to the healthcare system.

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As supervisor of this research and mentor throughout my surgical training

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1. Introduction

1.1 The Global Context of Trauma

The burden of trauma rests heavily on the South African public healthcare system. In keeping with the worldwide experience of trauma, interpersonal violence is a disease that affects predominately young males in our community. It can result in both immediate effects requiring medical attention, and long-term often life-long consequences, of psychological, physical and socio-economic morbidity.

Studies throughout the globe over the last twenty years have sought to define the causes of violent conflict and these have included alcohol, poor socio-economic status, income inequality, racial and other ideological motivations, and the ready availability of weapons (Ekere, et al., 2005; Hedeboe, 1985; Howe and Crilly 2002; Humphrey, 2003; Wright and Kariya, 1997). As this report aims to show, it is clear that many of these causes linked to interpersonal violence are present in the environment around the Johannesburg Hospital Trauma Unit.

1.2 Trauma in South Africa

A South African Violence and Injury Surveillance Consortium report in 2002 of all facilities in South Africa estimated 1.5 million trauma cases presented annually at secondary and tertiary centres. Violence, defined as

> "The intentional use of physical force or power, threatened or actual, against oneself, another person,or against a group or community, that either results in or has a high likelihood of resulting in, injury, death, psychological harm, mal-development or deprivation."
>
> (Matzopoulos, et al., 2008, p.682)

accounted for more than half the trauma caseload managed (Matzopoulos, et al., 2002,). These figures can be compared to the 1.6 million assault-related injuries presenting annually in the USA, a country with four times the population of South Africa, but where violence has been declared a public health emergency (Satcher, 1995). In declaring this, the USA joined the developed nations of Europe and Australasia in recognising the individual and societal impact of violent conflict. As Howe, et al. (2002) states:

> "The public health approach to violence and its prevention is increasingly advocated; identifying the magnitude of the problem, studying risk factors, developing interventions that address the risk factors and evaluating the effectiveness of those interventions" (p.15)

The pervasiveness of interpersonal violence in South African society has not been determined and it is argued in this report that this lens of public health preventative measures should be used to examine prevalence of these conflicts and subsequent injuries in this society.

Statistics published by the National Injury Mortality Surveillance System (NIMSS) for 2007 found that the leading cause of death in South Africa during the period of this study was homicide (37.5%) (Dalton, 2008). In Johannesburg the leading cause of death was accident (47%) followed by homicide (n=1567, 34.4%) and suicide (11.5%). There were 4644 non-natural deaths were reported during the year, which is on average 12.7 deaths per day (or 509 non-natural deaths during the 40 days of this study). Between 15 and 44 years, the principle cause of death was violence, with more than 50% of deaths from 15-65 years due to firearms (Donson, 2008).

1.3 Trauma care facilities in Johannesburg

The Johannesburg Hospital Trauma Unit (JHTU) forms part of the Johannesburg General Hospital, now Charlotte Maxeke Johannesburg Academic Hospital. This is the central hospital for

Johannesburg with 1088 beds, which also acts as a secondary and tertiary referral unit for Greater Johannesburg, much of the Gauteng province and neighbouring provinces. It is funded by a National Provincial Services grant as well as the provincial government.

The JHTU is a part of the Department of Surgery of both the hospital and the affiliated University of the Witswatersrand. It complies with the American College of Surgeons guidelines for a Level 1 Trauma Centre as described in their *"Resources for Optimal Care for the Injured Patient"* document. This is defined as a Unit that can provide the highest possible level of surgical and other specialist care to trauma patients requiring a full range of specialists available 24 hours, including neurosurgery, plastic surgery, orthopaedic surgery, maxillofacial surgery and a specialist trauma surgeon resident on site. There must be a minimum annual volume of severely injured patients and the full backup of anaesthesiology with dedicated emergency theatres and critical care facilities (American College of Surgeons, 2011).

The JHTU consists of an acute receiving area with major injury resuscitation facilities available for up to six patients, a thirty-bed trauma ward and a separate closed trauma intensive care unit. Additional backup is provided by the Department of General Surgery and main hospital Intensive Care Unit. The JHTU runs education programmes at undergraduate and postgraduate levels, as well as paramedical and outreach programmes. There is a heavy emphasis on research and audit in the Unit, which has been facilitated by the pioneering Traumabank database of all seriously-injured patients treated at JHTU. In this way, the Unit's influence extends from pre-hospital care at the location of incident, through the acute services to rehabilitation of all trauma patients and advancement of trauma services through research. The annual patient workload is approximately 20 000 including 1700 major resuscitations.

The hospital is situated in Parktown, an old suburb of Johannesburg on the edge of the Johannesburg inner city. Although primarily a referral hospital for regional and provincial health

services, it also acts as the primary receiving hospital for the central business district of Johannesburg and inner city areas of the city. The surrounding suburbs of Hillbrow and Berea suffer from increased levels of crime, with high levels of poverty and unemployment and the image of poor personal security. In 2005, there was an estimated 300 street children in Hillbrow alone, and 5000 homeless people situated through the CBD (Johannesburg Development Agency (JDA), 2004). In the following years since 2005, there has been an increase in migrants to the city from surrounding countries, most notably Zimbabwe, adding to the numbers of dispossessed. Other social issues identified as key in the area are prevalence of sex workers, drug abuse and sexual and domestic violence Also affecting health is the high proportion of decayed and poorly-maintained 'slum' properties in these areas, result in poor living conditions, overcrowding and marginalisation of communities residing there (JDA, 2004).

1.4 Trauma epidemiology in South Africa

Whilst mortality figures are well described through the NIMMS there is little accurate description of non-fatal injuries in South Africa. With the notable exception of a small study in Lesotho (van Geldermalsen and van der Stuyft, 1993) and autopsy studies from the former Transkei region of the Eastern Cape (Meel 2004, 2007) current data on interpersonal violence stems predominately from Western Europe, the USA and Australasia. There is a lack of accurate data reflecting the impact of interpersonal violence in contemporary urban South Africa.

Most studies of the last fifteen years summarised below take a similar approach to data collection, where the study looks at the rates of presentation of trauma to the relevant Accident and Emergency (A&E) Department and attempts to define the causes and demographics of those affected.

The results, unsurprising given the relatively homogeneous populations studied, paint similar pictures of the presenting patients: the burden of trauma is shouldered by young unemployed men and from areas of deprivation, drunk in the early hours of a weekend morning, attacking each other spontaneously, normally without recourse to a weapon. O'Sullivan and O'Conor (2003), studying those presenting to an Irish A&E Department even goes so far as to describe these young men as fast "becoming an increasingly vulnerable sub-group of Irish society" (p307).

The vulnerability of these individuals has been shown to correlate with social circumstances. Howe and Crilly (2001) showed a strong association between violence and deprivation in the UK (measuring deprivation according to postal code on the Townsend scale which looks at car and house ownership, unemployment and overcrowding as indicators). Other studies have suggested that greater disposable income may also be associated with violence through excessive alcohol purchase and consumption (Luke, et al., 2002). The factors of deprivation and heavy weekend alcohol consumption, together with inequality in income unemployment and drug abuse, point to a general nihilism and marginalisation of the individual which appears to be the unifying factor in interpersonal conflict.

The anthropologist Robert Merton recognises this in his Strain theory (1938) where he suggests that the frustration faced by individuals who view success around them but have no opportunity to achieve it themselves, can lead those individuals to crime. The greater the inequality, the greater the strain (and anomie, a feeling of alienation) felt by the individual. The presence of inequality and relatively poor circumstances is a theme that runs throughout each analysis of urban violent conflict: from the industrial towns of Liverpool (Primohamed, 2000) and Glasgow

(Wright, et al., 1997) in the UK to Australia (Chikritzh and Stockwell, 2002) and Jamaica (Mansingh and Ramphal, 1993). Underlining the common factors of alienation, deprivation and heavy alcohol abuse in trauma, many studies show an over-representation of marginalised groups in the trauma statistics. Studies in New Zealand and Taiwan both found indigenous populations were overrepresented in trauma and all alcohol-related injuries (Humphrey, et al., 2003; Li, 2006).

1.5 Violence and Weapons

An area of interest in studying the pattern of violence in a South African context is the prevalence of weapon use. Although the majority of the assaults studied in other countries were as a result of 'fist and feet' (blunt assaults where no weapon was used) the most serious injuries resulted from weapon use (Brennan, et al., 2006). In studies in Paisley, Scotland and in Denmark, fatalities only resulted from weapon use (Wright, et al., 1997; Hedeboe, et al., 1985).

The perception from personal clinical experience as a surgeon at JHTU is that weapon use is high, and when working in acute surgery the daily prevalence of gunshot, knife and bottle injuries are alarming. A recent study of the Transkei region of South Africa bears this out: from 1994 to 2004 the gunshot-related mortality rate was 48.4 deaths per 100,000 with a record year in 2001 of 67.8 deaths per 100,000 (Meel, 2007). In Johannesburg during the time of this study the homicide rate was 39.9 deaths per 100 000 of which 19.4 per 100 000 were from firearms. This does show a local decrease in violent mortality rates, however, they remain at an alarmingly high level (Donson, 2008).

Scotland also has a relatively high rate of homicide (4th in an international scale of comparable countries) and although the national rate is 0.2%, the homicide rate rises in the Glasgow region

to 2%, which is attributed by the authors of the study to heavy knife usage (Wright, et al., 1997). Recent high profile police operations (Operation Blade) are laudable but they have failed to make a significant impact (Bleetman, et al., 1997).

The identification of weapon prevalence and type in the South African context may contribute to informing authorities who could direct preventative strategies to minimise the impact of the resulting injuries. South African gun laws allow licensed firearms to be legally carried although many of the guns used in interpersonal violence may not be legally held (Gun Control Alliance, 2007). Public health measures abroad to decrease violent weapon use have included laws restricting knife sale and and the carrying of knives as seen in the UK Strathclyde Police Operation Blade (Bleetman, et al., 1997) and bottle laws to encourage the return of empty glass bottles [although primarily introduced to reduce accidental glass injury (Baker1986)] and the replacement of bar glasses and bottles with plastic (Coomaraswamy and Shepherd, 2003).

Dr J Shepard from the Cardiff Violence Research Group in the UK has spearheaded this last strategy, in which his work as a Maxillofacial surgeon initially led to the documentation of facial injuries and prevalence of such injuries by bar glasses. He then moved to provoke government strategies and glass industry measures to cut down the wounding potential of glasses, with variable amounts of success (Warburton, 2000). In South Africa the same level of bar glass injuries is not found in the public sector of health, but the presence and wounding potential of beer-bottle related injuries are unknown but perceived to be high.

1.6 Describing Interpersonal Violence in Johannesburg

Using studies that have carried out similar assessments in other populations as a background we can compare the profile of violent-conflict related injuries of Johannesburg to those in other parts of the world. The social profile of South Africa is as unique as its history. There is the

legacy of apartheid and the often violent struggle for democracy by many of its civilian people. Since the first democratic elections of 1994 there have been many socio-economic changes but there remains a high prevalence of crime, violence and a widened gap between rich and poor (Moller, 2007). It should be expected that the patterns of trauma are very different to those in more developed countries.

There is little data describing the effects of interpersonal violence in the urban South African context, and in particular the patterns of weapon use and subsequent injuries sustained. Previous local auditing of trauma care provision and national statistics indicate that there is a higher prevalence of trauma in South Africa than elsewhere and it is also indicated that there are higher levels of weapon use, with more significant injuries presenting to healthcare services.

This study aims to describe patterns of interpersonal violence present in the population accessing the trauma services in Johannesburg. It will identify the prevalence of weapon use among this population and the impact that the use of weapons have on subsequent injuries.

Looking for the similarities that may be present between this data and that in other societies enables a comparison of public health strategies used in response to other studies. This in turn can help identify particular strategies that may be applicable or useful when tailored to the unique South African setting.

2. Methods

This is a cross-sectional observational study allowing us to sample all patients who attended the Johannesburg Hospital Trauma Unit over a fixed period of forty consecutive days. The study is based on the initial assessment and treatment of each patient managed in the Unit. There is a high turnover of patients, majority of whom are not admitted and discharged to local and unarranged follow-up. To enable optimal capturing of data each case seen in the JHTU will be reviewed within 24 hours of the clinical episode.

Approval for the study was obtained from the Human Research Ethics Committee of the University of the Witwatersrand (Clearance certificate number M017007).

2.1 Data Collection

The admissions book for the Unit contains the identification data, demographics and mechanism of injury for each patient, in addition to time and date of admission. This was used to gain data regarding every admission to the Unit. Inclusion criteria were all mechanisms of injury consistent with an episode of interpersonal violence. The records for each patient suitable for inclusion were reviewed within twenty-four hours of the patient's initial presentation at the Trauma Unit.

Files reviewed included all patient files documenting the assessment and treatment in the accident receiving area of the Unit with observations by the nursing sisters and junior medical staff in the Unit. Resuscitation forms for Priority One[1] patients were also reviewed including all

[1]All patients presenting with trauma are triaged and categorised according to the levels of injury into one of four categories: Priority One patients are critically injured and require immediate attention with full resuscitation. Priority Two patients are injured and require resuscitation within 15 minutes. Priority Three

those requiring a multi-person resuscitation, those with severe or life-threatening injuries or mechanisms of injury; and hospital files of admitted patients that document any operations or further treatments undergone over the first twenty-four hours since presentation.

The immediate nature of data-gathering allowed for direct clarification of any missing data particularly discrepancies between forms or omissions of documentation and missed data from medical personnel in the unit. This this allowed us to minimize the loss of data and study participants. Files were either traced if absent from the receiving area or obtained from medical records department or from ward staff and filing areas.

2.2 Study length

The optimal study length was determined at forty-one consecutive days in order to obtain an adequate sample size for accurate statistical analysis. This study was also designed to take advantage of the natural variation of daily trauma unit attendance, which follows an ebb-and-flow pattern over a weekly and monthly cycle. This is proposed to be closely associated to the availability of money, increased social interaction, increased alcohol consumption and violence previously described. Classically, the weekend closest to the end of the month has the highest incidence of trauma unit attendances, which then decline gradually over the month. The study length ensured that at least one full month 'cycle' was covered.

2.3 Recruitment

patients are the "walking wounded" who require non-immediate care. Priority Four patients are dead and therefore require no immediate attention.

Information about the study was disseminated to all JHTU personnel to encourage a more complete data capture. This was done in two ways. First, through one-on-one and small group interactions with nursing staff, clerks and junior medical staff in the acute receiving area of the trauma unit. Secondly, shift leaders, clerks and other personnel from both the day and night shifts were invited to comment on the feasibility of the study and on any potential difficulties they could foresee.

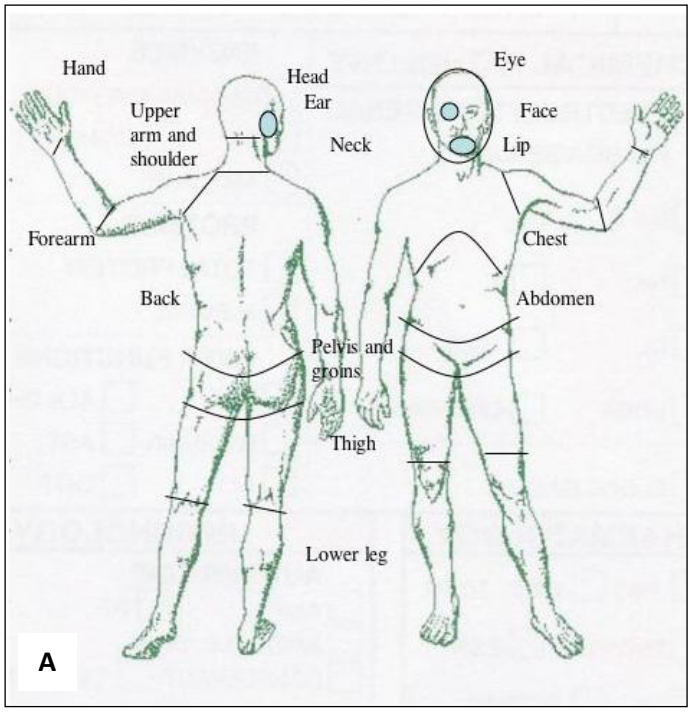
The importance of gathering objective, good-quality data was emphasised and the reasons behind the study with potential outcomes were discussed in terms of good epidemiological data that could influence public health decisions at a hospital, provincial and national level. As a result, nursing staff were keen to identify potential patients and remind other staff to maintain close attention to detail, particularly when recording mechanisms of injury in the admissions book. This process was repeated amongst the junior medical staff who operate in the unit, and other junior medical staff in the consulting specialities. Throughout the study, close contact was maintained between the researchers and medical staff emphasising and re-emphasising the importance of accuracy of data and record-keeping. Accuracy was particularly important in documenting the presence and type of weapon used in an assault and the position of all injuries. This personal dissemination of information was followed up with a series of posters placed prominently around the main records and clerking area of the acute receiving area.

2.4 Data recording

Demographic data such as age and gender and were recorded. All data obtained was kept anonymous by assigning study numbers to each patient. A mark was made on the file once it had been assessed to prevent duplication of data-gathering.

Alcohol intoxication was not used as a variable for two reasons. The only objective way of assessing alcohol consumption is through the use of a blood alcohol assay or breath alcohol level test (clinical scales such as the ethyl scale have poor sensitivity and rely on a physicians subjective assessment of intoxication). The implications of attempting consent from patients whom one suspects of being intoxicated is difficult and would go beyond the scope of this study. In addition, the relationships between alcohol, particularly excessive alcohol intake, violent conflict and attendance in the emergency room have been well documented in many countries. These observations were validated locally for South Africa in a multi-centre study in 2004 (Plueddemann, et al., 2004).

The injury pattern was recorded by the doctor doing the initial patient assessment and often supplemented by additional findings on specialist consult (particularly in hand injuries). Injuries were recorded in anatomical terms often with drawings of the anatomical site of injury. This allowed us to enhance accuracy of our data, especially on the face. These were then recorded under one of sixteen anatomical areas in data collection and subsequently further condensed into six regions for analysis. The diagrams used are indicated in Figure 2.1. The severity of each injury was then categorised and recorded. These were then separated into major and minor injuries. Minor injuries included swellings, lacerations, tangential gunshot wounds (GSW) and closed fractures. This is summarised in Table 2.1.



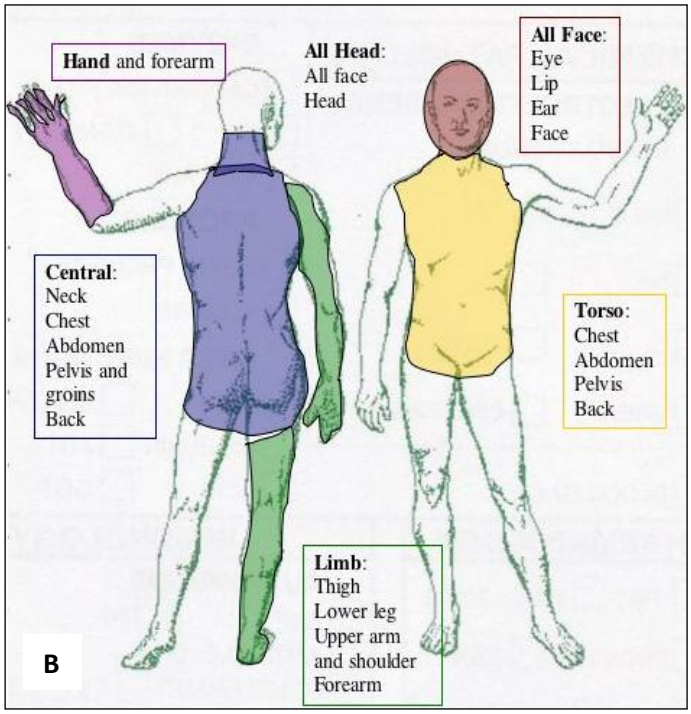


Figure 2.1

A: Areas of injury B: Condensed areas of injury

Table 2.1: Division of types of injury

Minor injury	*Major injury*
Laceration	Multiple lacerations
Soft tissue swelling or haematoma	Dislocation
Simple fracture	Complex fracture
Tangential injury	Internal organ damage
	Intracranial bleed/contusion
	Nerve damage
	Vascular damage
	Penetrating injury
	Tendon injury
	Burns

The mechanism of trauma, whether blunt or penetrating, was recorded giving close attention to head wounds where blunt-force trauma may often result in heavily-bleeding lacerations. The presence of a weapon in the assault was noted either as described by the patient or as evidence from the type of wound (such as a gunshot). In low-velocity penetrating trauma, the type of weapon used was also recorded albeit intoxication and location of injury may affect the accuracy of that description. No further description of the incident such as information that could be used in a police report was recorded in accordance with Witswatersrand Human Research Ethics Committee; there was no follow-up of cases beyond the initial assessment and management.

Initial management of injuries for patient was recorded. This was limited to investigations and management within the acute receiving area and included X-rays CT, MRI or contrast studies. Interventions such as intercostal drain insertion, suturing, management of wounds requiring theatre and all specialist consultations whilst in the Trauma Unit were also recorded. It should be noted that the Unit manages all intra-abdominal, thoracic and vascular injuries within the Unit. The final variable noted was the deposition of the patient, whether discharged from the Unit or admitted.

Patients were excluded from the study if the mode of injury was determined to be accidental or non-intentional. This included all motor vehicle accidents, pedestrian accidents, falls from height and occupation-related injuries. Patients presenting with old injuries, either with sepsis or wounds treated at referring hospitals were also excluded as the initial assessment and management phase had passed. Minors (under 16 years) were excluded because the overlap of referrals between the Paediatric Emergency Department, Paediatric Surgical Department and Trauma Unit meant the full cohort of patients could be missed and subsequently represent younger patients inaccurately.

2.5 Analysis

The study data was recorded using a proforma allowing for the data to be kept anonymous. It was then processed in Microsoft Excel (Microsoft Excel 97-2003, Microsoft Office).As the nature of the data obtained in this study was simple descriptive analysis, results have been reported as frequencies and mean ± std, or median and range. Where comparative analysis was possible, the statistical package SAS (V9.2) was used for Chi-square and Fisher's exact tests to determine differences between groups with a p-value less than 0.05 regarded as significant.

3. Results

During the forty-one day study period, July to September 2007 (midwinter), the total number of patients attending the Johannesburg Hospital Trauma Unit (JHTU) was 1304.

Interpersonal violence was associated in 498 cases (38.2%). Excluded from further analysis were 806 cases due to non-intentional trauma (n=790), incomplete data (n=14) and age under 16 years (n=2).

3.1 Basic Demographics

The majority of patients were young men: included subjects consisted of 427 males (87.3%) and 59 females (12.7%). The age distribution was heavily weighted towards the third decade of life with a further sharp decline in incidence of interpersonal violence after 40 years. The median age for both sexes was similar where males were 29.3 years (± 7.7 years) and females 28.6 years (± 8.6 years). This can be seen in Figure 3.1

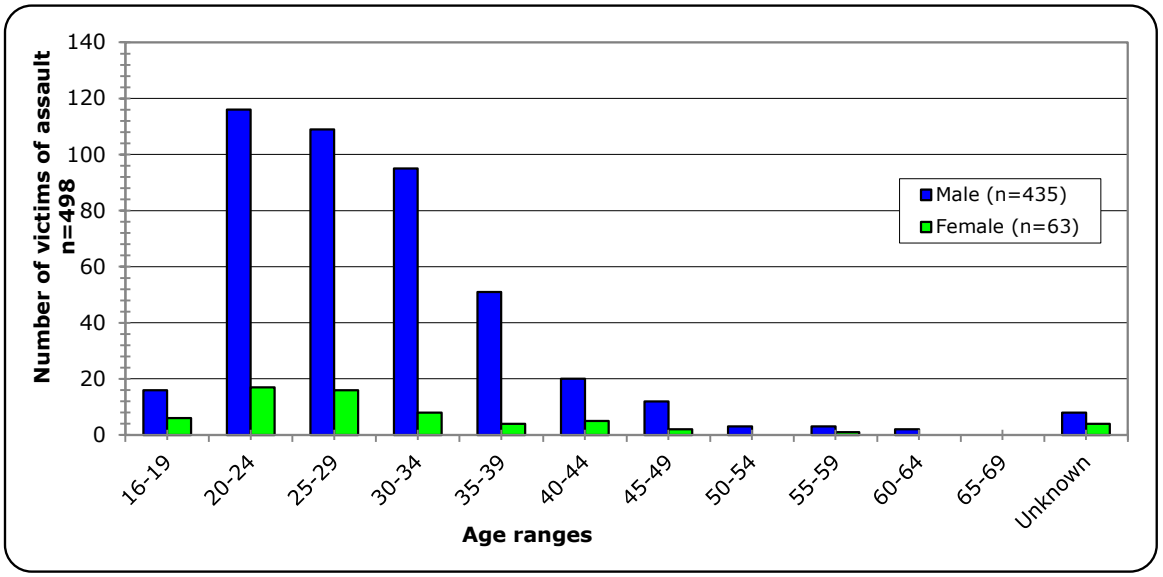


Figure 3.1

Age and Sex distribution for victims of assault attending JHTU during study period

3.2 Attendance

The peak times of attendance in the Unit were weekends, with a consistent increase in presentations over each Saturday and Sunday. Although time of attendance was not recorded, assaults taking place on Saturday night may present in the early hours of Sunday morning. Weekend presentations (Saturday to Monday) represented 65-70% of the attendances each week and overall 67.1% of attendances were over a weekend. The exception to this was the second week of the study where a public holiday fell on a Thursday. In that week, weekday and weekend attendances were 50% each. This is shown in Figure 3.2)

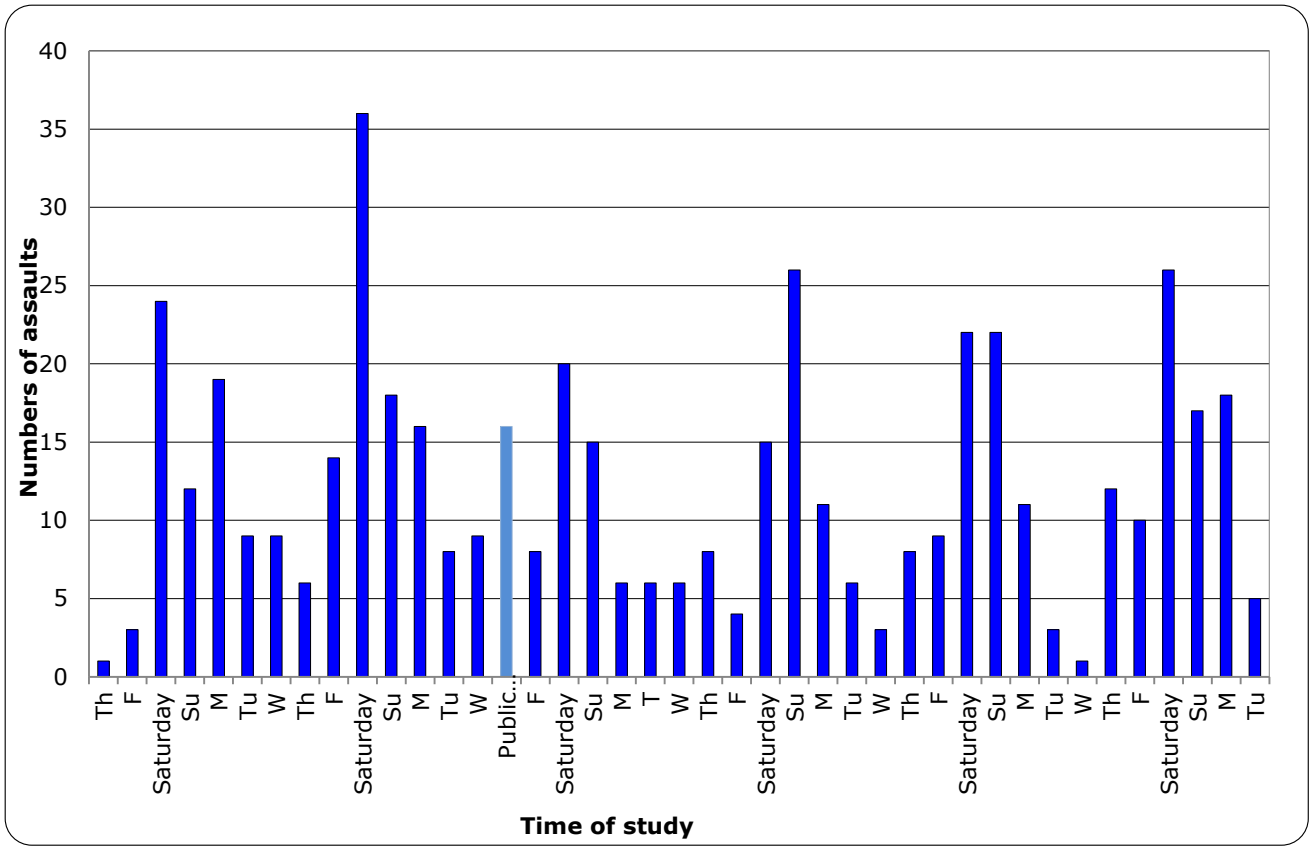


Figure 3.2

Attendance for assault injuries by date (Public Holiday shown in light blue)

3.3 Profile of Injuries

Six hundred and twenty-four injuries were recorded in our cohort (n=498). A single injury was recorded in 77.1% (n=384), 20.3% had two injuries and 2.6% of patients had multiple areas of injury (more than two). This was equally found between the sexes (males 2.5% multiple, females 3.2%).

Minor injuries were the most frequent injuries described (55.6% of all cases). In eight of the cases (0.8%) injuries were unknown or undocumented. More serious injuries such as penetrating torso and neck trauma, neurovascular and tendon injuries, multiple lacerations or intracranial pathology were present in 42.8% of patients. Fractures were seen in 78 patients of which 44.9% were simple closed fractures (n=35). Gunshot injuries caused fractures in 25 patients affecting the limbs in 11 cases and the spinal column in 5 cases (the remaining 9 affected the abdomen, chest and head). A simple laceration was the most serious injury in 33.3% of all cases seen.

3.4 Weapons

More than 65% of all assaults involved a known weapon. Eight percent of cases had no evidence to suggest weapon use, implying 'fists and feet', whilst 25% of cases confirmed weapon use (Figure 3.3). This is contrary to patterns seen in other countries where most trauma is attributed to 'fists and feet'.

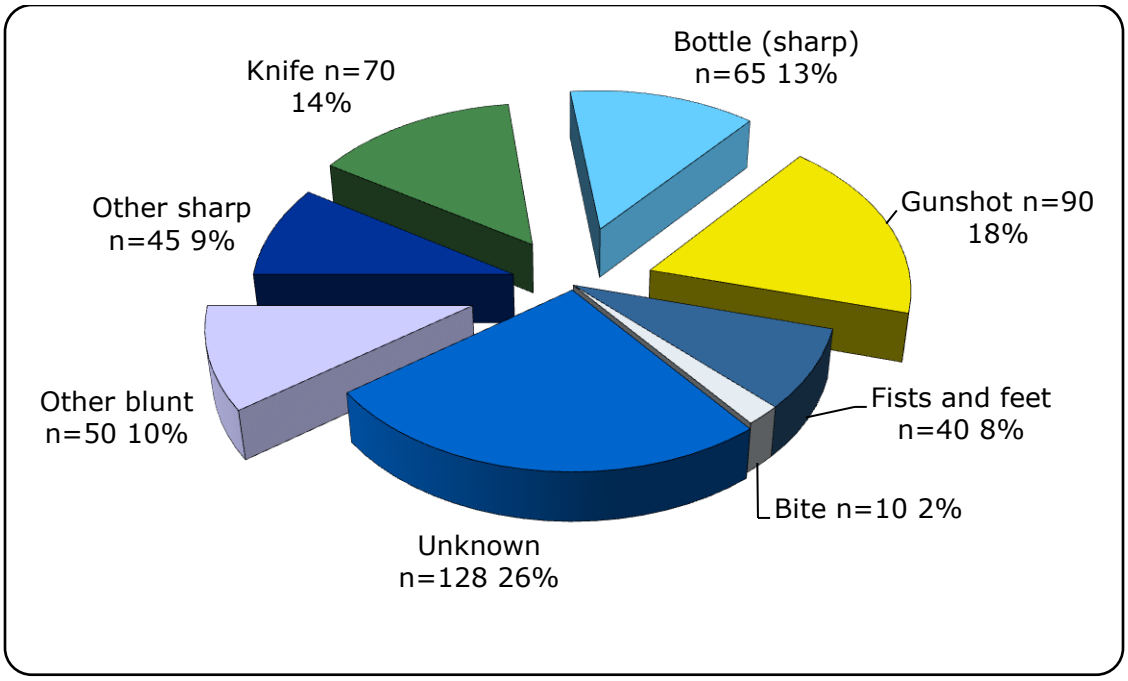


Figure 3.3

Distribution of weapons used

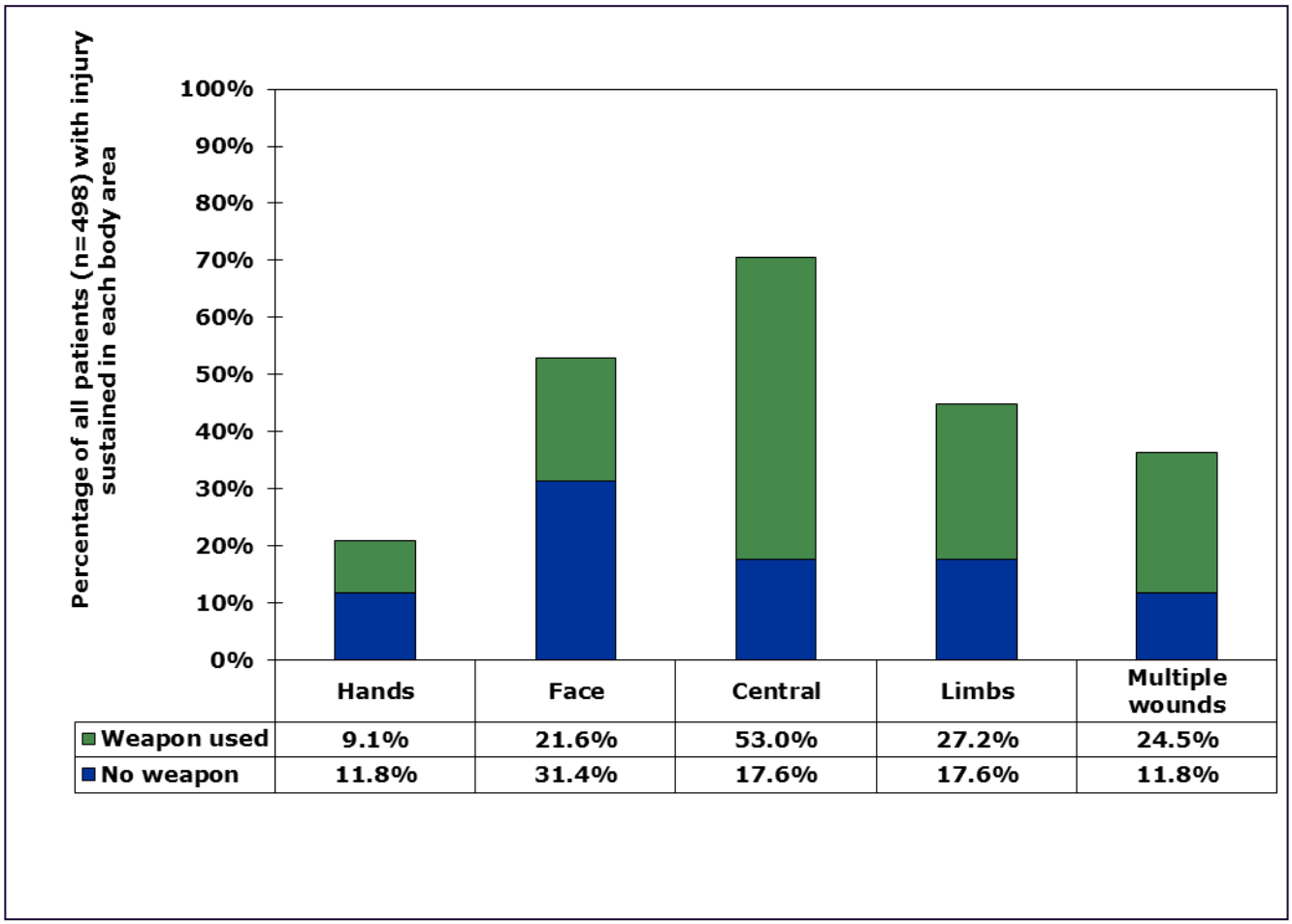
Higher-energy weapons (gunshots) were used in 18% of assaults. Low-energy weapons (such as knives and bottles) made up nearly half of all injuries (47%) which indicates a high proportion of assaults took place at close contact. Blunt trauma accounted for 10% of known trauma mechanisms.

There was a large category in which the mechanism of assault was unknown. One hundred and twenty-eight patients sustaining 160 injuries were unable to describe the mechanism (25.7% of patients) and a further 8% were unable to identify the weapon used in sharp assaults. 64.8% of patients with unknown mechanism of assault suffered injury to the head in comparison to 37.3% of known mechanisms ($p<0.0001$).

No weapon was definitely used in 50 cases, including 10 human bites. Non-weapon assaults were more likely to result in minor injuries such as swellings and lacerations (80.4%), compared with 52.8% of weapon-related assault ($p<0.0001$). In comparing the number of injuries sustained, multiple injuries were higher in the presence of a weapon ($p=0.0271$, 11.8% of injuries without a weapon and 24.5% of weapon-based injuries).

A significant injury where the mechanism did not involve a weapon was digit loss from human bites (n=4 in 41 days) where all patients required plastic surgical consultation and theatre.

Figure 3.4 compares the use of a weapon on the distribution of injuries sustained. There were more central injuries affecting the chest and abdomen in weapon-based trauma and a higher proportion of multiple wounds rather than one. Limb injuries were more common when a weapon was involved, and appeared more severe with more open fractures.



	Hands	Face	Central	Limbs	Multiple wounds
Weapon used	9.1%	21.6%	53.0%	27.2%	24.5%
No weapon	11.8%	31.4%	17.6%	17.6%	11.8%

Figure 3.4

Relationship of anatomical area injured to weapon usage

Patients assaulted with a weapon were more likely to require expensive or invasive radiological tests (beyond roentgenograms) such as contrast studies or CT. They were more likely to require admission and far more likely to require emergency theatre. This is shown in Figure 3.5.

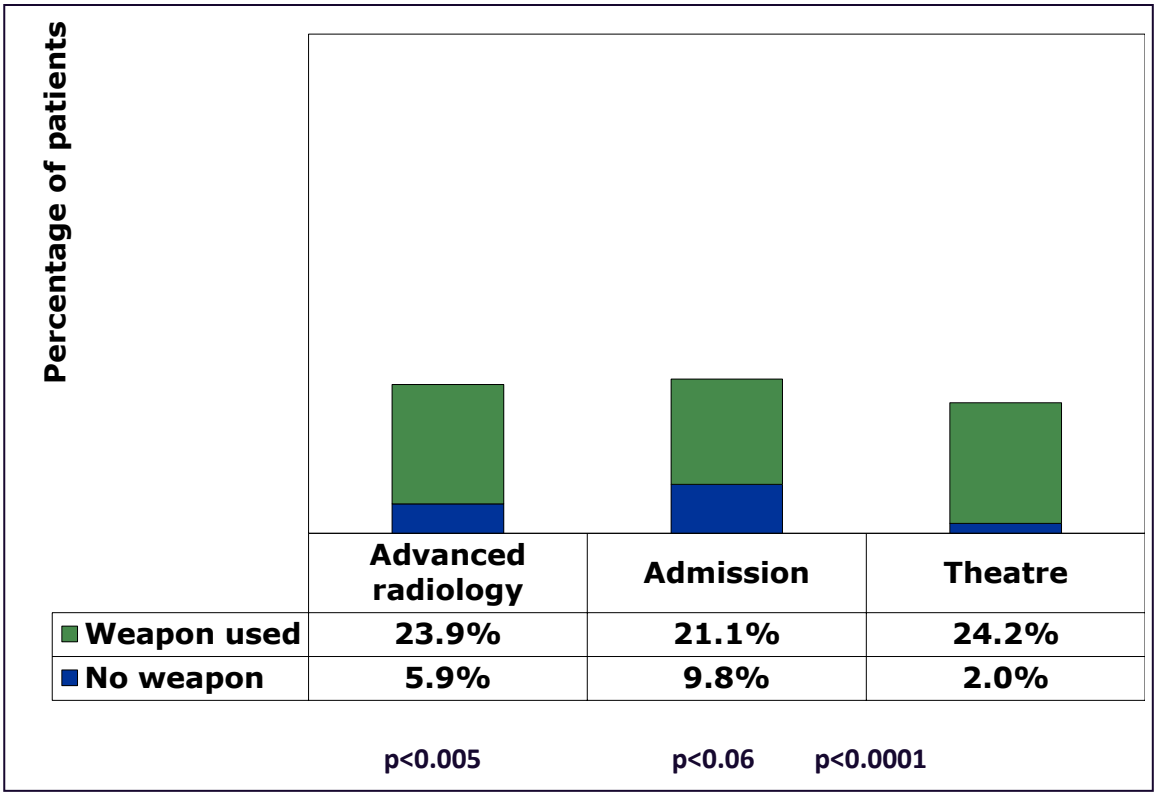


Figure 3.5

Requirements of patient management in relation to weapon usage

3.5 The relationship of weapon type to type and location of injury

On further analysis, weapons causing penetrating injuries were categorised into three groups: high-energy weapons (including all guns), glass bottles, and knife-like objects including screwdrivers, axes and stiletto shoes (the use of a stiletto shoe is interesting as this type of shoe is named after a thin-bladed knife used by medieval Italian criminals). This is summarised in Table 3.1.

Identified weapons show a relatively even distribution between the three groups. Weapons causing blunt injury included bricks, metal or wooden sticks, spanners, snooker cues, steering wheel locks, and sjamboks (traditional whip-like weapon that can have multiple tails causing subcutaneous muscle injury). A list of weapons with their prevalence is in Table 3.2 and the type of injuries seen are summarised in Table 3.3.

Table 3.1

Known weapons employed

Blunt force trauma	*Sharp trauma*
Brick	Firearm [High energy]
Bottle (blunt)	Bottle (sharp) [low energy]
Metal bar	Knife [low energy]
Sjambok	Axe [low energy]
Petrol	Glass [low energy]
Chair	Screwdriver [low energy]
Wooden bat	
Steering lock	
Spanner	
Snooker cue	

Table 3.2

Site of injuries of victims of assault

Area of injury	*Weapon*			*Non-weapon*
	Gunshot	*Knife*	*Bottle (sharp)*	*Blunt-force*
Face	2	10	23	12
All head	9	21	40	15
Torso	8	42	9	4
Abdomen	16	11	2	4
(penetrating injury)	3	3	2	0
(intra-abdominal injury)	13	2	0	0
Neck	4	5	6	0
Hand	3	16	18	5
Limb	22	13	0	7
Tendon injury	0	3	6	0
Other	9	21	0	7

Table 3.3

Nature of injury of assault victims

Type of injury	*Weapon*			*Non-weapon*
	Gunshot	*Knife*	*Bottle (sharp)*	*Blunt-force*
Minor injuries				
Swelling	1	0	0	27
Laceration	5	56	46	9
Multiple lacerations	1	1	12	0
Fracture	25	2	2	12
Major injuries				
Tangential	29	0	0	0
Intracranial injury	1	0	0	1
Internal injury	13	3	0	0
Penetrating	30	37	2	4
Other	7	4	9	1

3.6 Firearms

There were a total of 90 assaults involving firearms (17.9% of total cases). All were designated as sharp trauma. Twenty-eight wounds (29.2%) were tangential (penetrating soft-tissue only). Firearm injuries were the most serious of mechanisms, as measured by requirement of theatre, requirement of ICU and deaths within the initial treatment period the study covered. In comparing gunshot injuries with all patients, more patients required theatre (34.8% vs. 17.5% overall) and more required General Intensive Care (10.1% vs. 2.8% overall). This is seen in Figure 3.6.

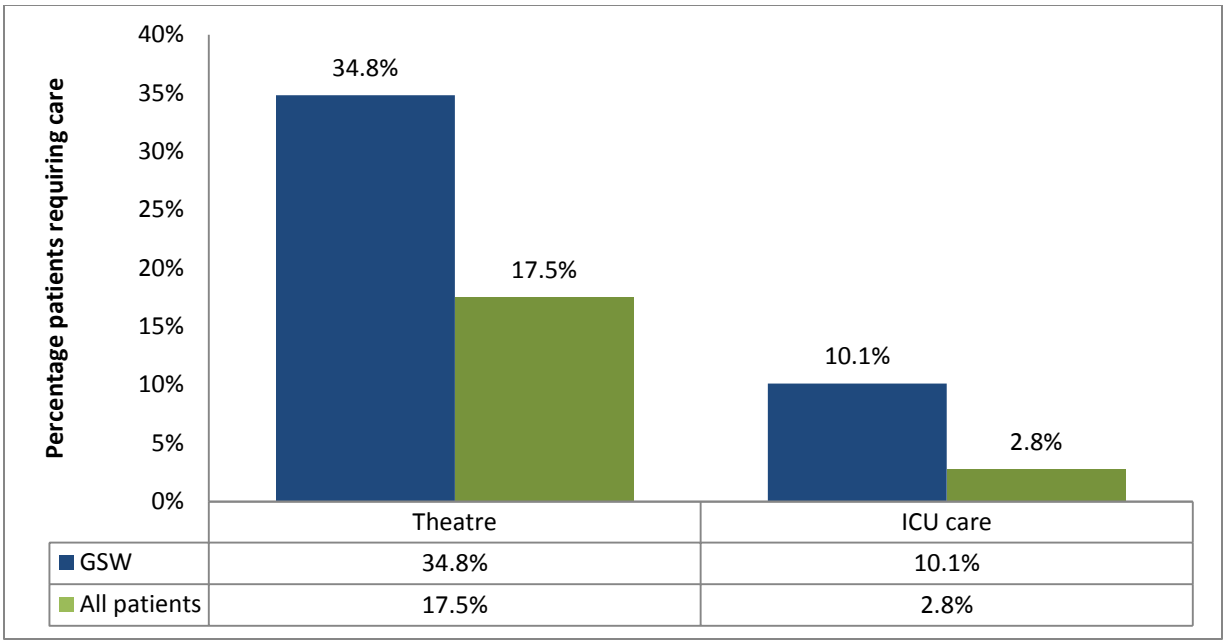


Figure 3.6

Comparing gunshot victims to all patients in theatre and ICU requirements

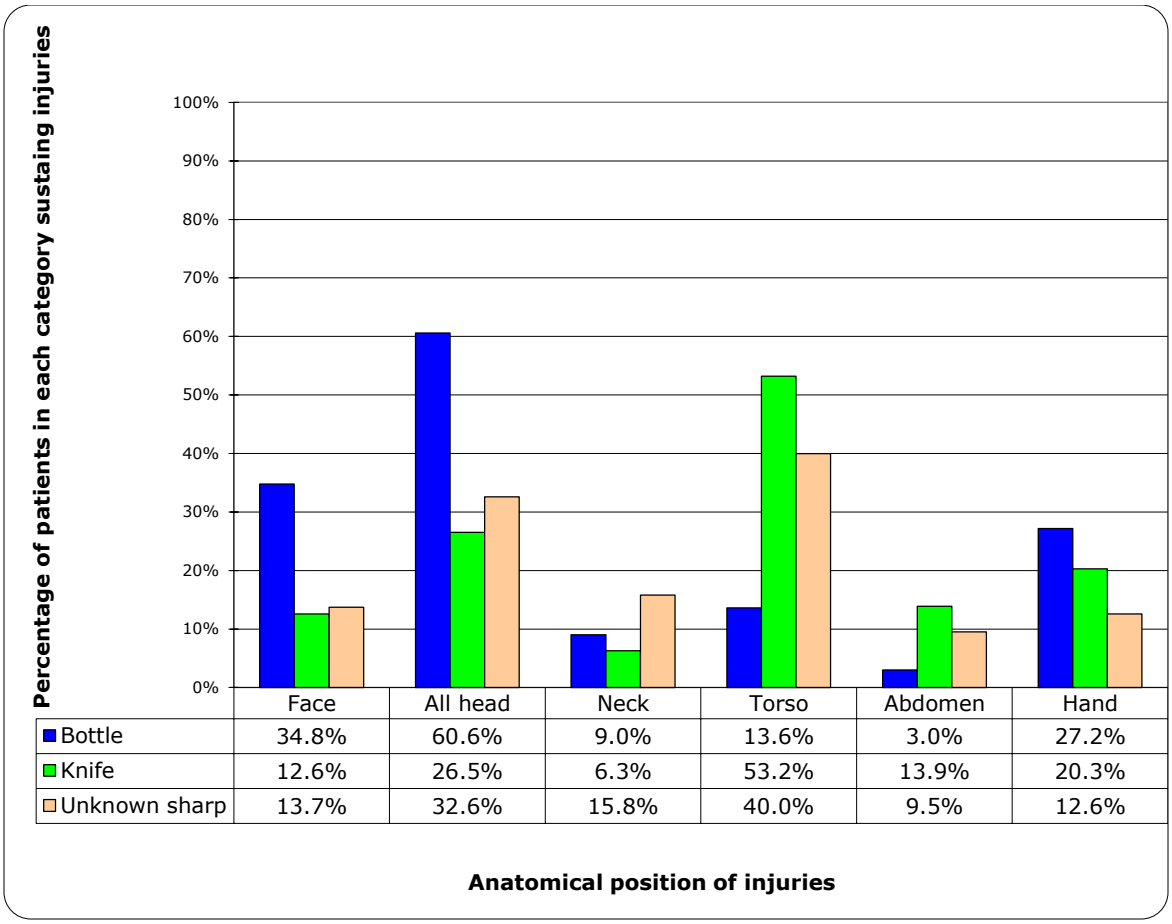
In this study there were four deaths occurring within the initial assessment period, two in the acute receiving area and two in theatre. Three of these deaths occurred secondary to gunshot injuries. One patient required an emergency thoractomy in the emergency room progressing to an emergency laparotomy but died before reaching theatre. The other two patients were taken to theatre for thoraco-abdominal injuries but died due to haemorrhagic shock secondary to intra-abdominal vascular injury. Therefore the mortality for gunshot injuries through our study was 3.3% with overall mortality for all assault patients 0.8% (n=4).

3.7 Low-energy weapons

A total of 230 patients (46.2% of total cases) presented with injuries sustained from a low velocity weapon. This was defined as any weapon using the force of the assailant only with no additional explosive force.

Distribution of weaponry in this category (n=230) was: 28.3% (n=65) sharp bottle injuries 34.3% (n=79) knife-like weapons (known in analysis as 'knives') and 37.4% (n=86) where a weapon was certainly used but the type was unknown to the patient (either sharp or blunt). Patients related that this was often due to the surprise nature of the attack or previous heavy consumption of alcohol by the victim.

It can be seen in Figure 3.7 that bottle injuries were significantly more common to the head ($p<0.001$) and face ($p<0.0001$). They were the most common weapon in hand injuries too but did not reach statistical significance.



	Face	All head	Neck	Torso	Abdomen	Hand
Bottle	34.8%	60.6%	9.0%	13.6%	3.0%	27.2%
Knife	12.6%	26.5%	6.3%	53.2%	13.9%	20.3%
Unknown sharp	13.7%	32.6%	15.8%	40.0%	9.5%	12.6%

Figure 3.7

Pattern of injuries by anatomical position and weapon type

Neck injuries were caused by both bottles and knives. All knife injuries required vascular contrast studies (indicated if penetration below the platysmus muscle) but only one third of bottle injuries required such studies. Only one patient (a knife injury) required theatre. Knife-related injuries were significantly more likely to affect the central area of the torso ($p<0.0001$) and the abdomen.

Figure 3.8 demonstrates that bottle injuries were significantly more likely to cause multiple lacerations ($p<0.0001$) and require specialist consultation when compared with knife injuries ($p<0.05$).

Weapon type did not significantly affect operation rates ($p=0.5$) or admission rates ($p=0.2$), although the characteristics of the admissions were different: 83% of bottle injuries were admitted to surgical specialties (Plastics, Ophthalmology) and only 32% of knife injuries (Plastics, Neurosurgery). Most knife injury admissions were to a general trauma ward following theatre for abdominal and chest trauma, or following intercostal drain insertion. There were no admissions to Trauma ICU in either group.

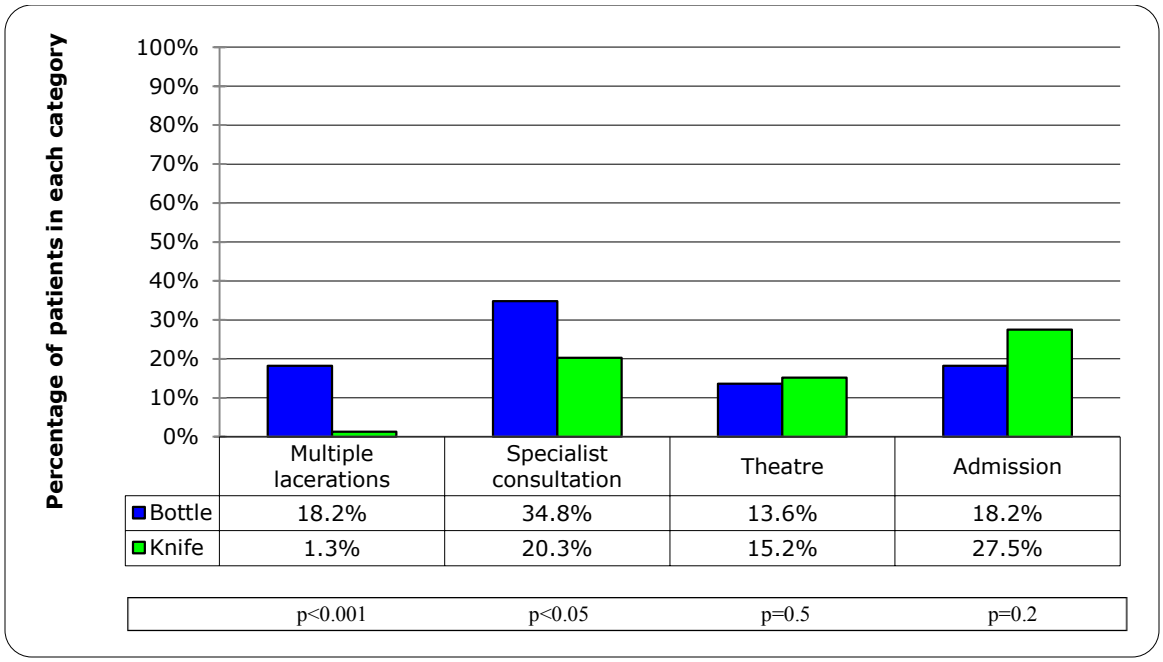


Figure 3.8

Comparison of pattern and management by weapon type

Chest trauma wounds resulting from known knife injuries were more likely to involve the torso ($p<0.0001$). They were also more likely to require radiology ($p=0.0002$) and intercostal drain insertion ($p<0.05$, ($n=26$)). The majority of patients were unable to describe the mechanism or weapon used (n=15, 57.7%). Of those patients who did report a weapon, 9 were knife wounds (81.8% of known injuries), 1 was from a bottle and one was blunt force trauma (fists and feet) causing rib fracture.

Due to the small numbers of reported weapons however on statistical analysis weapon type was not predictive for pneumothorax requiring an ICD in torso trauma alone ($p=0.35$; 19% torso knife injuries and 11% bottle torso injuries).

In analysing all low-energy weapons, 35.3% of patients required admission to hospital and of this group 46.6% (n=82) required theatre admission and operation. Emergency room suturing was carried out in 269 patients with 186 patients (37.3%) requiring suturing prior to discharge without admission (Figure 3.9).

There were 11 tendon injuries recorded that affected the hand and forearm. A considerably higher proportion of bottle than knife injuries that resulted in serious injuries were seen (Figure 3.10). Of the 11 upper limb tendon injuries recorded, six were caused by a bottle (54.5%) and three by a knife-like weapon. The incidence was equally spread between weekdays and weekends. All tendon injuries required a specialist consultation with Plastic Surgery and 81% (n=9) required admission and operative repair.

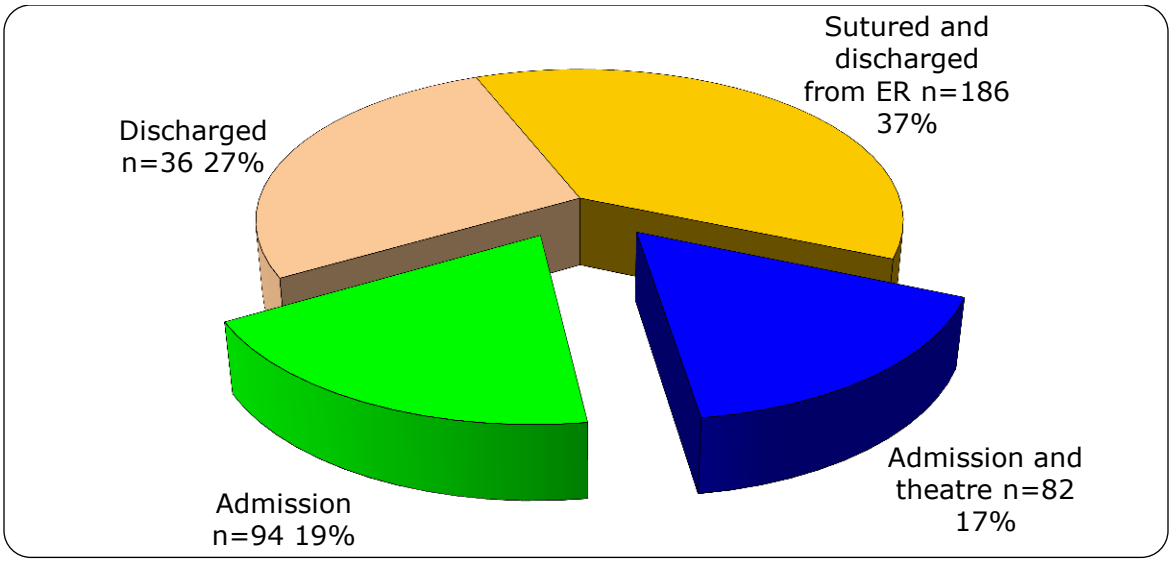


Figure 3.9

Summary of outcome of patient episodes

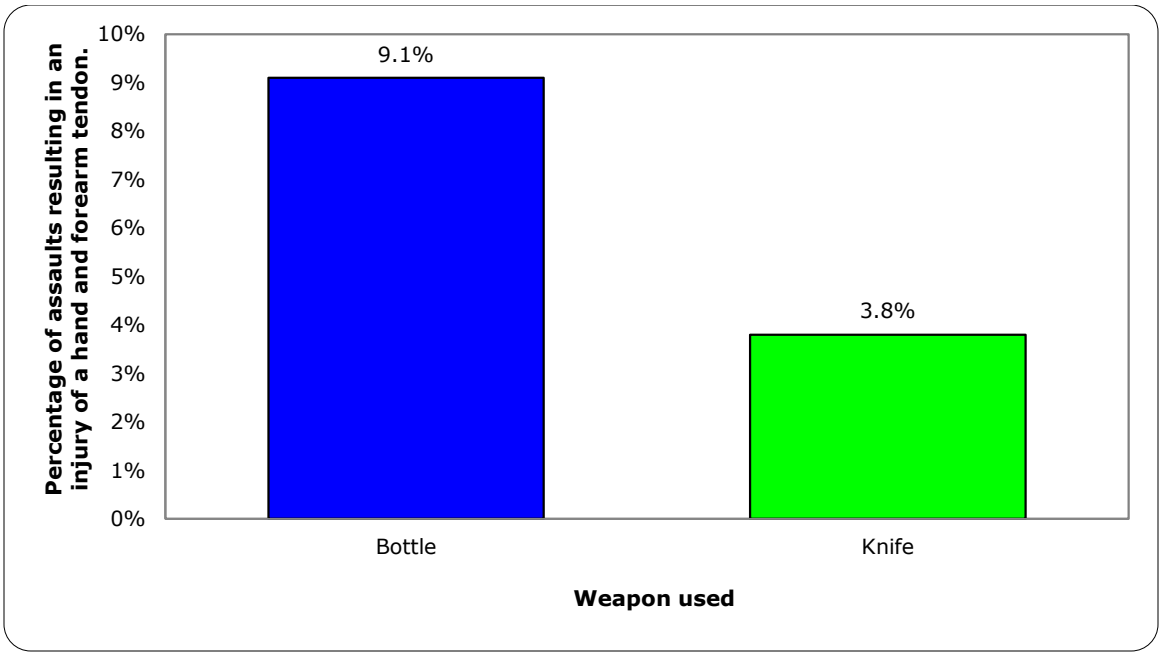


Figure 3.10

Percentage of assaults by weapon type resulting in an injury of a hand and forearm tendon.

4. Discussion

This work was intended as an epidemiological study to examine the prevalence of injuries resulting from interpersonal violence and their subsequent consequences. It was found that nearly 40% of all trauma presenting to the Johannesburg Hospital Trauma Unit resulted from of interpersonal violence.

The unique configuration of South Africa of Trauma Units alongside separate hospital emergency departments makes comparison of the assault related injury prevalence to other countries increasingly difficult. However we can easily see the greater prevalence in Johannesburg. In one year an inner city emergency room in the UK managed 735 trauma cases (1.7% of total cases; Howe and Crilly, 2001); and in Ireland, 122 cases were seen over six month period (O'Sullivan and O'Conor, 2003). In only forty days, 498 cases were seen in Johannesburg. This approximates to six times the amount of cases in the unit in the UK and twenty times more than that of the unit in Ireland.

Despite the increased levels in interpersonal violence present in Johannesburg, analysis reveals a population with similar characteristics worldwide presenting with assault injuries. In Ireland, this population has been described as an 'increasingly vulnerable subgroup' (O'Sullivan and O'Conor, 2003 p307)

4.1 Attendance

In Johannesburg assault related injuries occurred predominately in males in the 20-35 year age group. Few cases were seen below this age group and the number of cases tailed off markedly in the forty and above subset. A similar pattern of assault cases in youths was noted in studies

from the UK, Ireland and Denmark (Hedeboe, et al., 1985; Wright, et al., 1997; Howe and Crilly, 2002; O'Sullivan and O'Conor, 2003) however, in all these European cases the peak age was 15-19 years and declined steadily over the next four decades to age sixty. It was difficult to suggest why the age groups of our cases differ from these studies, but may suggest a geographically mobile population of younger men seeking employment in the inner city, and who subsequently move out of the inner city as the years progress to settle elsewhere. In common with many other studies (Howe and Crilly, 2002; O'Sullivan and O'Conor, 2003) the JHTU catchment area receives cases from an urban population of lower socio-economic groupings known to be more at risk of assault.

The prevalence of females in the Johannesburg study population was also notable in comparison to international studies. Figures recorded in Europe show 1:4 female:male ratio of reported assault incidence between the sexes, where approximately 20-25% of assaults are against women. In Johannesburg the figure of assaults against women was 12.7%, well below the average elsewhere. In the present study, although similar to the males, female assault cases were mostly in their thirties with a substantial number of cases noted up to sixty years of age.

As expected, attendance for assault injuries followed a weekly pattern with the greatest attendances over the weekend, and fewer cases presenting throughout the week. We noted a monthly pattern with the greatest incidences of assaults and attendance around the end/start of the month, confirming anecdotal observations of attending medical personnel. This normally follows the monthly remuneration payments which take place on the last Friday of the month. Although such a pattern has not been reported by other studies, it supports the known link between the availability of money, alcohol and interpersonal violence (Luke, et al., 2002).

The increase in attendance on the Thursday public holiday in the middle of the month (Figure 3.2- public holiday marked as PH) was followed by decrease in the weekend attendance following the public holiday. As noted in the previous paragraph, this may reflect casual labour being paid earlier than the usual Friday and individuals using up available money prior to the weekend or that many people took leave on the Friday to make a long weekend to go away from Johannesburg. This would explain the decrease in cases on this weekend.

4.2 Injury patterns

Multiple injuries, defined as injuries affecting more than one area of the body (as a single stab may cause swelling, laceration and an intra-abdominal injury but all within one area) were present in 22.9% of patients. There are no comparative international studies but this does indicate how generalised assault injuries can be both with and without weapons. The higher level of multiple injuries in non-weapon based trauma (seen in Figure 3.5) also reflects the more inaccurate approach and larger surface area potentially covered in 'fists and feet' type non-weapon assaults. Most of these injuries resulted in soft tissue swellings with few lacerations or more major injuries.

Similar to international studies, just under half of the patients sustained 'major injuries'. In Dublin, Ireland and in Paisley in the UK, most injuries recorded were superficial soft tissue injuries commonly affecting the face, neck and scalp (Wright, et al., 1997; O'Sullivan and O'Conor, 2003;). Lacerations and fractures occurred less commonly, 28% and 10% respectively in Paisley (Wright et al., 1997). Both of these studies showed about one fifth of patients required admission to hospital and in Dublin 30% required specialty consultation.

In the study from Chorley in Lancashire (UK), injuries to the head, neck and throat were more serious in comparison to injuries inflicted on the rest of the body (Howe and Crilly, 2001), and in all the studies examined the head was the most commonly affected area. None of the studies elaborated on the type of injuries further than this, or which areas, when injured, were more likely to require specialist or intensive medical treatment.

Data dichotomised into major and minor injury show how frequent and routine the treatment of trauma in Johannesburg has become. Soft tissue swelling, simple lacerations and fractures were all considered minor. In Howe's study of a UK emergency room (the only other study available with results which attempt to categorise or describe injuries), 43% of injuries were described as minor but these included only those with soft tissue swelling or bruising (Howe and Crilly, 2001). The corresponding figure in Johannesburg is 9.4%. These minor assaults were undoubtedly taking place within the community but were not presenting to the Trauma Unit and were perhaps managed at home or at the primary healthcare setting. There may also be a financial stimulus not to pay for a hospital attendance in the case of a minor injury where healthcare provision was not free.

The disparity between these figures indicates the heterogeneity between cultures and communities throughout the world in trauma presentations, especially when attempting comparison between high and low-to middle-income countries. It also reminds us that the attendances to hospital and the injuries seen in a hospital setting are not the complete picture of assaults going on in the surrounding community, but rather a picture of the more severe injuries occurring at one trauma unit.

It should also be noted that the categorisation of wounds into major and minor reflects the immediate threat to life or limb (as discussed in the Methods section). It fails to reflect both the

short and long-term effect such injuries can have physically and on well-being or functional outcome. As an example, a 'minor' tendon laceration of a digit in an artist or secretary requires as much intensive physiotherapy and occupational therapy as a femoral fracture in a farm labourer. A well-healed tibial fracture may have less long-term impact than a ragged keloid or mis-shaped scar of the face or neck from a simple laceration (Figure 4.1). Such scars may be either detrimental to the patient causing self-consciousness and anxiety, or increase their status as a 'badge of honour'. The psychological effects of such trauma will be discussed later.



Figure 4.1: Facial laceration (before and after treatment)

This study also classified closed simple fractures as minor injuries (see Method section) reflecting the potential for optimal and expedious healing. It is recognised that there is great variability of injuries that can be described as a fracture. For example a fracture may vary from a closed clavicle or rib fracture to a devascularised mangled extremity or gunshot with subsequent multi-fragmentary bony injury. In addition, it is important to consider that a 'simple' phalangeal finger fracture may have long-term employment implications if the patient was a skilled labourer.

4.3 Weapons

In the JHTU, the incidence of weapon injuries appeared to be in higher proportions of overall assaults than in the international studies. More than 65% of all assaults were known to involve a weapon and only 10% of injuries were definitely 'fist and feet'. This is in contrast to Denmark, where over 75% of injuries were caused by physical weapon-free assault (Hedeboe, et al., 1985) and in Scotland, one of the countries with a higher rate of weapon use (particularly knife-based crime) still more than 40% of injuries were 'fists and feet' (Wright, et al., 1997).

Injuries sustained during conflict without a weapon were evenly spread throughout all zones of the body, which may reflect the non-specific targeting of body areas indicative of non-weapon based conflict. The face was affected with a slightly greater proportion. It is not clear whether this is a true reflection of the injury pattern or whether patients who had alarming facial soft-tissue swelling often with compromised vision due to swollen eyes (Figure 4.2a) as opposed to soft tissue injuries and bruising in other areas of the body, were more likely to attend hospital. Significantly, more non-weapon assaults resulted in minor injuries and the proportion of patients who suffered swellings or lacerations was higher. A noteworthy injury where the mechanism was weapon-less was the loss of a digit resulting from a bite-injury (Figure 4.2b).



Figure 4.2
a: Facial swelling secondary to blunt assault.
b: Digital loss due to human bite

In this study the use of a weapon was more likely to increase the severity of injuries. This finding conflicts with other studies which found that the most injuries could be inflicted with 'fists and feet' rather than a weapon (Brennan, et al., 2006). This can depend on the weapon used however and the prevalence of firearms in this study is much higher. In blunt trauma it can be difficult in a post-assault situation to properly ascertain from the victim the exact mechanism of injuries, situations surrounding an assault, and which part of the body or weapon the aggressor used. This can be due to the presence of alcohol or concern over injuries and other psychological stressors. However, when assessing the extent of non-weapon based injury it is vital to find out the events surrounding the assault: whether there were multiple assailants and whether fists or feet were employed and the location of obvious or occult injuries have occurred.

There was notable presence of hand injuries in non-weapon assaults, indicating the injury may have been sustained during punching. It is important to recognise in treating conflict trauma that the patient may be the aggressor, the victim or both. Assault-related injuries are more common in patients who tend to display or have a history of other criminal behaviour, such as property-related crime (burglary or motor-vehicle theft) or violence against another person. Young patients in assault-related injuries are more likely to have criminal convictions in these areas than similar aged patients presenting with non-intentional trauma (Rivaria, et al., 1995). When one considers the risk factors for assault related injuries: young males, unemployed, poor socio-economic surroundings frequent alcohol or other substance use all appear as contributing variables. Many of these risk factors are also risk factors for violent or criminal behaviour.

Studies of patients with histories of physical or sexual abuse (particularly in the formative years) show that such individuals were more likely to carry out similar abuse themselves and problems experienced in childhood predispose individuals to violent behaviour later in life. This is true both internationally (Felson and Lane, 2009; Freisen, et al., 2010) and in South Africa (Gupta, et al., 2008). Exposure to violence, which is not necessarily suffered by the child but witnessed by them, can still

affect the likelihood of later violent conduct (Vung and Krantz, 2009). In the Western Cape men who had witnessed abuse of their mothers were three times more likely than other men to abuse their own intimate partner (Abrahams and Jewkes, 2005). Another study of the effect of community violence on children found that hearing of violence often produced as great an effect of psychological distress as witnessing episodes (Shields, et al., 2009). Chronic exposure to reports of violence and conflict as well as personally experienced episodes may increase the tolerance of an individual to the use of interpersonal violence themselves.

In central Los Angeles, USA which has a high-level of violence and subsequent trauma and injury, Sims (1989) found an alarming long-term consequences for patients admitted to a trauma centre for assault-related injuries. They showed that in the five years following their trauma episode, 44% of patients had a repeated assault-related injury, more than half of patients had a criminal record and 20% were dead (Sims, et al., 1989). With such grave implications for future care, it is extremely important that patients with injuries that particularly suggest perpetration of an assault, such as fifth metacarpal bone fractures (a finger fracture known as the 'boxer's fracture') or open wounds to the dorsum or knuckles of the hand should be particularly identified for possible intervention to prevent further episodes.

4.4 Major injuries

In this sample, weapon-related conflict caused more centrally located injuries, with wounds penetrating the neck, chest and abdomen and with accompanying internal organ damage and neurovascular injury. There were fewer limb injuries in non-weapon based trauma, reflecting the lower levels of force involved in the attack in comparison to blunt force trauma where a weapon such as an iron bar or brick is used, or penetrating gunshot injuries of a limb where the bullet traverses the bone causing complex fractures.

Patients assaulted with a weapon were more likely to require intensive investigation and management. These injuries also resulted in more admissions to hospital. Only one patient in the present study suffering a 'fists and feet'-type assault required theatre. This was a result of significant blunt force trauma to the head resulting in intracranial bleeding and subsequent neurosurgical intervention and intensive care. The high prevalence of weapon-related injuries results in an increased burden on the system as more tests, admissions and consultations were required and ultimately result in increased healthcare expenditure. In a system with finite resources, the quicker depletion of resources consequently places a limitation of resources in other areas or causes a failure to treat all patients optimally. Similarly, the requirement for more consultations involves more doctors per case thereby increasing workload on already overburdened healthcare professionals.

There was a large grouping of patients where the mechanism of injury was unknown. Patients were often unable to recount a mechanism because of the relative surprise nature of the attack. This accounts for some of the unknown sharp and blunt injuries, where the victim was aware that a weapon has been used but the characteristics of the implement could not be identified. Patients may also be reluctant to permit close questioning into the mechanism or events surrounding the assault because of concerns over police involvement. This was most relevant when the assaulting party is known, particularly in cases of intimate partner violence.

Although the level of alcohol use was not investigated in this study, there is a known close correlation between alcohol consumption and subsequent violence, particularly in head injuries (Yates, et al., 2006). The high presence of alcohol in patients presenting with traumatic injuries may lead to a decrease in the ability to accurately recount the events leading up to and surrounding the trauma. Therefore, one may argue that alcohol has a two-fold effect on the treatment of trauma in the emergency rooms namely increasing the volume of injuries presenting but decreasing the ability of the patient to assist the clinician in determining mechanism or severity of injury.

Patients with injuries to the face and head were considerably more likely to be unable to identify the method of assault. This may represent the temporary amnesia (particularly retrograde) or loss of consciousness associated with assaults to the head. More than 80% of patients with severe head injuries were unable to describe the mechanism of injury often because of a low Glasgow Coma Scale on presentation which persisted throughout treatment in the acute receiving unit.

It is also important to note that failure to accurately establish a mechanism of injury may be attributed to a reporting error, either because the clinician did not have time to question the patient adequately or has not documented the mechanism appropriately. Evident in this study is that each weapon displays its own pattern of injuries. These patterns indicate the potential severity of injuries or suggest related occult injuries. It is vitally important to firmly establish a mechanism as part of the initial patient assessment.

4.5 Types of Weapons

In looking at the types of weapons that could be identified in conflicts, there was a relatively even distribution between knife-like injuries, bottle injuries and gunshot injuries, with a slightly smaller proportion of blunt-force trauma with known weapons. There is a well-known high level of firearm use in South Africa (Gun Control Alliance, 2007), which is supported in this study (18% of injuries involved a gun). It proves to be far greater than that seen in any European study, although studies from the West coast of North America do report a high incidence of firearm injuries and mortality, particularly in the African-American and Hispanic populations (Vassar, et al., 1996; Demetriades, et al., 1998).

The types of weapons used could also be used in attempts to characterise the pattern of interpersonal violence occurring. The majority of injuries were secondary to direct contact assaults with a low-energy weapon where assailant and victim are in close proximity. Interpersonal violence and injuring behaviour can then be seen as an event continuum rather than discreet moment in time. In studies of interpersonal conflict there is often a crescendo of increasingly threatening and

intrusive behaviour over a period of time that finally results in a physical assault (Crowner, et al., 2005). It is unclear if this behaviour may be altered if a firearm is employed enabling an attack to take place with distance between the individuals. This may result in a different pattern of culmination between the conflicting parties. This is yet to be studied.

4.6 The cost of weapon carriage

This study does show a relative level of preparedness of the individuals in the studied community in Johannesburg, to precipitate or defend themselves against potentially violent situations. In South Africa, 38% of males and 8% of females of school age admitted to carrying a weapon at some point over the preceding 6 months (Matzopoulos, et al., 2008). The risk of being involved in a violent situation was increased in these individuals and those around them. A woman whose intimate partner owns a legal gun remains ten times more likely to die violently (Personal data in Matzopoulos, et al., 2008).

Assaults in which firearms or knives were used (including screwdrivers and other easily concealed weapons) show premeditation to possible assault. In approximately one quarter of injuries that took place in this study, the weapon used suggested spontaneity of episode. These were patients assaulted either without recourse to a weapon or using temporary weapons such as beer bottles, chairs, bricks or other items that could be obtained immediately from the surroundings. These injuries tended to be less in both severity and consequences than those involving a knife or gun.

There is a high incidence of carrying weapons amongst this population at risk, a problem also reflected by this country's mortality figures (Donson, 2008) and it remains a problem difficult to address. However difficult, this problem needs urgent attention not only because of justice and public safety, but because of its impact on public health and health economics.

Firearm injuries were the cause of three quarters of the mortalities over the study period. Gunshot injuries resulted in a disproportionate demand on resources when compared with all injuries. Patients with gunshot injuries were more likely to go to theatre and intensive care and by implication have a generally more complicated and prolonged stay in hospital. The destructive nature of firearm injuries means that, even if not life-threatening, these injuries can be far more complex injuries and inevitably lead to multiple speciality consultations and further rehabilitation. This has a higher potential for long term disability and its associated social and economic cost to the individual and family.

The number of illegal guns in South Africa remains unknown with the estimates of pressure groups ranging between 500 000 and 4 million. Recently, over a four-year period, 112 692 guns were reported lost or stolen in the country and the police alone cannot account for 8000 official firearms in 2009 (GunFree SA, 2009). The high prevalence of mortality from firearms in Johannesburg seen in the NIMSS report (Donson, 2008), and high levels of firearm injuries seen in this study underlines the significance of this problem. The law in South Africa at present requires that any bullet extracted from a patient in hospital should be retained, documented and passed to the South African Police Service. It does not require the mandatory reporting of all firearm injuries, which limits the ability to identify possible inappropriate gun use and possible illegal gun carriage.

There was an interesting contrast in the pattern of injuries inflicted by knife-like weapons and broken beer bottles. Knife injuries were more likely to involve the torso and require an intercostal drain insertion. The high levels of unknown weapons in the study causing thoracic injury mean that this did not show significance but further studies may show an ability to predict significant chest injury based on mechanism. In contrast, when a bottle was used head and face injuries were more common, often with multiple lacerations and more likely to injure the hands, particularly causing tendon injuries in the hand and forearm. These injuries to the face and hands resulted in more

specialist consultations and the resulting injuries, particularly to the hand, require very intensive follow-up and rehabilitation to prevent enduring disability.

As previously discussed, knife injuries indicate an amount of premeditation due to carriage of a weapon where bottle injuries may indicate a spontaneous episode. The presence of a beer bottle as a wounding implement also points heavily to the use of alcohol immediately prior to the assault.

Considering the concerns in many countries over reducing the incidence of knife carriage, and the vigour employed by the police and justice services in preventing illegal gun carriage, it is interesting to observe that in conjunction with the known causative factor of alcohol in interpersonal violence many beverage companies continue to market violence-inducing liquor and serve it in large quantities to a 'vulnerable population', conveniently encased within a handy weapon (the glass bottle).

4.7 Hidden Injuries

Although in trauma surgery literature suitable and recognized management for injuries to each different area of the body has been extensively reviewed in textbooks and is the subject of international courses such as Advanced Trauma Life Support (ATLS™) and Definitive Trauma Skills Course (DSTC™), the long-term physical or psychological morbidity has rarely been mentioned. Some surgical specialties have looked at the long-term impact of violent injury, perhaps reflecting recognition that injuries to the eyes, hands or face may have more long-term consequences than the more immediately threatening abdominal or thoracic wounds. These central injuries, although more serious in the short-term, may have a relatively short course of management to full recovery.

In a study looking at the long-term burden of injuries sustained during violence, Wong (2007) found considerable psychological sequelae resulting from facial injuries with 34% meeting criteria for post-traumatic stress disorder and a further 35% for probable major depression. All the injuries sustained were from blunt physical assault with no additional weapons, but even these injuries on the face

"with its visibility and uniquely individualized features… substantially defines [an] individual's perception of self-image and identity" (Wong, et al., 2007 p119). The study also found significant barriers to psychosocial aftercare, both by the individual and in accessing facilities. There is also a higher incidence of alcohol intake and subsequent abuse among patients with facial injuries post-trauma (Levine, et al., 2005). The long-term morbidity of trauma-related injuries may also be significant in eye injuries where broken glass injuries resulted in more severe damage requiring more surgical interventions with worse prognosis. In one study, after an eye injury 26% of the patients remained blind in the affected eye (Kuhn, 2004).

Serious sequelae may also result from injuries to the hands which are first assessed as minor. After traumatic injury residual functional impairment of the hand was found in 58.5% at 18 months and nearly 10% of employed patients required a change of job or disability pension (Trybus, et al., 2006). These injuries are a hidden cost to the healthcare system in terms of theatre time, additional physician hours and intensive rehabilitation. It may be compounded by the considerable consequences for the patient: physically, psychologically (particularly disfiguring lacerations to the face) and economically as extended specialist rehabilitation or long-term disability affects employment and requires financial support.

In addition to the psychological distress caused by the injuries there may be compounding distress caused by the nature of the attack. Levels of anxiety and depression rise following an assault including higher incidences of psychiatric symptoms (Shepherd, et al., 1990). Victims may experience feelings of real or perceived personal insecurity with a lack of faith in the police or surrounding community. They may fear further violence or blame themselves as is often found in intimate partner and sexual violence (Shields, et al., 2009). These feelings may lead to alcohol or substance abuse or, particularly in youth interpersonal conflict, feelings of personal insecurity can lead to weapon carriage or assault retaliation which in turn predisposes to a recurrence of assault and possible injury (Sims, et al., 2005; Rich, et al., 2005). Increasing episodes of violence also have an

intergenerational effect, predisposing the next generation to feelings of personal insecurity and subsequent violent behaviour (Shields, et al., 2009; Vung, et al., 2009).

Assaults on women comprised 12.7% of the total incidences in this study, but only two of these women (3.4%) were referred for gynaecology consultation. In both cases, the females were pregnant and had sustained blunt force assault to the abdomen. There were no recorded cases of sexual assault or rape. South Africa has one of the highest incidences of rape in the world, with an estimated 494 000 cases per year (although less than 15% of these are reported to the police). A recent study of adolescents found that 26.3% of females had been subjected to physical or sexual violence (Peltzer and Pengpid, 2008). It is difficult to explain the absence of rape cases in this study. It may be that these patients are referred directly to gynaecology, although inter-current injuries requiring assessment by a trauma specialist would be expected in some cases, as it should not be expected that all rapes cases during the study period took place without any non-genital physical injury to the patient.

Given the level of reporting that takes place after sexual assault, it was more likely that female patients suffering assault were not asked by medical staff, or did not reveal any sexual violence. As part of the HIV/AIDS initiative post-exposure prophylaxis for prevention of HIV is available at government centres for rape and sexual assault victims with high success rates (Wulfsohn, et al., 2003) and therefore it is important to actively seek out patients who may have been victims of abuse. Where patients cannot describe the mechanism of injury through diminished consciousness, active measures should be taken to ensure the patient's protection including protection from HIV, other sexually transmitted infections and pregnancy.

4.8 Public Health Implications

Understanding the impact of violence-related injury, particularly when related to weapons, requires an understanding of the pattern of injuries and subsequent cost to the victim and society. The

International Committee of the Red Cross has consulted with the medical profession on the effects of weapons within the context of warfare (Tubbs, 1998). The resulting SirUS project identifies and makes illegal under the Geneva Convention weapons that cause "superfluous injury or abhorrent suffering" (Tubbs, 1998, p.85). The terms under which they consider these weapons can also be used to direct research and public policy in a civilian society:

> "Any use of any weapon against human beings carries an intent to cause bodily harm. Understanding and quantification of that bodily harm can help to limit more effectively the suffering caused by weapons both current and future. In relation to policy and law, considering the real effects that weapons have on human beings before the weapons' nature or technology is logical…" (Tubbs, 1998, p.85)

This study has shown that the communities surrounding the JHTU suffer from high levels of violent crime and interpersonal violence. There continues to be a high level of weapon use which may be a cause of this violence but can also be a consequence of the ongoing exposure to violence. This leads to decreased feelings of personal and sexual security which in turn leads to weapon carriage and subsequent use, perpetuating the cycle of injury.

This study has contrasted unfavourably the current incidence of interpersonal violence in South Africa with European and USA figures for intentional trauma prevalence. The profile of the assaults also differs in South Africa, with more weapons used in violence resulting in more serious injuries. Interpersonal violence caused more than 1 million Disability-Adjusted-Life Years (DALYs) in South Africa in 2000 (Norman, et al., 2007).

As the study only recorded an isolated period of time, it is limited in its impact and it becomes difficult to ascertain whether levels of interpersonal violence are improving in South Africa. Recent national studies suggest mortality from homicide has decreased in the past 10 years but injury levels are unknown (Donson, 2010). The National Injury Mortality Surveillance Scheme has been instituted

to estimate the level of mortality caused by injury in South Africa. As an urban mortuary-based study, it is limited to fatal injuries and there still remains a place for the surveillance of non-fatal injuries and subsequent on-going morbidity.

The present study highlights the need for a system of injury surveillance based in public and private hospitals throughout the country. It becomes clear that based on current police reporting rates, hospitals see more injuries resulting from assault than those reported to the police and therefore hospital-based figures may be useful in monitoring injury rates and more accurately identifying those at risk of re-injury and mortality from trauma. If 20% of assault victims are at risk of mortality in 5 years (Sims et al., 1989), patients who present to hospital with an assault–related injury become a population who should be screened for potential risk factors with a view to risk-factor reduction in much the same manner as a cancer-screening service. Any comprehensive injury surveillance scheme would also complement the mortality information gathering, and could be used as a marker for successful responses to public health measures. It may also be important to institute longitudinal studies to assess the ongoing morbidity and disability stemming from trauma and the requirement for rehabilitation along with subsequent health care and community socio-economic costs.

This study found that there is a pattern of weapon use unique to the South Africa setting. There was a higher prevalence of firearm use than found in other countries. This may be due to the relative ease with which firearms may be obtained either legally (although the Firearm Control Act is seeking to address this (Gun Control Alliance, 2006)) or illegally, stolen in South Africa or smuggled from ex-conflict regions further north in the continent. A recent amnesty on illegally held guns lead to the destruction of 109 582 weapons but whether this has an impact on injury figures has yet to be determined (SouthAfrica.info, 2010).

Knife injuries and the implicit high levels of weapon carriage leading to such injuries, were also found to be high in this study. This is an area that has received little attention in South Africa, although

such weapons are shown in this study to cause more injuries and more severe injuries than physical non-weapon based attacks alone. It would be an important and relatively straightforward public health measure to raise awareness of knife injuries and the potential increase in assaults to those who carry weapons. This may be relevant particularly for adolescents and learners.

The high level of bottle injuries is an interesting finding. These injuries were more likely to involve the face with its subsequent psychological consequences, and hand injuries with further requirement for rehabilitation and potential disability. It is difficult to legislate and effectively carry out legislation for the prevention of knife carriage or illegal firearms (Bleetman, et al., 1997) and the burden of work relies on the police force and judicial services. The possibility of preventing bottle injuries however may lie with the brewing and liquor industries in preventing and regulating circulation of the potential 'weapons' rather than relying on police services to find and confiscate the weapon from the would-be assailant.

Already the wounding ability of a broken beer bottle has been recognised in medical literature and the fact that bottles cause preventable injuries has led to the banning of such items from major sporting and music events, even in Johannesburg (Liz Leuenberger, Medical Coordinator, Ellis Park Stadium- personal correspondence). Within preparations for the 2010 World Cup in South Africa, measures for limiting alcohol intake and limiting sale of alcohol to plastic containers were recommended in official venues. These risks are well known to the brewing industries and the same companies who distribute in glass bottles in South Africa are extending their use of plastic bottles in the USA due to tighter regulation surrounding sales in areas such as beaches, nightclubs and stadiums.

In the South African population, where the danger of bottle injury is not limited to sporting events but to every alcohol outlet and shebeen [unlicensed drinking establishment], legislative measures to encourage a move to the routine use of recyclable Polyethylene terephthalate (PET) plastic for all

alcohol should be encouraged. If it is recognised that a stadium is not a safe place to be supplying alcohol and a potential weapon together, it should also be recognised that any gathering of people, in a shebeen, bar or party is also a potential arena for interpersonal violence and any measures to prevent spontaneous weapon use should be instituted.

South Africa now contains both national and provincial HIV units within the Department of Health as correct recognition of the impact HIV has on our society, and the need for prevention and treatment. There is national and international research ongoing for cardiovascular disease prevention and management. National TB, malaria and infectious disease immunisation and prevention programmes are in progress in South Africa. Trauma is also a disease which can be viewed in the same epidemiological manner as these infectious diseases: within the triangle of host, agent-vector of disease and environment permissive of transmission (Flint, et al., 2007). Measures directed at the 'host' (the population affected by violence) may include preventing illegal firearms or excessive alcohol consumption. The environment may be altered with public health measures, and agent-vector (the weapon) may be controlled with measures to address illicit weapon carriage. Interpersonal violence should be recognised and treated as a disease, with prevention and management strategies. A directorate of injury prevention at national level with multi-disciplinary input involving health, justice and social security to allow for injury surveillance, community education and intervention, justice for victims and rehabilitation of perpetrators is required.

In Bogota, Colombia, one of the few places with comparable homicide rates to urban South Africa, a joint violence prevention programme between many different departments of local government and other intuitions dramatically decreased rates of homicide by three-quarters over ten years (Guerrero, 2006). In a study comparing the similar cities of Seattle (USA) and Vancouver (Canada), cities with similar demographics but very different gun-law policies there was a 65% difference in

firearms homicide. It was concluded that strict regulatory policy concerning access to firearms might reduce the rate of homicide (Sloan, et al., 1988).

The characteristics of patients in this study reflected some of the risk factors for assault injuries. These determinants of interpersonal violence may be a legacy of the previous era of violence and injustice in South Africa where much of the social fabric of communities and family structure was destroyed. Continued social injustice, economic inequalities, poor personal security, gender inequalities and violence, and lack of family cohesion due to economic migration or disease continue to contribute to the ongoing levels of violence. Any long-term multi-disciplinary measures to prevent interpersonal violence must also attempt to address some of these issues.

Within the healthcare professions the most effective changes in levels of morbidity and mortality of interpersonal violence injuries can be made not primarily by improving or increasing trauma services provision, but by using injury surveillance, statistics and research to influence policy makers within the judicial and public health services sectors of government. There should be an endeavour to decrease weapon carriage, decrease the availability of spontaneous weapons such as glass beer bottles and increase post-injury counselling and support to individuals to prevent recurrence. This may lead in turn to a decrease in the trauma burden and makes available more time, medical personnel and resources to those patients whose medical problems or injuries we cannot prevent.

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