

From Karolinska Institutet, Department of Public Health Sciences,
Division of Social Medicine, SE-171 76 Stockholm, Sweden

Paediatric burn injuries in Cape Town, South Africa

Context, circumstances, and prevention barriers

Ashley van Niekerk



Stockholm 2007

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ISBN 978-91-7357-178-4

Karolinska Institutet, Department of Public Health Sciences,
Division of Social Medicine, Norrbacka
SE-171 76 Stockholm, Sweden

Printed in Sweden by US-AB, 2007

ABSTRACT

Despite concerns about the impact of childhood burns, there remains a paucity of systematic descriptions of its epidemiology, contexts of occurrence, and preventability. This information is essential for the development of prevention interventions in Cape Town, South Africa. The thesis sought to identify the individual patterns and circumstances of the burn injury, neighbourhood determinants of risk, caregiver accounts of these injury events and their mechanisms, and the barriers and enablers to prevention. It comprises four studies, two of which use currently available register data, one of these in combination with South African census data, while two utilise interviews as a basis for qualitative studies into the burn event and counter-measure barriers and enablers.

The first study describes the epidemiology and patterns of moderate to severe childhood burn injuries in the surrounding Western Cape province. Burn injury incidence is particularly high for toddlers and infants, for boys, and for African children. There are four burn injury patterns of occurrence: “infant scalding”, “toddler scalding”, “injuries among older children with an over-representation of flame-related burns” and “other causes of burns sustained to the head and neck region”. The second study is an ecological investigation into the impact of local circumstances of living in Cape Town on childhood burn injury levels. The main dimensions of contextual exposure were defined as housing conditions, socio-economic barriers and child dependency. All have associations, and the first two even graded relationships with injury level.

The third study reports on the testimonies of caregivers whose children have recently been hospitalised with burn injuries. They highlighted the multi-factorial nature of the injury event; contexts of extensive exposure to adverse environmental, domestic and personal conditions; and environmental, spatial and supervision strategies for future prevention. The fourth study identifies caregiver and stakeholder representations of scalding counter-measures, and barriers and enablers to its implementation, in response to depictions of typical scalding scenarios. Counter-measures included: changes to home practices, safety enhancements to the home environment, and improvements of individual competence. Barriers to these focused on limitations in the physical environment, product limitations, executive hinderers, and hardship, most of which are not easily modifiable. The proposed enablers involved the reversal or alleviation of the identified barriers.

In conclusion, the thesis highlights the need for burn injury prevention efforts that address the physical aspects of the home environment, such as spatial layout, storage and working facilities, and heating appliances that incorporate safety technology. This may require concerted efforts and advocacy given the various needs of impoverished and marginalized communities.

Keywords: burns, paediatric, injury circumstances, low-income context, prevention barriers

LIST OF PUBLICATIONS

The thesis is based on the following publications, which will be referred to in the text by their Roman numerals:

- I. Van Niekerk, A., Rode, H. & Laflamme, L. (2004). Incidence and patterns of childhood burn injuries in the Western Cape, South Africa. *Burns*, **30**(4), 341-347.
- II. Van Niekerk, A., Reimers, A. & Laflamme, L. (2006). Area characteristics and determinants of childhood burn injury in Cape Town. *Public Health*, **120**(2), 115-124.
- III. Van Niekerk, A., Seedat, M., Menckel, E. & Laflamme, L. (2007). Caregiver experiences, contextualisations and understandings of the burn injury to their child. Accounts from low-income settings in South Africa. *Child: Care, Health and Development*, **33**(3), 236-245.
- IV. Van Niekerk, A., Menckel, E. & Laflamme, L. (Submitted). The barriers and enablers to paediatric scalding prevention in the home. An interview study in Cape Town.

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1. INTRODUCTION

Burn injuries are a serious global health threat to young children. This threat is disproportionately concentrated in South-East Asia and Africa (World Health Organisation, 2002). In sub-Saharan Africa alone it is estimated that between 18 000 and 30 000 children younger than age five die annually as a result of fire-related injuries (World Health Organisation, 2002). In addition, it is estimated that at least 300 000 and possibly as many as 17 million cases of childhood burn injuries occur in Africa each year (Hyder, Kashyap, Fishman & Wali, 2004). Most burns are caused by thermal energy including scalding and fires, with the minority caused by exposure to chemicals, electricity, ultraviolet radiation, and ionizing radiation (Forjuoh, 2006).

Apart from causing death and injury, thermal injuries may leave disabling scars not only to the skin or the body of the child, but also to her or his psyche. Burns are amongst the most traumatic injuries and may impose significant psychological, educational, social and future occupational impairments to the young child. The consequent adjustments may be exacerbated by a range of factors, including the circumstances, severity and site(s) of the injury, the qualities of the child's personality, and the access to supportive social relationships (Barss, Smith, Baker & Mohan, 1998; Rode, Millar, Le, Van der Riet & Cywes, 1989; Van Niekerk, Du Toit, Nowell, Moore & Van As, 2004).

As for other injury mechanisms, the prevention of burns requires an adequate knowledge of its epidemiological characteristics, associated risk factors, and information on the effectiveness of prevention and control efforts. However, while much has been accomplished in the prevention of fires and burns in many high-income countries (HICs), this cannot be said of the majority of low- and middle-income countries (LMICs) (Forjuoh, 2006), and of sub-Saharan Africa in particular (Hyder *et al.*, 2006). In LMICs, child injury problems are typically aggravated by the lack or unavailability of specialised intervention policies, staff and technologies (Barss *et al.*, 1998; WHO, 2003). South Africa, despite its democratic transformation, the strength of its emerging economy, and the widespread structural and social policy changes since 1994, continues to be challenged by the extent of its social and health problems (Policy Coordination and Advisory Services, 2003). This thesis seeks to expand the knowledge of childhood burns. These are reported to be a persisting concern, especially as manifest in low-income, marginalized South African communities. The thesis seeks to contribute to understandings on its epidemiology, the forms of its occurrence, its risks and contributors, and matters related to its preventability.

2. BACKGROUND

Globally, fire-related burns are responsible for about 265,000 deaths annually. Over 90% of fatal fire-related burns occur in low- and middle-income countries with South-East Asia alone accounting for over half of these fire-related deaths (World Health Organisation, 2002; 2006). In 2001, the rates of deaths from fires and burns for LMICs were 4 per 100,000 persons and 7 per 100,000 persons for males and females, respectively. The rates of flame deaths are greatly maldistributed with the overall rates in LMICs around 9 times higher than for HICs (4.53 compared to 0.51 per 100,000) (World Health Organisation, 2002).

A significant body of literature has contributed to understanding the epidemiological characteristics, risk factors, treatment, and prevention of burns in LMIC settings (Forjuoh, 2006; Hyder *et al.*, 2004). The accumulated research has been directed at the epidemiology of childhood burn injuries, the identification of the individual demographics and the circumstantial characteristics of burn injuries, some investigations into the mechanisms underlying these, and initial evaluations of prevention programmes (Forjuoh, 2006; Hyder *et al.*, 2004; Van Niekerk, 2006). The vast majority of these studies were descriptive using case reports, case series, or the cross-sectional design, compounding concerns about the knowledge of risk factors in these settings (Forjuoh, 2006).

Burn injuries and their predisposing factors have been well-studied in HICs, leading to a reduction in such injuries, largely through interventions and legislation to reduce risk exposure (Forjuoh, 2006). However, these injuries remain a significant public health concern in LMICs, where research and interventions to control exposure is lacking. The South African situation echoes that described for other LMICs (Albertyn, Bickler & Rode, 2006; Van Niekerk, 2006). In recent years, there has been an increase in the attention directed at the epidemiology of childhood injuries in South Africa (Van Niekerk, 2006; Van Niekerk *et al.*, 2004) and further afield across the LMICs contexts on the African continent (for example, in Ghana, Nigeria, Egypt, Morocco, Ethiopia), and elsewhere (Albertyn, Bickler & Rode, 2006; Forjuoh, 2006; Hyder *et al.*, 2004). These studies all indicate that burn injuries are a leading cause of injury in young children, especially those aged between one and five years.

2.1 SOUTH AFRICAN STUDIES

In South Africa, there has been an emphasis of clinic or hospital-based studies into burn injuries. These studies have tended to focus on the clinical profile of burn injuries, initial descriptions of the epidemiology of burn injuries, amongst both adults but mostly children, and preliminary discussions around injury prevention (Chopra, Kettle, Wilkinson & Stirling, 1997; Kibel, Bass & Cywes, 1990; Peden, 1997; Van Niekerk, 2006; Van Niekerk *et al.*, 2004; Zwi, Zwi, Smettanikov, Soderlund & Logan, 1995).

Despite the implementation in 1999 of a National Injury Mortality Surveillance System (NIMSS) (Burrows, Bowman, Matzopoulos & van Niekerk, 2001; Butchart, Peden, Matzopoulos *et al.*, 2001), extensive, reliable national level data on the extent and patterns of childhood burn injury mortality remains scant, making it difficult to define the risks, determinants, costs, and best practice prevention interventions for these injuries (Van Niekerk, 2006). Indications from an initial analysis of the NIMSS in Cape Town over a four year period highlight the ages that are at highest risk to sustaining a fatal burn injury (see Figure 1, Van Niekerk & Laflamme, forthcoming).

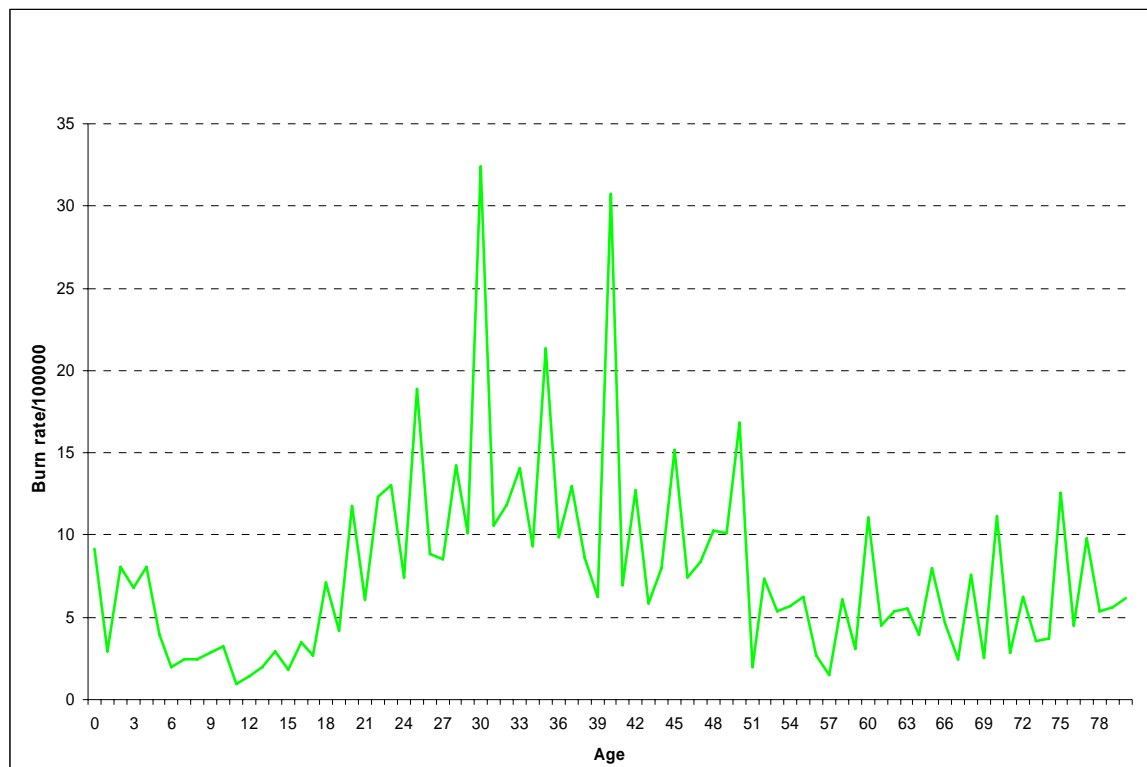


Figure 1. Age distribution of burn fatalities in Cape Town over the period 2001 to 2004

South Africa's burn fatality rate amongst children aged 14 years and younger, has been estimated at four times the number in HICs (Peden, 1997). These burn fatalities are due to exposure to open flames, which are reported to be especially dangerous and result in more severe injuries, as opposed to scalding. These deaths are concentrated amongst black¹ South Africans, take place in the home itself, and during early mornings and late evenings (Peden, 1997). There is a more acute scarcity of information for non-fatal burn injury with current data sources restricted to hospital and other sentinel sites located in a number of the major cities (Chopra *et al.*, 1997; Du Toit, Dragosavac, Van As & Rode, 2001; Van Niekerk *et al.*, 2004). A study in Cape Town provided some data on the epidemiology of non-fatal burn injuries (Peden, 1997). Injuries due to scalding accounted for about 70% of injuries, with some variation depending on urban or rural location, with open flames accounting for a further 20% of injuries. Injuries peaked during sleep times, mealtimes, and just after children returned from school.

These contributions have drawn attention to the occurrence of burn injury in South Africa (Albertyn *et al.*, 2006; Albertyn, Rode, Thomas, *et al.*, 1999; Chopra *et al.*, 1997; Du Toit, 1999; Hudson & Duminy, 1998). They provide initial descriptions of fatal and non-fatal burn injury, with limited if any examination of the mechanisms underlying their occurrence. It is expected that the scarcity of significant South African burn risk research has limited the impact of burn injury prevention and control initiatives (Van Niekerk, 2006). In order to develop effective injury prevention and control interventions, it is argued that the epidemiological work on burn injuries include more comprehensive information about the pertinent individual, familial, household, product and area risk factors, and consider the enablers and barriers to the control of these risks.

¹ In South Africa, the terms "African", "coloured" (referring to mixed heritage) and "white" refer to various population groups, with "black" used collectively to describe all people of colour. The use of these terms is contentious and does not imply acceptance of the racist assumptions on which these labels are based. It is recognized that these categories are a social construction that has served particular political purposes. It is not implied that such categories have any anthropological or scientific basis. The terms are used to reflect the differential manner in which the earlier South African policies of racial segregation, or *apartheid* had impacted on the lives of various groups of South Africans, and still does.

2.2 CONTEXTS AND CIRCUMSTANCES OF CHILDHOOD BURNS

A number of factors, with varying degrees of evidence, have been linked to a high burn injury risk in children (see for example: Daisy, Mostaque, Bari, *et al.*, 2001; Delgado, Ramirez-Cardich, Gilman *et al.*, 2002; Rossi, Braga, Barruffini & Carvalho, 1998; Petridou, Trichopoulos, Mera, *et al.*, 1998). This review of the contexts and circumstantial descriptions of childhood burn injury focuses on specific individual and familial circumstances, physical household environments, and living area risks emphasized in the international, and especially the LMIC literature.

Individual and family

Infancy and toddlerhood: Infants and toddlers from birth to 4 years of age have reported a disproportionately higher number of burns (Boukind, Chafiki, Terrab, *et al.*, 1995; Forjuoh, Keyl, Diener-West, Smith & Guyer, 1995; Iregbulem & Nnabuko, 1993; Kalayi & Muhammad, 1994; Rossi, Braga, Barruffini & Carvalho, 1998; Vilasco & Bondurand, 1995). For example, in a Nigerian study, injuries peaked in the first and second years of life, with a gradual decline thereafter (Iregbulem & Nnabuko, 1993). A Ghanaian study identified children younger than three years as most vulnerable to burn injuries (Forjuoh, Guyer & Smith, 1995). Descriptions from a number of LMIC settings such as Brazil, Côte d'Ivoire and India, reported this age group to account for nearly half of all childhood burns (Forjuoh, 2006). The number of burns was reported to then gradually decline until adolescence when burns began to increase again, with the onset in many settings of particular occupational exposures and increased involvement with heating appliances and flammable substances (Forjuoh, 2006).

Gender considerations. In 2002, the WHO estimated that 39837 female and 34011 male children and adolescents suffered fatal flame injuries (WHO, 2006). In many LMICs settings, females are at a higher risk because of their involvement in domestic activities near open flames and because of clothing styles (Hemeda, Maher & Mabrouk, 2003; Kalayi & Muhammad, 1994). Many country-specific studies have in contrast indicated a preponderance of male burn injuries (Daisy *et al.*, 2001; Forjuoh, 2006; Iregbulem & Nnabuko, 1993). For example, in a Ghanaian study male children up until the age of four years reported more burns in all categories, except contact burns, although with older children the trend equalized (Forjuoh *et al.*, 1995). A Nigerian study however reported a non-significant male preponderance of burn injuries amongst children older than a year (Iregbulem & Nnabuko, 1993). In

the Mediterranean and South East Asia settings the concentration on girl children is pronounced (Kalayi & Muhammad, 1994, WHO, 2006).

Scalding, flames and electrical burns. The primary mechanisms for burns are the result of scalding from hot liquids which accounts for at least one-third to one-half of all burns (Forjuoh *et al.*, 1995; Rossi *et al.*, 1998; Vilasco & Bondurand, 1995; Lari, Panjeshahin, Talei, Rossignol & Alaghehbandan, 2002; Boukind *et al.*, 1995). This was followed by hot objects and flame (Boukind *et al.*, 1995; Forjuoh *et al.*, 1995; Gupta, Gupta & Goil, 1992). Burns through clothing ignition were reported in India and other contexts and were partly attributed to the use of loose clothes made solely of cotton, a highly flammable fabric (Forjuoh, 2006; Kalayi & Muhammad, 1994; Kalayi & Muhammad, 1996). Electrical or chemical burns were found to be uncommon in LMICs (Forjuoh, 2006; Forjuoh *et al.*, 1995).

Pre-existing adaptive impairments. A study indicated some burned Ghanaian children to have had hearing losses, impaired vision, lameness secondary to polio, or epilepsy (Forjuoh, Guyer, Strobino *et al.*, 1995). Other developmental factors have been more tentatively reported on, and include specific impairments such as hyperactivity, adaptive problems and psychiatric disorders (Werneck & Reichenheim, 1997). However, others have found that individual burn history consistent with theories about burn proneness and hyperactivity were not related to childhood burn injury (Petridou *et al.*, 1998).

Socio-economic status. Some evidence has linked a number of familial factors to burn injuries amongst children. They include low socio-economic status of the family (Petridou *et al.*, 1998; Rossi *et al.*, 1998) low education level of the mother (Daisy *et al.*, 2001; Forjuoh *et al.*, 1995; Petridou *et al.*, 1998; Werneck & Reichenheim, 1997) parental alertness to burns (Daisy *et al.*, 2001), psychosocial stress in the family and multiparity (Rossi *et al.*, 1998). There is some evidence that additional familial factors may include residents per room (as an indicator of overcrowding) (Daisy *et al.*, 2001), a history of family conflict, and unemployment (Barss *et al.*, 1998). Alcohol consumption and cigarette smoking amongst parents or other adults is also thought to consider an injury risk (Boukind *et al.*, 1995; Werneck & Reichenheim, 1997).

The significance of a history of burn injuries to a sibling and sibling death due to burns is not clear (Forjuoh, Guyer & Smith, 1995), with a recent study indicating that individual burn history was not a risk factor for burn injury (Petridou *et al.*, 1998). In the latter study, Petridou and colleagues also report that sibship size, birth order, and number of residents were not related to the childhood burn injuries in their study (Petridou *et al.*, 1998).

Household environments

The home has been identified as the most common scene for sustaining a burn injury (El-Badawy & Mabrouk, 1998; Hudson & Duminy, 1995; Iregbulem & Nnabuko, 1993; Kalayi & Muhammad, 1994). Related features of the home environment may include the use of flammable household building materials in the construction of the home (Delgado *et al.*, 2002), the storage and use of fossil fuels for heating and lighting (Forjuoh *et al.*, 1995), the lack of clear demarcations of cooking or washing areas (Delgado *et al.*, 2002), and the number of rooms (Petridou *et al.*, 1998). In addition, many synthetics used in furniture, drapery and building materials emit highly toxic fumes when ignited, including carbon monoxide and hydrogen cyanide (Daisy *et al.*, 2001; Delgado *et al.*, 2002). A flammable housing construction, often with only a single exit, together with almost continuous use of open flames for cooking, heating and illumination comprise a hazardous combination. Lightning strikes may also be a hazard, especially for farming families in rural areas who may be exposed in small flammable housing or field huts during storms (Barss *et al.*, 1998).

Heating, cooking and lighting equipment may constitute important injury risks in low-income settings (Barss *et al.*, 1998). The design, location, and use of this equipment, especially open-candles, portable stoves, and homemade bottle lamps for lighting are hazardous, especially when situated on unstable surfaces. The use of portable kerosene and gas stoves and the storage of flammable substances in the home, are also considered injury risks (Forjuoh, 2006; Kalayi & Muhammad, 1994). Where volatile petroleum based fuels have recently been introduced for domestic use or in small industries, flash burns are a serious hazard for the domestic user, and catastrophic fatal explosions can occur in workplaces. Clothing and other fires can start when leaking fuel ignites or when a stove sitting on an uneven floor is overturned (El-Badawy & Mabrouk, 1998; Kalayi & Muhammad, 1994). Cigarettes, particularly their composition, have also been implicated in many burn injuries. The length of time that they smoulder and the temperatures at which they burn are characteristics that may influence the ignition of mattresses (Liao & Rossignol, 2000).

Vulnerable neighbourhoods

The socio-economic characteristics of a community, variously defined according to census tracts, suburbs or wards, are reported to contribute to local access to goods, products and services, the features of the built environment, the level of residential mobility, and social norms. Recent reviews suggest that community

characteristics can, independently from individual characteristics, impact upon population health. Lower social positions, at both the individual and living-area level, are generally associated with a higher risk of specific forms of injury, one of which is burns (Cubbin & Smith, 2002; Dowswell & Towner, 2002; Diderichsen, Laflamme & Hallqvist, 1999). A recent review identified a few studies that examined the relationship between either individual or community aggregated socio-economic status and burn mortality or injury (Cubbin & Smith, 2002). These studies consistently indicated burn injury or mortality to be inversely associated with individual or community socio-economic indicators (Istre, McCoy, Osborn, Barnard & Bolton, 2001; Locke, Rossignol & Burke, 1990). The examination of this relationship with respect to other variables such as individual characteristics, such as age or gender, is limited. In South Africa, the impact of individual or contextual socioeconomic characteristics on burn injury has not been substantially researched although it is anticipated that area characteristics have some impact on burn injury exposure.

2.3 PREVENTION MEASURES

Interventions have been directed at the prevention of fire and to a more limited extent scalding injuries, and include smoke detector promotion programmes, tap water temperature reduction, and parent and child education (DiGuisseppi & Higgins, 2000; Harvey *et al.*, 2004; Towner *et al.*, 2001; Warda *et al.*, 1999). A number of these interventions have demonstrated some success, but very rarely in actual reductions in child burn morbidity (Warda *et al.*, 1999).

Based on available evidence, it appears that educational strategies and publicity campaigns have tended to have a short-term impact, unlikely to be sustained without repetition. Focused educational interventions have had some success in lowering burn incidents and their severity (Liao & Rossignol, 2000). Critics of the effectiveness of educational approaches have proposed a focus that still concentrates on changing individual decision-making, but also encompass a broader range of recipients, including professionals, practitioners, policy-makers and the at-risk children and families themselves.

It is passive strategies directed at the home environment, such as smoke detectors, reducing water temperature, fire-safe cigarettes and reduced flammability of clothing products, that have received significant support in the international literature (Liao & Rossignol, 2000; Towner & Errington, 2004; Towner *et al.*, 2001; Warda *et al.*, 1999), however, they have had limited

application in South Africa. Other potential environmental interventions that may be significant in the South African context include the development of safe housing and safe housing standards, firebreaks between informal housing, access to water in informal settlements, and fireguards. Legislation controlling clothing and cigarette flammability, stove design, and the lowering of tap water thermostat settings, have been implemented or recognised as promising prevention interventions (Liao & Rossignol, 2000).

Intervention barriers and hindrances

The implementation of these and other childhood injury control interventions continues in general to face a range of hindrances (Barss *et al.*, 1998; Brannan, 1992; Gaerling & Gaerling, 1993; Kendrick & Marsh, 1999; Peterson & Saldana, 1996; Thompson *et al.*, 1998). The childhood injury prevention literature includes a distinct body of research on the barriers, and to a lesser extent the enablers, particular to the prevention of childhood injury occurring in the home. This body of work has for example examined the roles of service affordability, awareness, cultural values and the attitudes of providers, to the use of child safety resources by impoverished communities (Barss *et al.*, 1998; Brannan, 1992; Peterson & Saldana, 1996; Saluja *et al.*, 2004; Maclure-Martinez & Cohn, 1996). So too, but in a far more limited fashion, has been the examination of child safety enablers, such as caregiver supervision, reported as a key enabler but also in its absence, as a contributor to unintentional injury (Saluja *et al.*, 2004). There is less if any investigation or discussion on the enablers or barriers specific to the prevention of childhood scalding.

2.4 SUMMARY OF KNOWLEDGE AND RELEVANCE OF RESEARCH

In recent years burn injuries have been reported as a grave concern amongst young children in low-income contexts, including that of South Africa. Despite this recognition, there are incomplete descriptions of the individuals and circumstances of occurrence of these injuries. In South Africa, the evidence accumulated so far, though scarce, echoes the concerns raised in the international literature. There remains a paucity of systematic information on childhood burn injuries and their causes, information essential for the development of prevention interventions (Van Niekerk, 2006).

Recent studies have linked a number of factors to the occurrence of burns amongst children. These include amongst others, the child's age and gender, family education, poor living conditions and overcrowding. There are initial accounts of the contribution of environmental conditions, such as the use of various fuels for heating, and cooking, and various heating and cooking appliances.

Finally, there is an emerging knowledge base on evaluated burn prevention measures, concentrated in HICs, but scant information on prevention efforts in LMICs and South Africa in particular. There is little if any data on the factors that may hinder or enable burn prevention.

3. AIMS

The overall aim of this thesis is to identify the characteristics, patterns and geographic determinants of childhood burn injuries, exploring caregiver accounts of these injuries and their immediate and remote mechanisms, and identifying the barriers and enablers to their prevention in the home.

The studies forming the thesis will focus on situations in Cape Town and the surrounding province of the Western Cape, and include the following specific objectives:

- to identify typical patterns and circumstances of paediatric burn injuries leading to hospitalisation (Study I);
- to assess the effect of various characteristics of the living area on paediatric burn injuries (Study II);
- to highlight caregiver understandings of the injury to their children, considering both injury determinants and their preventive means (Study III); and
- to determine enablers and barriers to the creation of safe environments, the implementation of safe practices and the use of products that control or prevent childhood burn injuries in the home (Study IV).

4. MATERIALS AND METHODS

4.1. SETTING

The thesis comprises four studies, all of which were implemented in either the Western Cape province, or its capital, the City of Cape Town, close to the southernmost point of South Africa (see Figure 2). The Western Cape is one of nine provinces and comprises 9.7% of the total South African population. The total land area is 129,370 km², about 10.6% of the country's total. It is roughly the size of England. The Western Cape Province's total GDP is the third-highest contribution to the country's total, at 14.6%. In 2004, an estimated 16.9% of the working population was unemployed, giving the Western Cape a substantially lower unemployment rate than the other provinces and the national rate of 27.8% (Statistics South Africa, 2004). There are just over 4.5 million people and 1,173,302 households residing in the province. The population density is 35.0/km² while the household density is 9.1/km. The average household size is 3.9. The population is relatively youthful, with 27.3% under the age of 15, 19.4% aged from 15 to 24, 32.9% from 25 to 44, 15.2% from 45 to 64, and 5.2% aged 65 years and older. The majority of this population resides in urban areas (89%), compared to the national average of 54% (Statistics South Africa, 2004).

The City of Cape Town is the urban centre of the province and one of six metropolitan areas in South Africa. Cape Town covers an area of just under 2500 square kilometres. In 2001 it was estimated that the city was home to 2.9 million residents, with 23.1% (or 668 900) aged 12 years and younger, and 71.9% aged between 15 and 64 years. There is on average, 0.9 children aged 12 years and younger in each household. Just over 48.1% of the population comprised 'coloured' residents (i.e. of mixed descent), 31.7% black African, and 18.8% white individuals. The racial makeup of the province is 53.9% coloured, 26.7% black African, 1.0% Indian and Asian and 18.4% white. The Western Cape is one of two provinces where the majority are coloured. In South Africa as a whole, black Africans constitute more than three-quarters of South Africa's total population with 79% or 35.4-million, while whites make up 9.6% (4.3-million), coloureds 8.9% (4-million), and Indians/Asians 2.5% (1.1-million) (Statistics South Africa, 2004).

An estimated 41.4% of the Cape Town population speak Afrikaans, 28.7% Xhosa and 28.0% English. Over 18.4% of the 777 393 homes in the City

comprise informal shacks. The City of Cape Town is the nation's Legislature. The iniquitous apartheid laws were drafted for the country in the City of Cape Town Parliament between the 1950s and 1970s. These laws limited black African migration to the city and enforced the separation of white and coloured people. The racial division of living areas ended in 1990, however racial and socio-economic differences between areas remain marked. A huge migration of black African people followed the easing of racial laws, and the city has grown vastly in the last decade, with one third now Xhosa-speaking or black African (Statistics South Africa, 2004).



Figure 2. Map of Cape Town and the surrounding Western Province

4.2. DATA SOURCES

As shown in Figure 3, the thesis is structured around four studies. Two (Study I and II) utilize an already available injury register data in combination with South African census data. A further two studies are based on study specific individual semi-structured interviews conducted with the caregivers of recently injured children (Study III) and thereafter, with both caregivers and other stakeholders (Study IV).

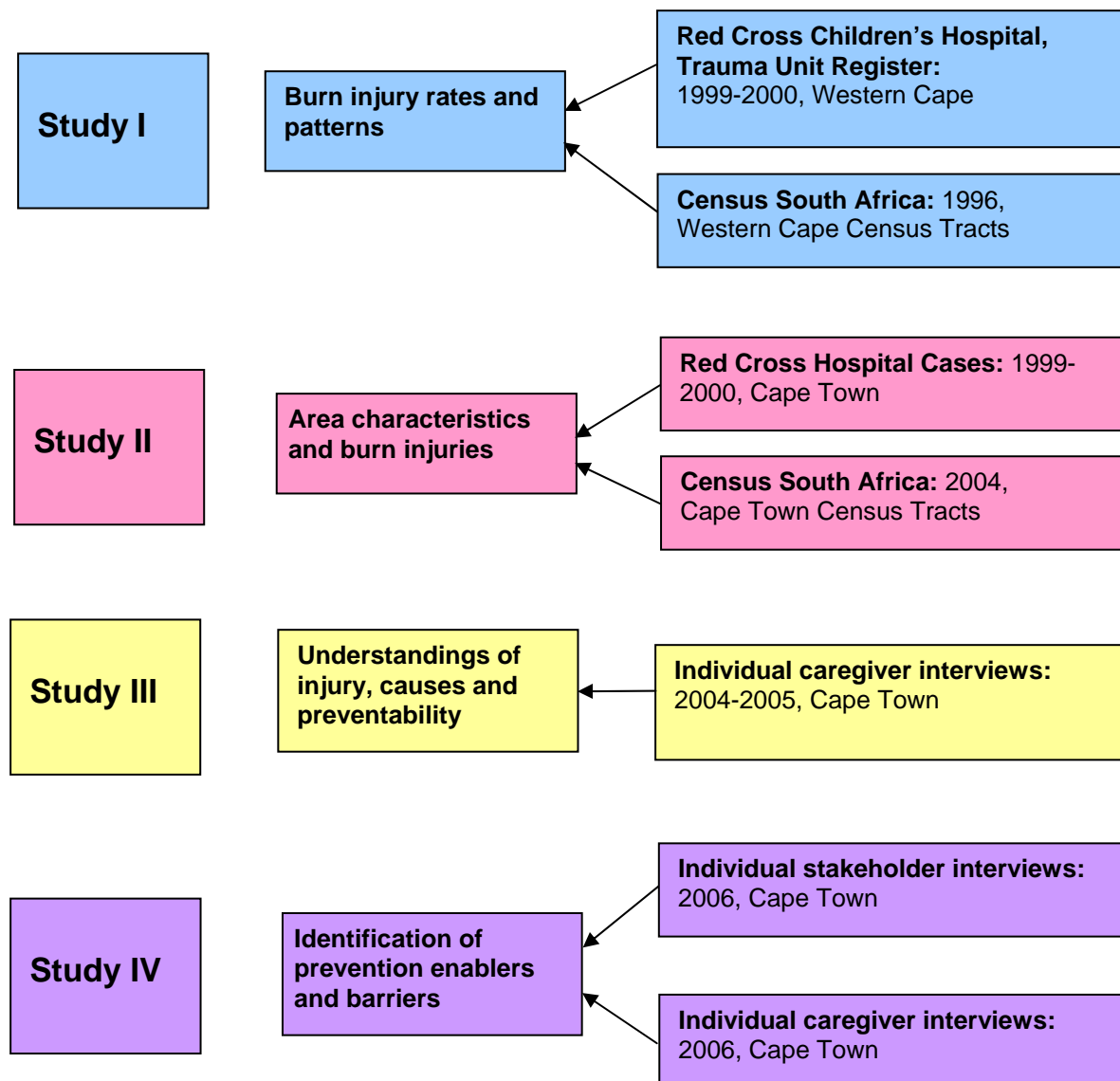


Figure 3. Objectives and data sources for each study respectively

4.2.1 Register data

Burn injury data (for the period 1st of January 1999 to the 31st of December 2000) were extracted from the trauma unit register located at the Red Cross Children's Hospital in the City of Cape Town (Rode *et al.*, 1989). The Red Cross Children's Hospital is a public institution, and since 1999, the only such hospital to which moderate and severe burn injured children aged 12 years and younger are referred to in the province of the Western Cape. Moderate to severe injuries are those that involve more than 10% of the body surface area by at least a second-degree burn (where the epidermis is partially burnt through and blistered). In addition, all burns involving the face, eyes, ears, hands, feet, perineum, all inhalation injuries, circumferential burns, electrical injuries, neonatal burns, and burns in patients with serious pre-existing diseases are considered to be moderate to severe injuries (Rode *et al.*, 1989). These injuries typically result in hospitalisation although many patients are also treated on an outpatient basis.

The register intake form has been standardized since 1991; primarily to serve as a basis for primary care services and, eventually, the development of injury prevention interventions. The conditions for inclusion in the register is that a child, aged 12 years and younger, had presented at the emergency reception to see a doctor, even if no medical treatment was prescribed.

The Red Cross register allows for detailed data capture in its emergency care unit (see Appendix A: Trauma Unit Register). The register includes a range of items, some of which are required for an International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10, 1994) burn injury diagnosis: the cause of injury (7 categories: flame, fluid, heat contact, electrical, chemical, explosion and other), place of occurrence (10 categories: own home inside, own home outside, other home inside, other home outside, road/pavement, school/crèche, public place, sport, other, unknown), affected anatomical site (40 categories, see Appendix A), and injury severity (using the four Abbreviated Injury Scale categories: minor, moderate, severe, mortal). Additional observations may be made during the patient examination and history taking, but there is no attached guideline for this and the completion of this section appears to lie at the discretion of the examiner. Data are collected at the hospital's emergency care unit, where the nursing staff complete the form based on the initial clinical assessment and an interview with one of the accompanying adults (usually a parent).

The register does not include cases that are referred to the private health care system. Indications are that the moderate to severe cases treated in private health

care hospitals in Cape Town and the surrounding Western Cape tend to be minimal. This is due to firstly, the respected reputation of the Red Cross Children's Hospital's Burn Unit, and secondly, the significant financial costs of burn treatment in the private health care system, estimated to be 40% greater than that in the public health care system. In addition, the register does not include the fatal burn injury cases that are referred directly to the state mortuaries. Between 2001 and 2004, the City of Cape Town, for which there is full fatal injury coverage, reported 111 burn fatalities to children aged 12 years and younger (Van Niekerk & Laflamme, forthcoming). The Red Cross register has itself additional limitations that affect the quality of the dataset, with missing data important for Study I, notably information relevant to the description of the burn injuries, and for Study II, both descriptive information and the address information required to geographically locate injuries.

4.2.2 Census data

The South African Census is the most exclusive and comprehensive socio-economic and geographic database for both the Western Cape (Study I) and Cape Town (Study II). Study I uses the Census data for 1996 to provide a regional population estimate for the Western Cape. The population's annual growth rate for the province between 1996 and 1999 was estimated at 1.5% per annum regardless of age. Adult or child specific growth rates for the province are also not available.

Study II used data from the South African Census for 2001. That census provided information on the 683 demarcated suburbs for Cape Town. The analysis was restricted to 634 of these, excluding areas with less than 10 children, most of which were nature reserves, industrial parks, recreational areas and small holdings with restricted child populations. This was done on arbitrary grounds but in order to ensure the inclusion of all areas that met the criteria of a minimum child population and thus ensure that most living areas were included as a basis for future population-based injury prevention programs.

The relevant Census variables descriptive of the social and economic living circumstances of Cape Town were considered. These variables included for example: the proportions of children, home ownership, proportions of female headed households, crowding and child dependency proportions for each suburb.

4.2.3 Interviews

Studies III and IV were interview-based so as to explore caregiver and stakeholder experiences and accounts of the burn injury and issues related to its preventability. These individually administered semi-structured interviews allowed for firstly, an exploration of the dimensions of a burn injury from the caregivers' direct experience (Study III), and subsequently, an exploration of accounts again from the perspectives of caregivers and other stakeholders, of the hindrances and enablers of scalding prevention in the home (Study IV). Semi-structured interviews are useful and appropriate because they provide data that address a wider range of factors contributing to the understandings of burn injury and its preventability than administrative or surveillance registers do (Gaskell, 2000). Given the study questions, these interviews allowed us to turn directly to parents themselves. The semi-structured interview is more appropriate than a questionnaire, given how delicate the questions for Study III are and the lack of knowledge about how parents of injured children react when having to talk about the injury event. The interview also allows for both Studies III and IV a greater exploration of injury and prevention phenomena not previously investigated. However, these interviews are often a time-consuming approach to data gathering, their reliability may be difficult to demonstrate, and the data quality is typically dependent on the skill and sensitivity of both the interviewer and the analyst.

4.3. INDIVIDUAL STUDY DESIGN, MATERIAL AND METHODS, AND ANALYSIS

The study designs and methods of the four studies are described in greater detail below.

4.3.1 Study I

Distribution, typical patterns and circumstances of burn injuries in the Western Cape

Study I describes the incidence and patterns of childhood burn injuries in the Western Cape. Burn injuries sustained by children aged 12 years and younger and registered over January 1999 to December 2000 at the Red Cross Children's Hospital were analysed. Of the 1276 burns cases registered over this period, 73 were excluded, 36 because the children were older than 12 years and an

additional 39 cases because of several missing entries relevant to the description of the injury.

To test for the effect on burn injury occurrence of age groups, gender, population group and season, risk ratios with 95% confidence intervals were measured, using as reference groups, toddlers (two year olds), boys, Africans and the winter season. Denominators were based on a regional population estimate for the Western Cape, derived from the 1996 Census data, which was obtained from the South African Municipal Demarcation Board (2002).

Typical burn injury patterns were identified employing a classification method based on the use of two multivariate analysis techniques applied in sequence: the Factorial Analysis of Correspondence (FAC) and the Hierarchical Ascendant Classification (HAC) (Benzécri, 1985; Fénélon, 1981; Greenacre, 1984). These are data-reduction techniques that focus on the categories of variables. The HAC classifies events into a number of (unempty) classes in such a way that every case belongs to one and just one class. It maximizes the variance between classes and minimizes it within classes. The inter-class inertia is a measure of the separateness or distinctness of classes. The higher the inter-class variance, the greater is the difference between classes. The intra-class variance is the measure of the internal consistency of a class, i.e. its compactness, or the degree of similarity between the injury events and circumstances that form the class. The HAC was performed on the first four factors identified by the FAC, i.e., using the coordinates of the burn injuries analysed on the first four factorial axes. This procedure ensures that any classification is structured on the most significant interrelations between the categories of the variables of interest.

4.3.2 Study II

Area characteristics and determinants of hospitalized childhood burn injury in the City of Cape Town

Study II is ecological and examines how area characteristics relate to childhood burn injuries in the City of Cape Town (reference periods 2001 and 1999-2000 respectively). The study is an ecological one using factor analysis to identify the associations between contextual factors. Two data sources were used in the study. Based on the South African Population Census of 2001, 15 area descriptors were extracted at the suburb level (n=634 suburbs for the City) that were found under the following domains:

- (1) population socio-demographics (including proportions of children, young heads of household, low education, ethnic composition, formal employment, home ownership, and recent migration);
- (2) household structure, constituents and density (proportions of female headed households, formal employment, crowding and child dependency); and
- (3) dwelling types and services (proportions of informal dwellings, paraffin use, access to piped water and access to toilet facilities).

At the time of Study II, the Census 2001 description was the only comprehensive database on geographic areas available for Cape Town, temporally the closest approximation of the 1999 to 2000 period, and therefore the most accurate available indication of the socio-physical situation in Cape Town for that period (Statistics South Africa, 2001a; 2001b). Statistics South Africa utilised an enhanced place name database for Census 2001, an improvement on the 1996 place name database. All place names were audited (with new names added and invalid names renamed) and coded, with main place name and sub place (i.e. suburb) names assigned to each enumerator area. A preliminary independent demographic analysis of the 2001 Census results suggest that the final figures probably represent, among others, an underestimate of children under the age of five; an underestimate of men relative to women; and an underestimate of the white population (Statistics South Africa, 2004). There is however no indication that these underestimates are biased towards particular suburbs.

The 15 characteristics were analysed simultaneously by factorial analysis using their prevalence (in %) at the suburb level ($n=634$). This was realised by means of an exploratory factor analysis using the principal axis method. Factor scores were estimated by creating linear composites of the observed variables, that is, factor scores were computed by adding together the suburbs' optimally weighted scores on each of the observed variables.

Thereafter, suburb contextual characteristics and burn injury were linked based on the three factors emerging from the exploratory factor analysis. Suburbs were ranked by factor score, split into three levels (i.e. the specific value of a factor calculated for a particular sampling unit, which is represented by the weighted sum of the variables for that sampling unit).

For the period January 1999 to December 2000, a total of 1131 cases of moderate to severe paediatric burn injuries (children aged 12 years and younger) were registered for the City of Cape Town (see Figure 2). Of these 208 (18.4%) were excluded because of missing or incomplete address information relevant to

the identification of the suburb area in which the injury was reported, with 923 injuries considered in the study.

Odds ratios (ORs) with 95% confidence intervals (CIs) were compiled by logistic regression and used to estimate the association of the three contextual dimensions on childhood burn injuries. The reference group for each dimension was the most favourable level, i.e. fair housing conditions, low child dependency, and low socio-economic barriers.

4.3.3 Study III

Caregivers' experiences, contextualisations and understandings of the burn injury to their child

Study III involved individual semi-structured interviews with caregivers of child burn injury patients who had been hospitalised for a moderate to severe burn injury in Cape Town in 2005. Thirteen caregivers who were responsible for the care of the child patient at the time of the injury; whether present or in close proximity to the burn injury event, participated in the study. Three caregivers were approached and interviewed between March and April 2005, and the others over a two- day period every two to three weeks between September and December 2005. The caregivers were interviewed as soon as they agreed to participate in the study, usually within one to three weeks of the incident.

The individual semi-structured interviews were conducted on the basis of an interview guide consisting of open ended questions that defined the area to be explored, at least initially. The guide comprised three main questions that explored the caregiver's understanding of the injury event and its causes, the structural factors associated with the event, and their reaction to the burn of their child and its preventability. From these questions the interviewer or interviewee was able to pursue emerging ideas and experiences in more detail. Interviews were conducted in either English or Afrikaans, two of the three dominant languages of the city. Each interview took between 25 and 50 minutes.

All interviews were audio-recorded, transcribed verbatim and analysed using a general procedure operationalising grounded theory principles with core content analytic steps. The interview transcription and a short memo comprising observational interview notes provided the textual data for the analysis. Each transcript was first examined within two weeks of the interview. In the process of a number of readings, the principle investigator openly coded each transcript, thereafter categorising codes according to higher order, conceptual categories and sub-categories relevant to the research questions. A second member of the

research team independently examined selected transcripts in an attempt to validate the categorising method. The lists of categories, sub-categories and codes were then discussed within the research team, with points of convergence accepted and divergence discussed further and reconciled. Adjustments were made on agreement that the category or code in question had some relevance to the research questions. Data samples were thereafter linked to selectively illustrate the categories, sub-categories and codes.

4.3.4 Study IV

Stakeholder representations of the barriers and enablers to the prevention of childhood burn injuries in the home

Study IV documented accounts by thirteen caregivers and eight burn prevention research, policy or practitioner professional stakeholders of paediatric scalding counter-measures, and hinders and enablers to these (see Tables 1 and 2) . The study involved individual semi-structured interviews with caregivers (all mothers except for one grandmother) from low-income Cape Town neighbourhoods identified as high risk (Study II).

Table 1. Demographics of caregivers participating in Study IV

Suburb	Age	Number of children	Children Ages
Manenberg	30	2	3 months, 3 years
Manenberg	20	1	2 years
Manenberg	55	1	1year and 6 months
Manenberg	32	4	13years, 9 years, 4 years, 6 months
New Fields Village	34	3	14 years, 4 years, 6 years
Tarentaal, Strand	39	4	18 years, 14 years, 12 years, 6 years
Strand	29	2	12 years, 3 years
Nomzamo	31	2	12 years, 1 year
Nomzamo	24	1	6 years
Nomzama	34	2	19 years, 6 years
Nomzamo	30	3	9 years, 6 years, 2 years
Asane Village	37	2	19 years, 1 year and 11months
Asane Village	35	3	18 years, 14 years, 4 years

Table 2. Demographics and relevant experience of stakeholders participating in Study IV

Organisation	Organisational Affiliation, Profession	Experience
Child Accident Prevention Foundation; Red Cross Children's Hospital	Programme Coordinator; Chief Social Worker	Burn prevention education and research. Co-ordinator of Training, Burn Prevention; Burns Research
Child Accident Prevention Foundation; Red Cross Children's Hospital	Training Coordinator; Medical Social Worker	Burn prevention education, research and advocacy
Western Cape Department of Social Capital	Community Health Worker Coordinator; Nurse	18 years as a school nurse
Western Cape Department of School Health	School doctor	27 years clinical experience; consultant at Developmental Clinic at Red Cross Children's Hospital
Medical Research Council	Project Manager; Research psychologist	Child Injury Prevention Home Visitation Project
Medical Research Council	Research Intern	Child Injury Prevention Home Visitation Project
Metropolitan District Health Service	School doctor	Paediatric specialist
Western Cape Department of Social Capital	Community Health Worker Coordinator	Nurse for forty years

The interviews were based on an interview guide that was piloted in August 2006. It was structured around the illustration and presentation of circumstances surrounding the occurrence of paediatric scalding injuries typical for the Cape Town area (Studies I and III). Synopses of the two common sets of situations linked to scalding amongst infants and toddlers were prepared and used to guide an artist's development of two sketches of linked circumstances. The sketches focused on the circumstances surrounding those injuries rather than on the very injurious event itself, the illustrations depicting particular child and caregiver activities, and environmental hazards associated with the occurrence of childhood burn injury (see Figure 4). Each sketch was accompanied by a limited text description.

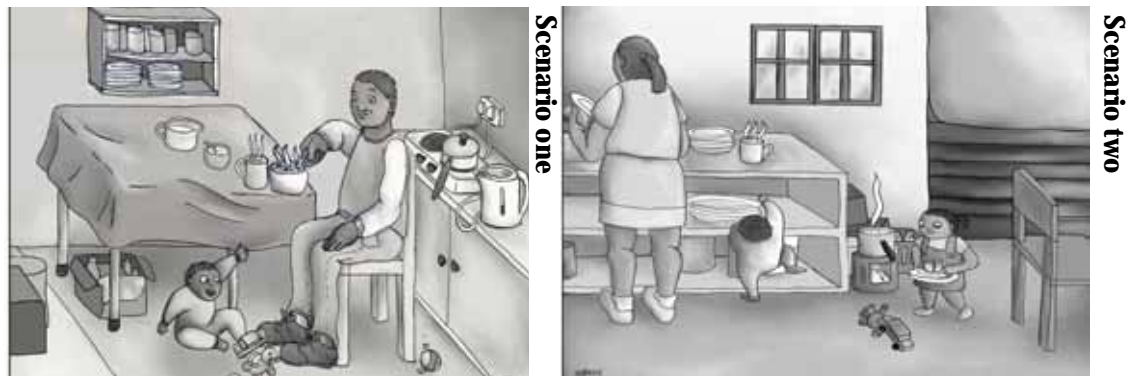


Figure 4. Scenarios depicting the circumstances of scalding injuries in Cape Town

After an introduction to the study, the respondent could choose which sketch to respond to first. Thereafter, the study questions were presented in the following order: 1) the interviewee's ideas about prevention measures or actions particular to the two scenarios, and their identification of 2) hinderers and 3) enablers to these measures. In addition, the interviewer probed the contributions of: 1) home design and layout, 2) home equipment and appliances, and 3) the use of this equipment in hindering or alternately enabling counter-measures to the two scenarios. Minor adjustments to accommodate the appropriateness of the questions to the different informant groups were ensured. The lead researcher interviewed informants from August to October 2006 with interviews lasting between 25 and 50 minutes. They were interviewed as soon as they agreed to participate in the study, or within a week.

The interviews were audio-recorded, transcribed verbatim and analysed using core content analytic steps (Babbie, 2001; Miller & Brewer, 2003; Patton, 2002). The interview transcription provided the textual data for the analysis. The transcripts were independently examined by the three researchers, who first looked at scenario one and then checked if the steps would hold for scenario two, which it did. The data was analysed in the same form of content analysis for all three study questions. The interview texts were read a number of times to identify counter-measures, related barriers or facilitators proposed for burn scalding scenario one and two respectively. The researchers identified relevant keywords or phrases, emerging themes, and finally categorised these themes according to higher order domains of counter-measure, barrier or enabler. All points of convergence and divergence were discussed, with the latter discussed further and adjustments made on agreement that the theme or category in question was a distinct and relevant description or domain of counter-measure, barrier or enabler respectively. The labeling of higher order domains was informed by the researchers' collective experience in injury studies in public health.

5. SUMMARY OF MAIN RESULTS

STUDY 1

What is the distribution and patterns of childhood burn injuries in the South African province of the Western Cape?

The distribution of burn injuries across age group, gender and population group

Burn injury incidence are particularly high for toddlers (15.8/10 000 child-years/c-y) and infants (14.6/10 000 c-y), for boys (7.0/10 000 c-y), and for African children (11.4/10 000 c-y). Differences between genders are more pronounced among younger and older age groups.

Seasonal variations

Burn injury incidence was highest in winter (1.7/10 000 c-y) but only significantly greater than the rate in summer (1.3/10 000 c-y).

Typical circumstances of occurrence of childhood burn injuries and distribution across population groups

Table 3 highlights the injury descriptors that are typical for each of the four classes identified respectively. The descriptors listed for any one class are significantly over-represented in the classes ($p < 0.05$) and contributed to its formation. The last column informs about corresponding proportions all injuries (and classes) aggregated. The classes were labeled: “infant scalding” (class 1), “toddler scalding” (class 2), “injuries among older children with an over-representation of flame-related burns” (class 3) and “other causes of burns sustained to the head and neck region” (class 4).

Table 3. Description of the four burn injury patterns

Burn injury pattern	Significant descriptors	Proportion in the class		Proportion (%) of all injuries, N=1201
		n	% in class	
Infant scalding	Infant	413	83.5	36.3
	Scalding		95.4	73.4
	Spring		45.3	26.1
	Upper body		53.3	35.5
	Inside		95.6	85.1
	Male		63.4	58.2
Toddler scalding	Scalding	372	94.9	73.4
	Toddlers		39.5	19.9
	Autumn		45.2	24.8
	Summer		39.5	21.7
	Inside		97.8	85.1
	Late toddler		21.0	10.4
	Lower body		45.7	30.4
	Female		48.1	41.8
	17h00-22h00		55.4	49.1
Burns among older children with an over-representation of flame-related burns	Flame	245	49.8	14.1
	23h00-10h00		42.0	16.1
	Preschool		40.8	15.7
	School-aged		40.8	17.6
	Lower body		52.6	30.4
	Winter		46.1	27.3
	Female		50.6	41.8
“Other causes” of burns sustained to the head and neck region	Other causes	171	68.4	12.5
	Outside		62.0	14.9
	Head and neck		60.2	34.1
	School-aged		29.8	17.6
	Late toddler		19.9	10.4
	Male		71.9	58.2
	Flame		22.8	14.1

Differences between population groups

There is no significant association between population group and burn injury class, i.e. children from the population groups are represented in expected proportions in all classes. However, altogether the burn injury risks for coloured (RR=0.50; CI: 0.44-0.60) and white children (RR= 0.11; CI: 0.08-0.15) were significantly lower than that for African children.

STUDY II

Do living area conditions have an impact on childhood burn injuries in the City of Cape Town?

The clusters of socio-physical area attributes representing Cape Town's citizens' living circumstances

The factor analysis identified three factors explaining 60 percent of the common variance in the data (comprising 15 variables and 634 suburbs). The correlations between factors were -0.25 for factors 1 and 2, 0.14 for factors 1 and 3, and 0.13 for factors 2 and 3. The first column of Table 4 highlights the label used for each factor and the variables related to each one of them. Factor 1, labeled "housing conditions" emphasised the four variables describing dwelling types and services, and the association to ethnicity. Factor 2 reflected an emphasis on high child concentration and densities, with an inverse association to migration, and labeled "child dependency". Factor 3 was labeled "socio-economic barriers" to reflect the difficulties faced by female-led households, unemployment, and the pressures of owning a house.

Table 4. Relationships between contextual exposure and burn injury (n=923)

Contextual exposures (variables forming the exposure)	Level of exposure (factor scores)	Burn injury OR (95% CI)
Housing conditions Informal dwelling; paraffin use; piped water(-); toilet facilities (-)	Fair ($\leq -0,44$)	1.00
	Poor ($-0,44$ to $-0,26$)	2.39 (2.07-2.75)
	Impoverished ($\geq -0,26$)	3.33 (2.84-3.91)
Child dependency high child numbers; child density; inverse migration (-)	Low ($\leq -0,57$)	1.00
	Medium ($-0,57$ to $0,34$)	0.94 (0.75-1.17)
	High ($\geq 0,35$)	1.80 (1.43-2.27)
Socio-economic barriers Employment; female headed households (-); home ownership (-)	Low ($\geq 0,34$)	1.00
	Medium ($0,32$ to 0)	1.94 (1.64-2.29)
	Severe ($\leq -0,42$)	3.61 (3.01-4.33)

Each factor was transformed into an additive index and broken down into three exposure levels. The suburbs were allocated to these levels based on their factor scores (see second column in Table 4). The reference group for each dimension was the most favourable level, i.e. fair housing conditions, low child dependency and low socio-economic barriers. For the factor socio-economic barriers, the choice of the reference group was inverted so as to have the best possible situation or level as the reference group here too.

The impact of these clusters of disadvantages on childhood burn injury

Each factor had a significant impact on burn injury risk level with increased levels of exposure leading to increased risk of burns. Table 4 shows the odds ratios with 95% confidence intervals for the effect of each level of the three dimensions on childhood burn injury. There is a graded relationship between housing conditions and childhood burn injury where the magnitude of the exposure, i.e. impoverished housing conditions, has a graded impact on the odds of burn injury. For child dependency there is a significantly increased risk of burn injury level, but this is only at a high level of exposure. Finally, there is also a graded relationship between socio-economic barriers and burn injury.

STUDY III

What are caregivers' experiences, contextualisations and understandings of the burn injury to their child?

Caregiver understandings of the injury event to their child can be separated into the child's activities, the activity undertaken by the caregiver at the time of the event, and the environmental hazards coming into play. Remote factors associated with the event were related to the individual caregiver, her family circumstances, the area's living conditions, and the cultural context. The caregiver's thoughts of the future focused on injury avoidance or control and encompass the injury event factors and to a more limited extent remote contributors. Her suggestions focused on the isolation of heat sources, caregiver supervision, and environmental renovations (see Figure 5).

Caregiver understandings of the burn injury event and its causes

Typically, children came close to the source of danger either in the course of movements done while engaged in age-based activities or during family-related chores. The caregivers for their part were either in the vicinity of the injury event, combining chores or interacting with the child, or not present at all. The exposure to environmental hazards came about either as the result of restricted home spaces, the presence of hazardous equipment and products, or in the context of a change in the household routine.

Study III provides examples of how codes and sub-categories combined in descriptions of these injury circumstances, with several codes involved under the

same category. In one example, an eight month old boy was playing a version of 'peek a boo' with his mother and aunt, when he was attracted to a recently boiled kettle on a counter adjacent to where he and his mother were seated. By pulling the kettle cord he was able to pull the hot water kettle onto himself. This incident took place in a small single roomed home and illustrates how, during what was described as an 'ordinary' play encounter and even with multiple caregivers in the immediate vicinity, the infant was able, in the limited space, to reach out and pull the cord of a nearby still steaming kettle.

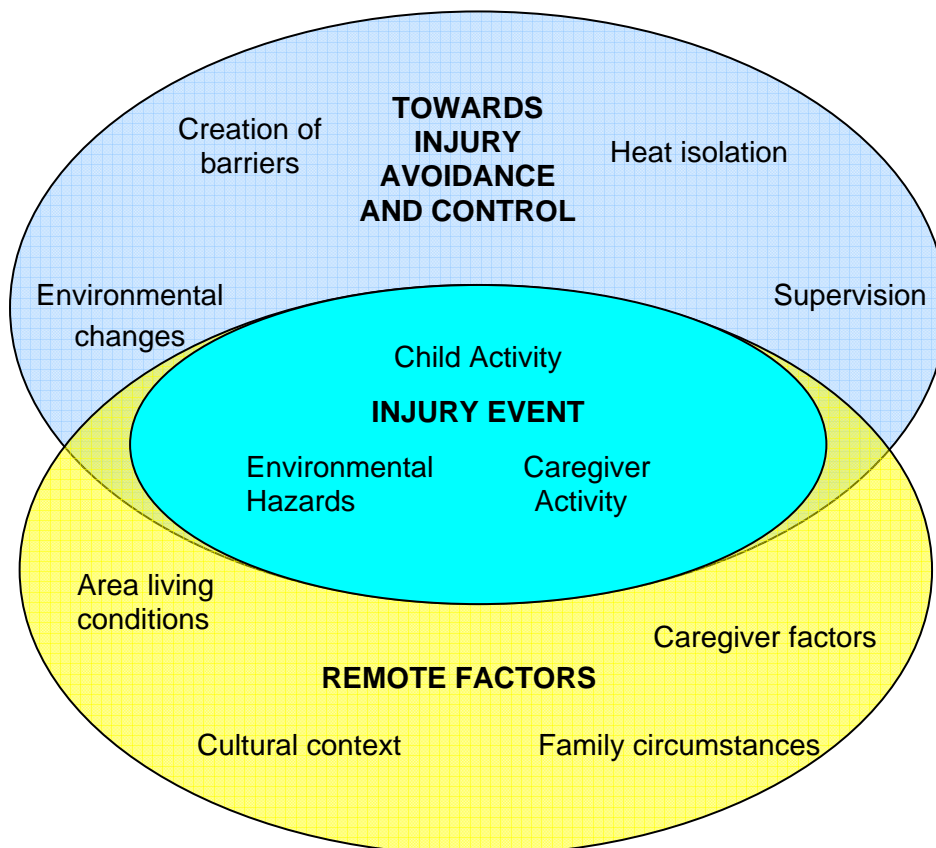


Figure 5. Burn injury event itself, remote and preventive factors

Remote factors associated with the event

The caregiver highlighted various remote and structural factors that contributed to the child's injury. These are separated into four main sub-categories: factors that impact upon the caregiver (individually), family circumstances, the area's living conditions, and the cultural context. The caregiver is influenced by a

demanding workload often with a negative and depressed state of mind and by the limited support for home chores and childcare. The family is impacted by impoverished socio-economic circumstances often with relational tensions in response to both everyday life events, the economic and emotional demands of several children, and hardship and everyday crises. The conditions that contribute to area living circumstances are poorly demarcated neighbourhood and limited household spaces that may facilitate contact with external hazards and sub-standard home equipment respectively. A fourth category, cultural aspects, highlights the contribution of religious and supernatural belief systems.

An example amplifies how some of the codes and sub-categories combined in accounts of these remote factors and how it can again be seen that several codes are sometimes involved in the same category. In one example a caregiver was preparing her child's morning bath. In between attending to the eight month old she pours the hot water into the portable tub and places it on the floor of the small main room, which has several functions. The family lives in an impoverished neighbourhood, and their home consists of a 'wendy-house', a wooden shed, where they sleep and bath, and a separate kitchen, which they share with another family. Her older son who usually occupies the baby while she manages the morning household chores is not there and in addition she is occupied with personal difficulties and has a lot on her mind. The child is recently more mobile and is able to crawl over to the bath-tub.

Looking ahead: Towards injury avoidance and control

Caregiver suggestions and observations on looking ahead focused on the isolation of and the creation of barriers to heat sources, caregiver supervision, and environmental changes. In one case, the caregiver reported a momentary shift of her attention during which her child moved across the room in his walking ring to a recently boiled kettle. The kettle stands on a counter that is narrow because of the small size and congested layout of the room, leaving the kettle cord hanging over the side. The caregiver indicates that she will remove the walking ring but also believes that the working surfaces and equipment layout of the kitchen will need to change. This is despite the reluctance of their landlord who has resisted requests to invest in internal modifications to the home.

STUDY IV

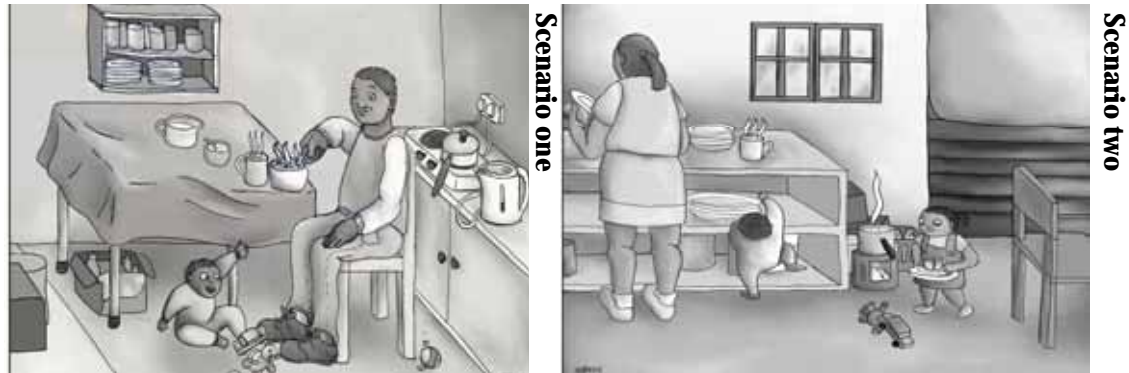
Which hinders and enablers to the scalding counter-measures are identified by caregivers and injury prevention stakeholders in Cape Town?

Informants identified scalding counter-measures that were directed at the more obvious physical elements represented in the sketches. In most cases, respondents reported that they could relate to the scenarios portrayed, and in many cases, but especially for caregivers, had actual experience or direct observations of the circumstances depicted. Thereafter, and for each scenario separately, informants reflected on hinders and enablers to the counter-measures, often referring back to the sketches and in some cases even questioning aspects of the counter-measures they had earlier proposed. Phrases used to describe each counter-measure, barrier and enabler were coded and are indicated on the left hand side of Tables 5, 6 and 7 respectively. Each code reflects a central element of the proposed counter-measure, barrier or enabler. These are organized around specific themes and these in turn around various categories. Themes and categories turned out to be similar, as was the order of appearance, for counter-measures, barriers and enablers, respectively.

Counter-measures

Table 5 provides an indication of the three main categories of scalding prevention strategy, for both scenarios. The codes associated to each theme are listed, as are the number of caregivers and stakeholders who identified each code. The categories are labeled: safety enhancements to the home environment (when the proposed measure targeted an aspect of the physical environment, including the home equipment available); changes to practices (i.e. when informants suggested doing things represented in the picture in a different manner); and improvements of individual competence (i.e. when the counter-measures proposed implied an enhancement or acquisition of individual ability or skill).

Table 5. Counter-measures to scalding scenarios one and two



Code	Scenario One		Scenario Two		Theme	Category
	C(13)	S(8)	C(13)	S(8)		
Home equipment	12	5	12	7	Control hazards	Enhance safety of the home environment
Play area	5	-	5	-		
Barriers to stoves	2	2	-	-	Creation of barriers	
Furniture	-	-	2	2		
Child space	1	2	-	-	Alter the home layout	
Surfaces for appliances	-	-	-	3		
Pan handles	1	2	-	-	Provision of home equipment	
Kettles	2	1	-	-		
Cooking utensils	-	1	-	-		
Stoves	-	-	1	-		
Appliances	-	-	1	-		
Pots	-	-	-	1		
Child	11	6	7	6	Child supervision	Change practice
Parent tasks	7	7	8	6		
Table cloths	7	5	-	-	Chores/ habits	
Child	8	2	3	5		
Hot things or liquids	7	3	8	6		
Parent	-	-	5	2		
Kettle	9	3	-	-	Equipment and appliance handling	
Stove	8	-	11	6		
Cooking utensils	-	4	-	-		
Appliances	-	-	2	2		
Children	3	2	1	-	Educate	Improve individual competence
Parent	2	2	-	2		
Parent	3	1	4	2	Time management	
Parent	-	3	2	3	Increase awareness	
Authorities	-	1	-	-		
Teachers	-	-	1	-		
Child	-	-	-	2		

Safety enhancements to the home environment. This category of counter-measure was a focus for the majority of informants, irrespective of the scenario. Proposals emphasized the control of hazards in the home and especially in the cooking area, and focused on the removal of hazardous home equipment from the reach of children. In scenario one, this involved the removal of hot substances in kettles and pots, and the control of lengthy kettle cords; and in scenario two, the removal or elevation of portable stoves and pots (of hot stuff). Caregivers alone stressed the importance of creating or ensuring a play area outside of the cooking area as a hazard control measure for both scenarios.

Changes in practice. Informants emphasized changes to child supervision in response to scenario one and changes to equipment and appliance handling for scenario two. In both scenarios, changes to child supervision highlighted the role of the parent in separating the child from dangerous cooking and eating environments, and greater support for the caregiver with child supervision and chores. The proposed changes to household chores and habits focused on the removal or replacement of tablecloths (for scenario one), the removal of hot liquids and foodstuff from the reach of children (for both scenarios), and the separation of cooking activities from the child. Changes to the handling of equipment and appliances emphasized the use of kettles with shortened cords and the removal of the kerosene stove out of the reach of children. Only caregivers highlighted the use of the back heating elements of portable electrical stoves.

Improvements to individual competencies. Proposals for both scenarios were limited to small proportions of informants who advocated for the use by caregivers of time plans and of educational programmes for both parents and children. The former measures included organizing and sequencing child activities and caregiver home chores while the latter involved the provision of information about risk situations that for example highlights the dangers of kerosene stoves. Mostly stakeholders sought to increase parental and child awareness as a counter to the scenarios.

Barriers

Four categories of barrier to the scalding prevention strategies are represented in Table 6. The arrangement of codes, themes and categories are similar to that for Table 5. The barriers are incorporated into one of four categories labelled: limitations in the physical environment (i.e. the physical or spatial arrangements and characteristics of the home environment that impair human activity); executive problems and hinderers (hinders that impede individual capacity to perform an activity in a safe manner); facility/product/appliance limitations (particular to appliances and physical equipment or facilities that impair scalding

counter-measures); and hardship (general, and more widespread material and human impoverishments). In turn, each of these categories is sub-divided into themes, definitions of which are provided in Study IV.

Table 6. Barriers to counter-measures for scenario one and two



Code	Scenario one		Scenario two		Theme	Barrier Category
	C(12)	S(8)	C(12)	S(8)		
No space for daily activities	7	6	5	6	Space restriction and congestion	Limitations in the physical environment
Appliance and furniture	2	4	3	2		
Family size	-	1	1	-		
Space arrangements	4	2	2	1	Child unfriendly environment	Facility/ product/ appliance limitations
Equipment	1	3	4	3		
No access to electricity	3	4	5	3	Insufficient electricity infrastructure	
Limited basic facilities or equipment	2	2	-	3		
Kerosene stoves	-	-	3	2		
Proper equipment	3	2	3	2	Unaffordability of facilities and equipment	
Storage and working spaces	2	-	2	2		
Horizontal	6	5	4	6	Competing activities	Executive problems and hinderers
Vertical	1	2	1	1		
Caregiver	5	5	6	6	Risk appraisal	
Child	2	3	1	1		
Cooking	2	1	2	2	Habits	
Material deprivation	1	4	2	4	Poverty	Hardship
Financial constraints	1	1	-	1		
Information utility	2	2	-	1	Inadequacy of available safety interventions	
Information quality and dissemination	1	1	1	3		
Poverty related	-	-	-	1	Social prejudice	
Age related	-	-	-	1		

Limitations in the physical environment. Most informants commented on spatial arrangements that limited the space for daily living activities. Low income homes

that comprised a single room, or a room in which a number of daily activities (such as cooking and leisure activities) takes place, or where there are limited working spaces (for cooking, cleaning, and sometimes bathing), were all commented upon. In such restricted spaces there is often no room for essential appliances, encouraging the use of portable but less stable cooking and heating equipment, and clutter, as cooking, adult leisure and child play spaces overlap with each other. Child unfriendly dimensions to the home focused on spatial and equipment hindrances that specifically increase the child's proximity to hazardous equipment. A common example was the location of the cooking equipment or hot pots adjacent to where the child plays or may walk as he or she assists in household chores.

Facility/product/appliance limitations. Insufficient electricity infrastructure involved the limited access of families to electricity; and the limited basic (electrical and other) facilities and equipment required for cooking (stable electrical stoves) but also for heating water (geysers). In homes with an electricity supply, many informants highlighted the difficulties around electricity usage as a result of limited plug points and the resulting limitations placed on the family in terms of the congested location of appliances around these points, and the consequent use of appliances in unsafe locations. Unaffordable facilities and equipment included the inability of many families to access basic home equipment such as heating and cooking appliances, working spaces, cupboards with closing and lockable doors, and even table mats. In such situations, families resort to using, for example, unstable but cheap equipment such as kerosene stoves and makeshift, but unstable work-surfaces.

Executive problems and hinderers. Informants indicated a multitude of horizontally competing demands on the caregiver such as chores, work, unexpected demands, conflict and child care; and to a lesser extent vertically competing activities, e.g. food provision, which would take precedence for a family's meager resources. In addition, a range of factors that could impair the caregiver's capacity to recognize and appraise scalding hazards were reported, including preoccupations with everyday problems, frustrations and lack of experience- especially for first time and young parents. A number of informants also drew attention to limitations in the child's ability to appraise danger, such as its growing curiosity and increasing physical ability to grasp, climb and explore its surrounds.

Hardship. Barriers related to poverty highlighted general material deprivation, as is especially manifest in impoverished living conditions and unemployment. A few informants commented on the inadequacies of the available safety interventions reporting difficulties imposed by information quality and dissemination problems (e.g. when safety messages are considered too impractical for caregivers to implement); and barriers related to information utility (e.g. when safety messages need to but do not take account of individual situations and design of homes). A

minority of stakeholders highlighted social prejudice as a barrier to the counter-measures proposed for scenario two, describing prejudice against poor people (specifically their restricted political and financial power to access safer services and products) and age related prejudice, specifically directed at children in informal settings.

Enablers

Enablers are incorporated into three categories and labelled: enhanced individual responsibility (i.e. caregivers' acknowledged roll in creating, maintaining or promoting safe living conditions in the home, e.g. around the child); built-in safety of equipment and structures (i.e. of the household design, structure and equipment, including spatial attributes); and supportive state policy (i.e. of state policy and responsibilities for promoting safety). Table 7 summarises the enablers to counter-measures to both scalding scenarios. These are collapsed as there were few enablers mentioned altogether.

Table 7. Enablers to counter-measures for scenario one and two

Theme	Scenario one and two (Combined responses)		Category
	C (10)	S (8)	
Caregiver	6	4	Enhanced individual responsibility
Others	2	1	
Safety features of appliances and equipment	3	5	Built-in safety of equipment and structures
Home structure and space	1	5	
Portability of appliances	1	3	
State policy and interventions	4	4	Supportive state policy and structures
Poverty alleviation	3	2	
Access/control of equipment/appliances	1	2	

Enhanced individual responsibility. Informants proposed that caregivers had the capacity to take greater responsibility for home activities. These responsibilities include greater management of the child's activities, sole responsibility for

dangerous cooking and heating appliances and related activities in the home, and sole management of cooking utensils such as pots and pans.

Built-in safety of equipment and structures were highlighted especially by stakeholders, who emphasized the existing safety features of appliances and home equipment (even of kerosene and portable electric stoves and kettles- they can for example be secured); the attributes of home structures and spaces (especially as regards the more effective use of space as illustrated in modern kitchen designs many of which are also small); and the portability of appliances and equipment (which can be moved to facilitate the safer use of the limited home space).

State policy and structures. Informants highlighted efforts to state authorities to promote and fund safety interventions, such as the use of safe energy sources, such as gas as an alternative to kerosene; financial subsidization of suitable heating or cooking equipment; and the provision of safety education. Current poverty alleviation initiatives were also focused on, such as the national programme funding entry level homes, and the potential for improving the construction quality and size of these homes.

6. DISCUSSION

South African studies have tended to focus on the clinical profile of burn injuries, initial descriptions of their epidemiology, and preliminary discussions around injury prevention. Despite initial indications of the prominence of burns and their reported impact, there remains a paucity of scientific information on childhood burn injuries, such as its extent, patterns of occurrence, risk factors, and rigorous, controlled evaluations of effective prevention; information considered essential for the development of prevention or control measures.

The overarching aim of this thesis is to contribute to the information platform required for burn injury prevention in low-income settings in Cape Town and other similar South Africa settings. This collection of studies investigates, via a combination of methods, the typical patterns and circumstances of paediatric burn injuries, informant perspectives on burn occurrence and its contributors, and the barriers and enablers to burn counter measures.

The thesis makes the following four contributions to paediatric burn injury prevention in South Africa.

Firstly, it expands on known descriptions of paediatric injury in South Africa. Four patterns of circumstances of occurrence are highlighted (Study I) which extends both the South African and African emphasis on univariate descriptions of age, sex, and race or population group (Forjuoh, 2006). This allows for a more synthetic description of how age of the victim, type of burn, environmental conditions, season and body region injured relate to each other. The patterns are age specific: the first two focus on scalding to infants and toddlers respectively, one on flame burns to older children, and one combines a mixture of aetiologies over a broader age range. The epidemiological description is the first and most detailed account from South Africa, and the burn pattern description the first reported for the African region.

Secondly, it shows clearly that the occurrence of paediatric burn injury is highly influenced by aspects of the local environment (Study II). The few studies conducted thus far have indicated that community socio-economic status impacts on both fatal (Cubbin, LeClere & Smith, 2000) and non-fatal burns (Hippisley-Cox *et al.*, 2002; Istre *et al.*, 2001), with the socioeconomic gradient for childhood burn morbidity being particularly steep (Cubbin & Smith, 2002). The ecological variables previously considered have been variables such as median income, or indicators

combining income, poverty, crowding, and unemployment (Cubbin, LeClere & Smith, 2000). In Study II, composite descriptions defined as housing conditions, child dependency and socio-economic barriers were found to impact on childhood burn injury in Cape Town. These composites provide essential targets of sustainable childhood burn injury control and prevention programmes for impoverished settings in Cape Town and potentially further afield. In broader terms, these findings echo those for other childhood injuries, including traffic (Engstrom, Diderichsen & Laflamme, 2002; Hasselberg, Laflamme & Ringbäck Weitoft, 2001) and intentional injuries (Engstrom *et al.*, 2002), highlighting the significant impact that certain aspects of the material environment have on children's injury risk.

Thirdly, it offers narratives of injury events, highlighting the multifaceted genesis of paediatric burn injury occurrence. This is based on the perspectives of caregivers that have had direct experiences of these injurious events to their children (Study III). These accounts add to the accumulated literature on burn injury causation. Caregivers highlight features of the injury epidemiologic triad, i.e. exposure to heat sources, age expected child activities, and household chore activities, in a context of domestic or economic burdens. They draw attention to the constricting impact of spatially congested homes, and the consequent augmentation of child interactions with unsafe domestic appliances, with the former posed as an essential contextual contribution to childhood burn injury. Informants close to the injury event propose context-relevant counter-measures, based in Study III on their personal experiences, and in Study IV on illustrations of typical scenarios of scalding burn injuries.

Fourthly, it identifies as far as is known, the first documented account of prevention hinders such as aspects of the physical environment; executive problems; appliance limitations; and hardship; and also the following prevention enablers: specific enhancements to individual responsibilities; built-in safety of equipment and structures; and supportive state policies (Study IV). There is scant information on the barriers and enablers to counter-measures directed particularly at scalding injuries. These reflections provide direction for further scalding and burn prevention research. A combination of informant groups in Cape Town, based on either their personal experiences (Study III) or in response to depictions of typical scenarios (Study IV), emphasized counter-measures directed at enhancements to the home environment and home practices, including supervision and chore management (Study III, IV). These categories of counter-measures closely match the injury event contributors identified in Study III.

6.1. CIRCUMSTANCES AND CONTEXTS

Early vulnerability: Confluences of temperament and socialization

Age and gender have provided a consistent indication of children's vulnerability to burn injury, reported on in studies conducted across Africa and further afield in other contexts (summarized in Van Niekerk, 2006). These typically indicate that burns are a disproportionate cause of injury, hospitalisation and even death to young children especially those aged from birth to four years, after which incidence steadily decreases (Forjuoh, 2006). Study I reports a concentration of burn injuries in the first two years of life, thereafter followed by a progressive decline in incidence. Male children were associated with an overall excess risk to burn injuries compared to girls, as they have in other studies (see for example: Daisy *et al.*, 2001; Lari *et al.*, 2002), with gender differences tending to decrease after toddlerhood, but emerging again with older school-going children (Study I). In other studies, there are indications that females in some societies may be at a higher risk because of their involvement in domestic activities near open flames and because of clothing styles (Davies, 1990; Forjuoh *et al.*, 1995).

The early vulnerability of boys may be considered a reflection of temperament and higher activity levels, with indications that temperament in toddlerhood is related to injury history (Schwebel & Plumert, 1999) but with more inconsistent findings of the impact of higher activity levels (Forjuoh, 2006). Boys are reported to behave more impulsively and over-estimate their physical abilities (Schwebel & Plumert, 1999). The early effect of differential socialization is a further consideration, for example it is reported that parents are less likely to restrain the exploratory behaviour of boys even if the child's behaviour is judged to pose an injury risk (Morrongiello & Rennie, 1998). In general, toddlers are characterised by a curiosity of their environment and an increased, but still evolving and unstable physical ability to explore it (Duncan, Van Niekerk & Mufamadi, 2003). It is during this developmental period that children learn to walk but are still very unsteady on their feet and prone to grabbing towards objects, such as table cloths or kettle cords, to steady themselves, but thereby coming into greater contact with heat sources, such as cooking pots, kettles or heating equipment, especially if found on floors or unsteady tables (Barss *et al.*, 1998; McLoughlin & McGuire, 1990).

Older children are exposed to a greater range of high-risk activities such as cooking, a reflection of greater physical mobility and social independence. These children are at heightened risk as a likely result of their involvement in the gathering of firewood and the lighting of fires for morning and evening meals, activities common for children in low-income settings (Barss *et al.*, 1998; Study I).

Older children spend an increasing amount of time with other children, older siblings and other adults, increasingly outside the home (Duncan *et al.*, 2003). Their widening social network may also open them to the risks posed by the open fires (and related hot objects) initiated for heating, cooking or other purposes, with older children having a greater capacity for starting fires, managing heating appliances and heated objects.

Supervision

The concentration of burn injuries amongst infants and toddlers is widespread, from settings like Brazil (Rossi *et al.*, 1998), Cote d'Ivoire (Vilasco & Bondurand, 1995) and India (Gupta *et al.*, 1992), to settings with lower burn injury rates such as Sweden (Carlsson, Udén, Håkansson & Karlsson, 2006), and found to account in LICs, for up to half of all childhood burns. This concentration has been attributed to the child's limited physical and cognitive vulnerabilities, its dependence on its caretakers, and the role of the environment, or various interactions between these (Barss *et al.*, 1998; Forjuoh, 2006). Caregiver observations highlight the contributions of age expected child activities and their own household chore activities and demands (Study III), indicating that burn events occur in the context of domestic or economic burdens, within the constricting impact of spatially congested homes, and the consequent augmentation of child interactions with unsafe domestic appliances. These accounts add to the body of knowledge that contextualizes caregiver activities at the time of the injury event within a convergence of psychosocial and physical environmental risk factors as opposed to the historically almost exclusive focus on explanations that highlight the characteristics of the caregiver and the adequacy of supervision (Evans, 2004; Saluja *et al.*, 2004).

Caregiver testimonies highlight the contribution of necessary social tasks, including chores, child care, unexpected events and crises, and work in undermining the caregiver's ability to supervise and protect the child in hazardous home environments (Study III, IV). These accounts identify the many challenges to the provision of effective supervision that may be described as constant, proximal and attentive to the child (Saluja *et al.*, 2004). Despite a recognition of their adverse circumstances, supervision is a responsibility that caregivers nonetheless still experienced as their own, one that in large measure remains ascribed to parents by many in the health sector (Morrongiello, 2005; Saluja *et al.*, 2004). The latter constitutes part of the social pressure experienced by caregivers for the almost unconditional guardianship of their children (Sidebotham & ALSPAC Study Team, 2001). However, there can be little surprise that these injury events occurred in the contexts described in the studies forming this thesis. Caregivers had their

psychological, familial and often neighbourhood resources tested in both the daily living struggles and the crises that they faced (Study III).

Household spatial arrangements and hazards exposure

The harmful impact of impoverished settings on children is asserted to be the result of an accumulation of physical and psychosocial conditions, many of which typically co-vary and rarely act in isolation (Evans, 2004). This thesis highlights household spatial arrangements as both a contributor to child injury (Study III) and a hinder to prevention measures (Study IV, discussed below). In particular, restricted home spaces augments the child's proximity and exposure to domestic equipment and heat sources with the latter often exacerbated by sudden and unexpected changes to household or childcare routines (Study III). The impact of the internal spatial arrangements of low-income homes is a neglected research area in the public health arena, but one recently identified as an area of concern in impoverished South African settlements (Seedat, Baadjies, Van Niekerk & Mdaka, 2006).

The physical spaces where burn injuries occur are usually small homes, comprising one or two rooms with further temporary internal divisions made of curtains or tall boards. These rooms are utilised for various functions, depending on the times of day and the families' particular requirements for sleeping, washing, cooking activities, meal-times (Seedat *et al.*, 2006) and in this and other contexts as a working space (Kellet & Tipple, 2000). In such living spaces the child has nearly permanent access to thermal equipment (Godwin *et al.*, 1996; Zwi *et al.*, 1995). Some of this equipment has a documented impact on childhood burn injury, such as kerosene stoves (Kalayi & Muhammad, 1994) and hot water cylinders with excessive water temperatures (Katcher, 1987), but others include informal outdoor heating appliances, and stoves and ovens that are unsteady or inappropriately secured. Despite the prioritisation of electrification in Cape Town and other South African cities, it is anticipated that low-income families will continue to rely on kerosene, coal or wood-fired stoves for cooking and heating tasks, and low quality hot water cylinders, because of the cost of both electricity and safe essential electrical appliances (Sustainable Energy Africa, 2003).

Persisting poverty and racial segregation

This thesis highlights the significantly higher rates of burn injury amongst African, as compared to white or coloured children, a likely reflection of greater exposure levels (Study I, II). This is consistent with these groups' histories of restricted access and marginalisation from social resources such as educational, health and others. Prior to 1994, black South Africans were restricted to designated 'homelands', formal townships, or settlements on the fringes of the

cities, this geographic dimension a key manifestation of policies of racial segregation and oppression. These living areas, often impoverished, poorly resourced, and marginally located, is argued to have institutionalised hazardous living area circumstances still ongoing and faced by many South African families and children today (May, 1998). Despite the country's social transformation, its current stability and its relative wealth, the African group continues to report lower income levels, literacy rates and overall health status, and higher levels of household crowding, with widening intra group economic differences (Study I, II) (Day & Gray, 2003; Statistics South Africa, 2004). In turn, the related variables of low socio-economic status of the family (Delgado *et al.*, 2002; Petridou *et al.*, 1998), low educational level of the mother (Daisy *et al.*, 2001; Furjuoh, Guyer, Strobino *et al.*, 1995; Petridou *et al.*, 1998; Werneck & Reichenheim, 1997), and psychosocial stress in the family (Werneck & Reichenheim, 1997) have all been linked to an increased risk to childhood burn injuries.

Currently, it still matters a great deal where people live in South Africa, with living conditions closely aligned with both family and neighbourhood descriptions of race and social class (Study I, II). South Africa's history of social inequalities and segregation has ensured that much of its population remains divided along social, economic and ethnic lines, with persisting geographic parallels to these divisions (Day & Gray, 2003). It is therefore not surprising that Cape Town suburbs are starkly different from one another in terms of housing conditions (suburban exposures that incorporate informal dwellings, kerosene usage, restricted access to piped water, flush toilets, a concentration of black African residents), child dependency (high child numbers and dependency, low migration) and socio-economic barriers (unemployment, economic and household demands on female household heads, financial demands of home ownership). Study II indicates that these suburban characteristics are strongly associated with burn injury occurrence among children, in that increased level of exposure led to an increased risk of child burn injury.

Elements individually related to both housing conditions and socio-economic barriers reflect the conditions faced by impoverished communities. The factors highlighted are informal settlements (Sustainable Energy Africa, 2003), aspects of the informal dwelling structure (Delgado *et al.*, 2002), including the lack of demarcations of cooking or washing areas (Delgado *et al.*, 2002; Petridou *et al.*, 1998), the storage and use of paraffin or kerosene (El-Badawy & Mabrouk, 1998; Forjuoh, Guyer & Smith, 1995; Furjuoh, Guyer, Strobino *et al.*, 1995; Hudson, Rode & Bloch, 1994; Kalayi & Muhammad, 1998), unemployment and low income (Locke, Rossignol & Burke, 1990; Furjuoh, Guyer, Strobino *et al.*, 1995;

Gupta, Bansal, Gupta & Goil, 1994), household crowding (but not necessarily child crowding) (Petridou *et al.*, 1998; Daisy *et al.*, 2001; May, 1998; Furjuoh, Guyer, Strobino *et al.*, 1995), and female-headed households (Pomerantz, Dowd & Buncher, 2001), all of which have indicated varying degrees of impact on childhood burn or other injury outcomes. Still others may require further clarification at individual level, such as migration rates, which may provide an indication of the deterioration of some low-income neighbourhoods (May, 1998; Mirafteb, 1997).

6.2. COUNTER-MEASURES, BARRIERS AND ENABLERS

Paediatric burn prevention programmes have been directed at the reduction of individual vulnerabilities, environmental change or combinations of these (Towner, Dowswell & Jarvis, 2001; Warda, Tenenbeim & Moffat, 1999). The few evaluations have been conducted on interventions directed at the prevention of fire and to a more limited extent scalding injuries, and include smoke detector promotion programmes, tap water temperature reduction, and parent and child education, predominantly in high resource countries (DiGuseppi & Higgins, 2000; Harvey *et al.*, 2004; Towner *et al.*, 2001; Warda *et al.*, 1999). Evaluations indicate that a number of these interventions have demonstrated some success, often manifest by either moderate increases in caregiver safety knowledge, some child and caregiver behaviour changes, but very rarely in actual reductions in child burn morbidity (Warda *et al.*, 1999). The implementation of these and other childhood injury control interventions continues in general to be hindered by a range of barriers and challenges (Barss *et al.*, 1998; Brannan, 1992; Gaerling & Gaerling, 1993; Kendrick & Marsh, 1999; Peterson & Saldana, 1996; Thompson *et al.*, 1998). There is some indication of the barriers, and to a lesser extent the enablers to the prevention of childhood injury occurring in the home, but little discussion on those specific to the prevention of childhood burns.

This thesis depicts key scalding counter-measures in Figure 6. Informants close to the injury event proposed these context-relevant measures based on their personal experiences (Study III) or in response to illustrations of typical scenarios of scalding burn injuries (Study IV). The three core dimensions to the injury event are represented as described in Study III, around which are structured three categories of counter-measure, in turn divided into 10 strategy or intervention types. The intervention 'slices' are proportional to the emphasis accorded them in Study IV and closely matched to the burn injury contributors identified in Study III.

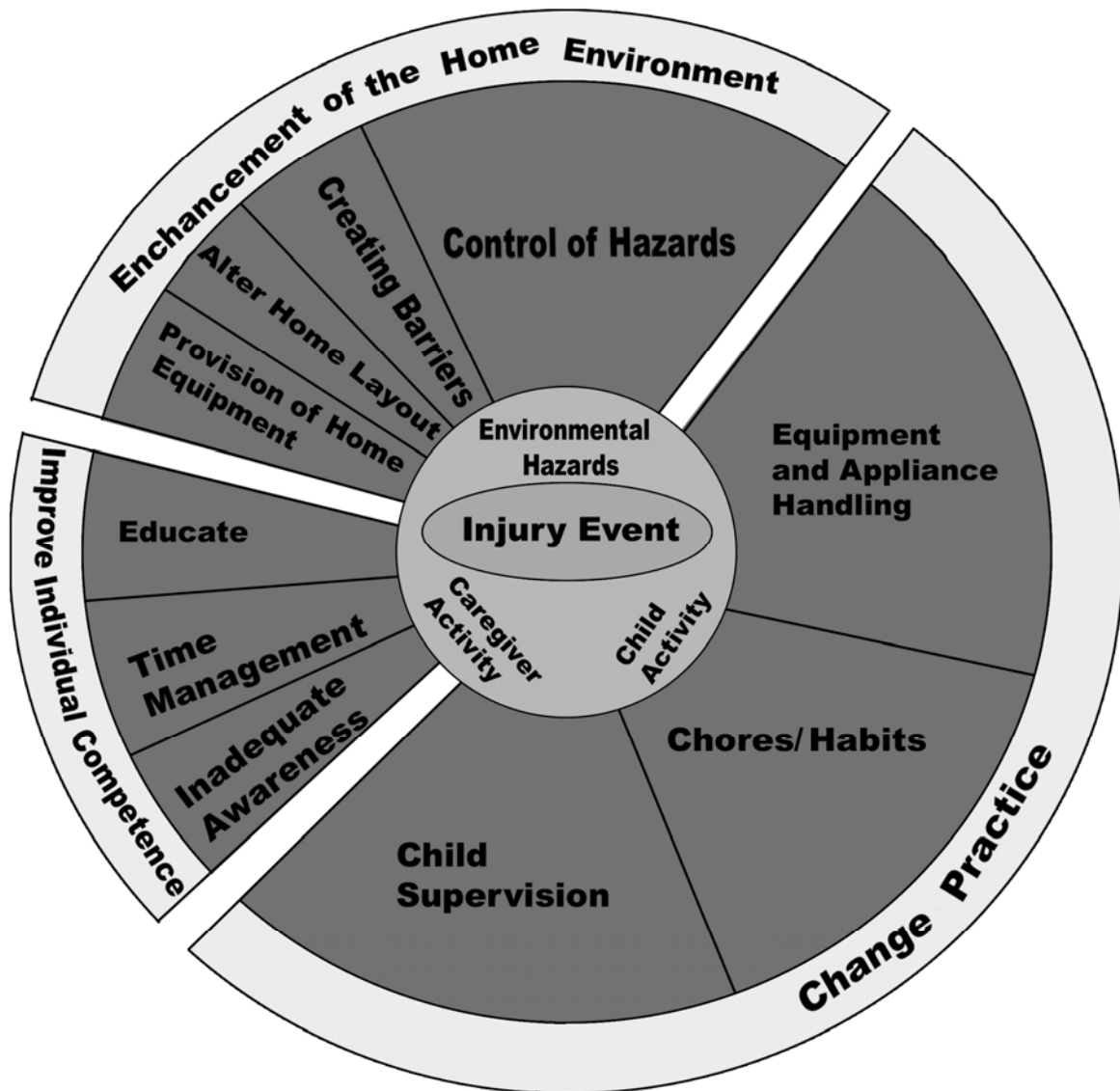


Figure 6: Three counter-measures for common scalding scenarios, comprising 10 actions

Enhancements to the home environment, home practices, and supervision

The control of hazards in the home focussed on changes to the physical environment, chore and child care practices, and supervision, interventions that are closely matched to the injury epidemiologic triad (Barss *et al.*, 1998). The creation of barriers to heat sources, and environmental and spatial changes are proposed for the home environment (Study III, IV). These particular intervention possibilities, drawn from the caregiver burn experiences in their

home environments, have strong support for their effectiveness (Dowswell *et al.*, 1996). There is less support for supervision when these activities require the adoption of 'safe' attitude, behaviour and skill modifications for the control of exposure to sources of danger (Barss *et al.*, 1998; Dowswell *et al.*, 1996). Nonetheless, caregivers identify increased child care and supervision as a priority intervention for their circumstances (Study III, IV). Despite their adverse environmental conditions, caregivers employed various child care strategies to contend with the daily risks in their environment, suggesting developed and for the most part successful indigenous and individualised risk appraisal and regulation systems (Glendon, 1999; Hale & Glendon, 1987). For example, caregivers reported the setting up of make-shift barriers to heat sources from available furniture and material in the home (Study III). This daily management was typically without the assistance of traditional safety equipment, such as fireguards, tap temperature controls and smoke detectors, that have had some documented impact on burn injury prevention (Dowswell *et al.*, 1996). However, as exposure levels are high in the homes of these families, already quite challenging demands are put on caregivers, who – as for other caregivers – have a range of other household considerations that they attend to.

Barriers, hinders and enablers

Space to live and move

The impact of the small home and especially the constrained cooking space was raised both as a contributor to burn injury (as discussed above) and as a hinder to scalding prevention efforts (Study IV). With limited physical space it is very difficult to manage essential daily activities, create barriers to prevent injuries, or compensate for human shortcomings. In impoverished communities, this is exacerbated by limited access to safe home facilities and appliances such as built-in working spaces and electrical stoves (Study IV). In these circumstances, the state policy and interventions proposed by informants especially poverty relief programmes (such as employment creation and housing provision interventions) and the proposed access of the poor to safety technology would be welcome responses to the material and spatial limitations associated with low-income homes. Since 1994 over 2 million housing subsidies have been allocated to the poor (Department of Housing, 2007). Many of these houses were however poorly built and tiny, although recent legislation has prioritized the development of minimum standards for entry level housing (Harsch, 2001). In the absence of a reduction of these structural risks, families would be obliged to continue essential living activities in high risk settings, with limited risk management strategies, and the deplorable burn consequences.

Safety of appliances

The effect of home cooking and heating appliances and related working and storage spaces were raised as important obstacles or conversely as enablers of prevention (Study IV). An inadequate electricity supply was highlighted, the latter compounded by the non-affordability of home equipment, such as cordless kettles, installed electrical stoves, plug points, stable working surfaces and table mats. Cheaper but unstable kerosene stoves were highlighted as an alternative, despite concerns about its hazardous nature (Forjuoh, 2006; Godwin *et al.*, 1996). Its use constitutes a considerable hinder to scalding prevention, especially to efforts to change cooking habits. Despite the unfavourable descriptions of kerosene and portable electrical appliances, stakeholders and some caregivers emphasized the inbuilt safety features of this equipment. The very portability of these electrical and kerosene stoves and kettles also allowed for greater flexibility and control over their location, to an extent demanded by the fluid conditions prompted by the internal spatial and functional arrangements in the home. Exposure to this equipment is heightened in the winter months in Cape Town (Study 1), as is reported for other contexts such as China, Egypt and India (Davies, 1990; Hemeda, Maher & Mabrouk, 2003; Zhu, Yang & Meng, 1988). During winter time, families are physically more bound inside their homes with a greater concentration of activities and consequently greater exposure to a range of household risks (Kalayi & Muhammad, 1994).

Human capacity

The numerous household chores, care of families with more than one child, and competing activities, including work, everyday tensions and distractions, are central prevention barriers (Study IV). Within the context of the material, spatial and equipment limitations mentioned above, it is obvious that the demands put on individual competencies are high, and probably regularly exceed sustainable human prevention capacity and efforts. There are considerable social pressures on parents to still succeed in these contexts, with stigmatisation of those who succumb to these adverse environments (Sidebotham & ALSPAC Study Team, 2001). Despite their adverse contexts, informants highlighted the potential for even greater individual responsibility for child safety. Considerations of safety as a secondary priority after other concerns about shelter, food stability or clothing needs were also raised, consistent with the intensity of the survival challenges reported by impoverished families (Study III).

Structural and social contextual barriers and enablers

Poor families confront the barriers of poverty from the level of physical and financial deprivation, to inadequate safety interventions, to persisting social prejudice (Study IV). The pervasive and oppressive impact of hardship to

individuals and their families are discussed above, and apply simultaneously as barriers to implementing prevention measures. Poor communities are prioritized for current and further recommended state policy interventions, especially those directed at poverty relief, the promotion and dissemination of safety technology, and the installation of safe infrastructure (Burger, 2006).

6.3. TOWARDS A PLATFORM FOR PREVENTION

The available paediatric burn prevention programmes interventions have been formulated in contexts with specific risk factors and often high levels of resources and medical care compared to where the burn injury burden is currently greatest, in South-East Asia and Africa (World Health Organisation, 2002). There is a general dearth of evaluated childhood burn prevention intervention research in the latter contexts (Forjuoh, 2006; Norton, Hyder, Bishai & Peden, 2006), as is the case for South Africa (Albertyn *et al.*, 2006; Van Niekerk, 2006; Van Niekerk *et al.*, 2004). This thesis (Study IV) identifies three contextually specific areas for childhood burn prevention, namely changes to the home environment, to home and child care practice, and to individual, especially caregiver competencies. These counter measures are within the context described above and expressed in response to two scalding scenarios typical for the Cape Town setting.

Basic housing

The home environment is identified as a key intervention site. Interventions highlighted here include the development of safe housing and safe housing standards, the subsidization of basic household equipment, such as cupboards, table coverings and shelving, and access to inexpensive but safe heating technology (especially stoves, hot water cylinders and cordless electric kettles) (Study IV). The focus on the home and the cooking areas is appropriate considering that firstly, the majority of burn injuries occur in those locations (Forjuoh, 2006; Van Niekerk, 2006), and secondly, the declaration of housing provision as a social priority in South Africa and the plethora of new homes since 1994 (Department of Housing, 2007). It is extremely timely that consideration is given to the safety aspects of South African housing policy. The housing allocated to poor families has typically been poorly built, tiny, and with limited basic facilities (Department of Housing, 2007). Current state expenditure on housing is still regarded as relatively low, estimated currently at 1.3%, although the National Housing Goal of increasing expenditure to 5% remains relevant, as do policy recommendations to encourage rental housing; complement the

subsidization of entry homes with loans; upgrade current settlements (as opposed to resettlement projects); and the implementation of strategies and projects to build neighbourhood cohesion (Burger, 2006; Smit, 2006). The safety aspects of these homes require immediate inclusion and prioritisation in the current debate on policy and implementation.

Sustainable energy provision

Complementing the provision of housing is the prioritisation of electrification in South Africa. The South African government has committed to universal energy access by 2014 with strategies for the provision of accessible, affordable and reliable energy, especially to the poor. However, many households still utilise household energy sources such as wood, coal, and paraffin (Burger, 2006). Since 2003, government electricity distributing agency ESKOM has implemented the National Electricity Basic Support Services Tariff Policy, making 50 kWh freely available to low income households. To make paraffin more available, the government has also removed it from the taxation system. The South African government has in the last six months also published two standards, one governing non-pressure paraffin appliances and another, a revised draft for pressurized paraffin-fuelled appliances. The updated standards set out to improve the health and safety aspects of these appliances to avoid some of the most common design faults. These include minimum performance criteria relating to the pressure release time; leak-proofing of the unit; combustion efficiencies; fuel cut-off devices; and, emergency self-extinguishing. For manufacturers, distributors and retailers it means that the legislated standards make it illegal for them to manufacture, stock, or sell affected appliances. It remains to be seen whether this legislation will be enforced, particularly in the light of cost and other barriers (Study IV).

Social and interpersonal support

Evaluations of home visitor and general practitioner counselling, home safety assessment programmes, training programmes and mass media campaigns provide some evidence of behavior change directed at childhood burn or unintentional injury prevention. However, despite the political, social, and financial support these programmes may generate, there is little evidence that actual injury reductions are achieved by these interventions (Towner *et al.*, 2001).

Priority recommendations

In the context of the above, a number of specific research and programmatic priorities are identified. Firstly, the ongoing surveillance of both fatal and non-fatal injury data is recommended as an essential monitoring and evaluation tool for prevention. The development, analysis and dissemination of the findings

produced by the National Injury Mortality Surveillance System, and sentinel burn injury surveillance sites, such as those located at the Red Cross Children's Hospital, Cape Town and elsewhere, constitute a critical information base for further analysis, and ultimately to stimulate and monitor interventions in the sector. Secondly, it is proposed that the expansion of the current fatal and non-fatal injury data sources includes information on permanent disfigurement, disability and the social and psychological impacts suffered by survivors, all of which are critical for a more complete determination of burn prevention priorities (Liao & Rossignol, 2000; Van Niekerk *et al.*, 2004). Thirdly, further investigation into the aetiological patterns peculiar to South African conditions is essential for understanding the multiple and often complex occurrences of childhood burn injury and investigations have been conducted to this end. The ongoing identification of individual, familial, household and community risks specific to the local occurrence of childhood burn injuries implies the implementation of specifically focused studies, although risk patterns, to some extent, may also be determined from current databases. The inclusion of children's perspectives on burns should also be considered, on both aetiological and preventive aspects, as children have been reported to be knowledgeable about both these aspects as they pertain to unintentional injury (Green & Hart, 1998).

Fourthly, since few South African burn prevention projects have been evaluated, a key recommendation for the South African sector therefore must include the ongoing identification, evaluation and dissemination of good burn injury prevention practices, especially those which explicitly benefit toddlers and infants. To assist in the evaluation of current interventions, it is proposed that appropriate evaluation protocols be utilised or developed for use in local injury prevention projects. Fifthly, this thesis specifically supports the evaluation and implementation of primarily passive environmental, product and legislative injury prevention interventions, or combinations of these strategies. The promotion of integrated technological safety solutions is featured (in Study IV), and may be illustrated by the South African specifications currently being proposed for kerosene stoves (Paraffin Safety Association of Southern Africa, 2007) and those legislated elsewhere for temperature controls for hot water cylinders or water outlet points (Erdmann, Feldman, Rivara, Heimbach & Wall, 1991; Katcher, 1987; Ytterstad & Sogaard, 1995), smoke detectors (McLoughlin, Marchone, Hanger, German & Baker, 1985), flame retardant children's clothing (McLoughlin, 1982), and baby-walker frames (Meyer, 1988).

It is no surprise that environmental interventions that focus on the kitchen have been proposed as part of the burn prevention agenda (Studies III and IV). These are under-represented in recent reviews (see for example: Towner, Dowswell &

Jarvis, 2001), even though the kitchen environment has been identified as a key target for prevention interventions (Daisy *et al.*, 2001). The design of optimal spatial demarcations for workings areas in kitchens are highlighted, and include integrated working spaces (with affordable, built-in appliances) and storage facilities, and the provision of electricity and other safe forms of home energy consumption. The specification and incorporation of safety features in low-income housing is a priority for the South African government. Finally, educational interventions received some support (Study III, IV) despite the lack of support for their impact on child safety outcomes (Liao & Rossignol, 2000). Health professionals, policy makers, children and parents should be included as the audiences for such interventions and the content of these programmes could be practically directed at the importance and construction of stable working surfaces, management of the child during cooking or other hazardous chores.

6.4. STRENGTHS AND LIMITATIONS OF THE STUDIES

Misclassification

The sources of possible misclassification and information biases require consideration in this thesis.

Register structure and entries. The Red Cross Children's Hospital's trauma register was originally designed and implemented to provide the hospital with timely information to support its administration of trauma care services and development of initial injury prevention interventions. The register includes items for the collection of the patient's demographics, cause of injury, place of occurrence, address where the incident occurred, admission decision, consciousness, affected anatomical site, injury severity and treatment codes, and additional observations made during the patient examination and history taking. The register thus involves core data required for an initial surveillance system (Rode *et al.*, 1989), but with limited consideration of other outcome dimensions (for example, related to impairment and disability), or aetiological factors that are of particular interest to prevention practitioners, for example, the involvement of household appliances and products (specifically heating, cooking and lighting equipment). The information that informs the four patterns identified in Study I is therefore limited to that currently available from the register. Descriptions on the injury circumstances (for example, caregiver and child activities at the time of injury) and home environment (for example, the appliances involved) would have added greater detail and facilitated further insights into the aetiological dynamics of the patterns of occurrence.

Registration procedures. The recording and consequent classification of burn injury data are subject to the registration procedures followed in the Red Cross Hospital's Trauma Unit. Registration duties are clearly allocated in this unit, with data collection principles documented (Rode *et al.*, 1989). Data is collected at the hospital's emergency care unit, where senior nursing staff complete the form based on an initial clinical assessment and an interview with an accompanying adult. At this point a first classification of the burn injury and the extent and depth of the wounds is made (Rode *et al.*, 1989). The completed registration form is validated by the surgeon responsible for the child's treatment, after which the information from this form is electronically captured by a support team dedicated to the management and dissemination of this data (Du Toit, 1999). The specifics of each of the registration entries are verified against the patient's clinical and administrative documents by a senior member of this team. The accuracy of these registration procedures have not been formally assessed, although the core demographic and injury descriptions are reported to be comprehensive (Du Toit, 1999; Du Toit *et al.*, 2001).

The address information as used in Study II, was however only available in the required detail for 81.6% of cases (with 208 cases having insufficient address information for the geographic coding process). These losses are for external reasons, with many of these the result of evolving and ongoing municipal demarcations and of cases reported in informal settlements. In these settings neighbourhood demarcations are transient and consequently home addresses are often poorly specified. The exclusion of these cases may have contributed to an underestimation of the observed differences on all three factors identified in Study II, as these suburbs are likely to be among the high exposures in the factors.

Population parameters. South African census data for 1996 and 2001 was used for Study I and II respectively. The latter was statistically adjusted for undercount on the basis of a nation-wide post-enumeration survey which indicated a 16.3% undercount for the Western Cape (Statistics South Africa, 2004). In Study I, the unadjusted use of the 1996 denominator and a consequent overestimation of burn incidence may have been countered by the likely underestimation of cases as a result of the selection biases reviewed below. In Study II however, it is the differences between rates that are measured and both the numerator and denominator can be considered to have been stable during the study period. The exposure period measured is from after that of the outcome. It is very unlikely that the bias introduced by this is of substantial importance as the differences measured are relative ones and both the numerator and denominator can be considered to have been stable during the study period. A further consideration

is the variation to the size of suburbs, which range from 12 to 32 258 households (on average 1272 households). This degree of variation suggests that the area descriptions used in the study may be less representative or diluted for larger areas, masking more accurate representations of smaller constituent areas. If heterogeneity is high then the relative differences will be diluted, with a tendency for odds ratios to shift towards unity. Nevertheless, as segregation is considerable, intra-variations are expected to be limited in most areas (Study II).

Selection bias

Selection biases are systematic errors that result from procedures to select subjects and from factors that influence study participation (Rothman & Greenland, 1998); a number of potential selection biases are considered below.

Urban predominance. The injury data used to represent the Western Cape in Study I is drawn from the Red Cross Children's Hospital in Cape Town. The hospital provides secondary care for the local population, and tertiary services for all hospitals in the surrounding Western Cape province. Formal procedures to refer all moderate to severe childhood burn injuries in the Western Cape were instituted in 1999. However, referral procedures might not have functioned consistently in this first year of its implementation, which also coincided with the first year of the injury data used in Studies I and II. Furthermore, the easier access to the hospital as a result of the closer proximity to the immediate Cape Town population may contribute to an over-representation of local users. This may have had an impact on Study I in particular, in that patients from rural areas may not have been provided the transport to the Red Cross Hospital and treated at alternative, usually general or adult facilities. This would have led to an underestimate of the hospitalized cases representing the province and therefore contributed to an underestimate of the magnitude of the problem. These losses would also contribute to some uncertainty about the classes of injury that may be present outside of the current urban setting; a focus for further research.

Register coverage. All childhood burn injuries in the Western Cape that are classified as moderate to severe are referred to the Red Cross Children's Hospital. These types of injuries comprise second-degree burns (where the epidermis is partially burnt through and blistered) and cover more than 10% of the body surface area. In addition, all burns involving the face, eyes, ears, hands, feet, perineum, all inhalation injuries, circumferential burns, electrical injuries, neonatal burns, and burns in patients with serious pre-existing diseases are considered to be moderate to severe injuries (Rode *et al.*, 1989). The register would not include fatalities that occur prior to hospitalisation and which would be referred directly to the state pathologists services. These cases have amounted to about 25 per year in Cape

Town since 2001 for children aged twelve years and younger (Van Niekerk & Laflamme, forthcoming). Other cases that are not reported to the hospital include the more minor ones that are reported outside of the hospital, at one of the other public hospitals (there are twelve in Cape Town), private hospitals (eight in Cape Town) and clinics or with private practitioners, a loss for which there is no estimate available. The addition of this data would provide a more accurate indication of the extent of the childhood burn injury problem in the Western Cape than estimated by Study I. To accommodate for this potential bias, both Study I and II coded cases according to severity categories, and focussed only on cases that required hospitalisation. The majority of such cases reporting to the public health system would have been referred to the Red Cross Children's Hospital. Efforts to obtain similar data from the private sector were declined for undisclosed reasons. Nonetheless, an in-house telephonic survey by the author of selected private hospitals in 2005 indicated that the hospitalised cases probably represent a limited proportion of the annual caseload for Cape Town and more broadly the Western Cape.

Other limitations

A number of other considerations may impact of the thesis findings, discussed below.

Ecological design. The investigation of the impact of living conditions on child burn injury must be considered within the limitations of the ecological study design (Study II). The study set out to measure the association between area characteristics and paediatric burn injuries, based on indications that child safety is strongly influenced by their living conditions (Engstrom *et al.*, 2002), that area has an independent effect on child safety (Reading, Haynes & Shenassa, 2005), and that area is a suitable target for prevention (Dowswell *et al.*, 1996). However, it is not clear if and how the findings can be applied at the individual child or family-household conditions, despite child burn injury occurrence being highly influenced by the local environment. It is further difficult to say whether this investigation measured sums of individual exposures (so-called compositional effects) or alternatively, if the results reflect more complex mechanisms that involve both area and individual factors. In the latter case the living area may be exacerbating the risks that are already present at the family unit level (Diderichsen, Laflamme & Hallqvist, 1999).

Racial classifications. Race is a concept that has remained of great interest to the South African public and research communities, because of its prominence in past South African policies of racial discrimination, disenfranchisement, domination and inequality, and group area segregation, but also its persistent

association with core indicators of living circumstances such as socio-economic status and barriers, and household conditions (Day & Gray, 2003; Statistics South Africa, 2004). In Studies I and II, racial terminology is used as a proxy for living conditions. The consistent associations between race and injury outcome is considered the result of differences in exposure or alternatively differential susceptibility, with the latter a reflection of aggregated socio-economic status, even though within racial groups (in particular those groups most discriminated against in the past, i.e. Africans) there are now growing differences in socio-economic status (Statistics South Africa, 2004).

Trustworthiness. Qualitative research allows an exploration of why rather than how often phenomena occur, and is especially useful for the investigation of events that are considered to have complex multi-faced aetiologies (Roberts, 1997). Qualitative research findings need to be evaluated in terms of the trustworthiness of their findings. The concepts of credibility, dependability and transferability have often been used to describe different aspects of data trustworthiness (Graneheim & Lundman, 2004).

Credibility. This deals with the quality of the research process and refers to how well data collection and processes of analysis address the research objectives (Graneheim & Lundman, 2004; Odberg Pettersson, 2004). The extensive interview preparation, and implementation and subsequent support arrangements were required in consideration of the traumatic experiences suffered by caregivers after the burn injury to their child (Study III). To accommodate for the sensitivity of these interviews, all were conducted by the thesis author, a clinical psychologist with both injury research and therapeutic experience of childhood and adult trauma, aware of the potentially intrusiveness nature of the interview. Despite the Red Cross Hospital and the Burn Unit's support for the study, almost 30% of those invited to participate in the study declined. In many cases this was evidently because of language barriers, but there are other plausible reasons like feelings of guilt (Scheidt *et al.* 2000) and where intentional injuries were inflicted, a potentially significant proportion of childhood burn events (Hobbs 1989).

Furthermore, interviews were only conducted in either English or Afrikaans (comprising 69.4% of the Cape Town population), which resulted in the exclusion of Xhosa interviews for Studies III and IV. This limited the participation of respondents from a population group that remains the most socially and economically marginalised (Dorrington 2000; May, 1998). It is however anticipated that the similarities in daily chores, sources of danger and manners of dealing with these in the home will be considerable among people in

low-income settings in Cape Town (Study III). The challenges to capturing the socio-linguistic context of Xhosa speakers, and the translation of complex responses via a process of categorisation and analysis, would have been exacerbated (Studies III and IV). However, it is anticipated that the researcher's technique would have been refined with each successive interview.

Dependability. This refers to how well study processes can be audited (Graneheim & Lundman, 2004; Odberg Pettersson, 2004). Audio recordings and verbatim recordings are available for all interviews conducted for Studies III and IV. The analytic processes are well defined according to a general procedure operationalising for Study III the grounded theory principles of Glaser and Strauss (1967) with core content analytic steps (Burnard 1991). Study IV followed content analytic steps alone (Babbie, 2001; Miller & Brewer, 2003; Patton, 2002). Rater responsibilities for transcript review, coding, categorising, and the selection of data illustrations, were well defined (Studies III and IV), and consistent with the respective analytic techniques (Burnard 1991; Glaser & Strauss, 1967).

Transferability. This refers to the extent to which findings can be transferred to other settings and groups, i.e. the generalisability of the results (Graneheim & Lundman, 2004). This is less a concern for this or other qualitative research, as its findings provide an indication of phenomena within a specific context (Hamberg, Johansson & Lindgren, 1994). This thesis focuses on the contexts and situations particular to Cape Town and its surrounds. Thus, the participants and their backgrounds are described in some detail to facilitate the implementation of similar research (Odberg Pettersson, 2004). Selected demographic data is available for the participants in Studies III and IV and the models of the burn injury event, and remote and preventive factors (Study III), of scalding counter-measures and actions (Study IV), and the lists and descriptions of counter-measure barriers and enablers (Study IV) may be compared to applications in similar contexts.

7. CONCLUSIONS

The thesis provides a detailed South African account of individual patterns and circumstances of paediatric burn occurrence, three main dimensions of contextual exposure, and depictions of three categories of counter-measures. The composite studies contribute to the emerging South African research platform for prevention, but highlights the considerable physical and social challenges likely to constrain even organised and committed individual and community prevention efforts.

The study results describe a synthesized account of the occurrence and circumstances of paediatric burns in and around Cape Town. It emphasizes four age and type specific patterns, providing greater clarity on the individuals at risk. The thesis expands on descriptions of the family, home and community contexts to these individual patterns of burn injury, emphasizing the persisting contributions of economic, social and personal hardship to burn injury vulnerability.

These studies indicate that impoverished home environments, marked by spatial congestion, the augmented access to thermal hazards, and numerous household chores and demands, are a considerable challenge to burn prevention; as witnessed in Studies III and IV, and shown ecologically in Study II. In these contexts, counter-measures that focus on changes to home practices and the physical home environment are appropriate considerations. These measures are consistent with the aetiological emphasis placed on their home environment and simultaneously with those public health recommendations for environmental and technological interventions. However, the barriers to these measures are considerable, and not easily modifiable.

The thesis highlights the need for burn injury prevention efforts that address these aspects of the home environment. It also calls for greater recognition of the considerable demands placed on families that are socially or economically pressured or marginalized. This may require a concerted effort and advocacy given the status of the affected communities.

8. ACKNOWLEDGEMENTS

There are a great many people, without which this thesis would not have taken the shape that it has.

Lucie Laflamme, my supervisor, collaborator and intellectual guide, for sharing with me, your vast knowledge, your many considered judgements, and your deep generosity of spirit. Thank you for striding the hurdles of time, geography and knowledge to enable my learning and my experiences of growth.

Mohamed Seedat, for firstly stimulating an interest in the world of community psychology and public health; and thereafter involving me in countless intellectual and social adventures, often across many time zones; my thanks to the opportunities you have unselfishly offered.

The many generous and kind people who participated in these studies, offering me their stories and experiences, and sharing many times both their insights and pain to a relative stranger. My thanks and warm thoughts to you for involving me in your lives.

My colleagues and friends in the small, feisty and committed world of burn prevention in South Africa, despite the limits that we continually face, the passion, perseverance and commitment for child safety that I have been privileged to share with you are indispensable in my own ongoing work.

The many dear and treasured friends, for tolerating my frequent absences, encouraging me when needed, you lift my spirits with your company and your presence in my life.

My family, my mother, father, sister, the many aunts and uncles and cousins. My life is anchored in your love and care. Always keep me close to you.

To the many colleagues that I have had the pleasure of working with: my heartfelt thanks to you for your many kind assistances along the way; sharing tea, editing references; compiling tables; picking me up at airports; thank you.

And finally, to my life partner, Rivashani, and my darling son Kai, who have forever changed my life, my place in this world, and brought a long overdue balance to my life, my deep love to you.

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APPENDIX

RED CROSS WAR MEMORIAL CHILDREN'S HOSPITAL

TRAUMA UNIT RECORD

FDX15

Sticky label

SURNAME: 81422 RACE/SEX: 81422

FIRST NAME: FOLDER No.: DATE OF BIRTH:

ADDRESS:

DATE: TIME (Nearest hr, 24 hr, clock): HOURS SINCE INJURY: RACE/SEX: 1=WM 3=CM 5=AM 7=BM 2=WF 4=CF 6=AF 8=BF

CAUSE (Mark one code with circle)

TRANSPORT	ASSAULT	BURN	FALL	MISCELLANEOUS
01 MVA Pedestrian	10 Blunt	20 Flame	30 Off bed	40 Struck by/Against
02 MVA Passenger - restrained	11 Sharp	21 Fluid	31 Stairs/steps	41 Caught between
03 MVA Passenger - unrestrained	12 Rape/sexual assault	22 Heat contact	32 Attendants arms	42 Sharp instrument
04 MVA Passenger - bkkd/minibus	13 Human bike	23 Electrical	33 Playground equip.	43 Firearm
05 Cycle	14 Other	24 Chemical	34 Mobile	44 Machinery
06 Motorcycle		25 Explosion	35 Other heights	45 Dog bite
07 Other, e.g. boat, train, plane, home		26 Other	36 Other level	46 Other bike
				47 Immersion/Drowning
				48 Suffocation
				49 Food FB
				50 Other FB
				51 Other cause
				52 Unknown

PLACE OF OCCURRENCE

OWN HOME	SCHOOL/CRECHE	ADDRESS WHERE ACCIDENT OCCURRED (If 56 = 5, 7, 8 or 9)	ADMISSION	DISPOSAL FROM TRAUMA UNIT
1 Own home inside	8 School/Creche		1 Not admitted	01 Abandoned
2 Own home outside	7 Public place*		2 Admitted to Trauma Unit	02 Home/OP
3 Other home inside	6 Sport*		3 Admitted directly to other ward/ICU	03 Day Hospital
4 Other home outside	5 Other*			04 Other Hospital
5 Road/Pavement*	0 Unknown			05 Out-Patient
				06 Went
				07 Burns unit
				08 ICU
				09 Childrens Agency
				10 Died

UNCONSCIOUS: 1 No, 2 Yes

SHOCK: 1 No, 2 Yes

RESUSCITATION: 1 None, 2 Simple, 3 Complex

ANAESTHETIC: 1 None, 2 Local/Regional, 3 General

SELF INFLECTION: 1 No, 2 Yes

ABUSE: 1 No, 2 Possible, 3 Yes

CODES FOR ANATOMY, PATHOLOGY, INJURY SCORE AND TREATMENT (ONE SET OF CODES/INJURY - MAX. 4)

ANAT	PATH	AIS	TRT	ANAT	PATH	AIS	TRT	ANAT	PATH	AIS	TRT	ANAT	PATH	AIS	TRT
1				2				3				4			

ANATOMY

01 No injury	16 Shoulder girdle	31 Kidney/lumbar
02 Neck	17 Shoulder joint	32 Bladder/urethra
03 Skull	18 Upper arm	33 Pelvis
04 Brain - Closed	19 Elbow (x/condylar)	34 Perineum/buttock
05 Brain - Open	20 Elbow - other	35 Vertebral column
06 Eye (x)	21 Forearm	36 Spinal cord
07 Nose	22 Wrist	37 Hip/shoulder neck
08 Facial bones	23 Hand	38 Femur - shaft/tibial
09 Mouth/Oral	24 Neck/neck	39 Knee region
10 Mandible	25 Throat/neck	40 Tib/fib, shaft/ball
11 Ear	26 Throat/neck	41 Ankle region
12 Face/Other	27 Throat/CVS	42 Foot
13 Neck	28 Abdominal wall	
14 Oesophagus	29 Abdominal visc	

PATHOLOGY

01 None	14 Joint injury - open
02 Concussion	15 Fracture - pathol.
03 Abrasions	16 Fracture - closed
04 Closed lacer	17 Fracture - open
05 Laceration - superficial	18 Fracture dislocation
06 Laceration - complex	19 Foreign body
07 Avulsion/amputation	20 Pneumothorax
08 Burns	21 Haemothorax
09 Vascular injury	22 Haemopneumothorax
10 Nerve injury	23 CSA no injury
11 Muscle/tendon injury	24 CSA injury present
12 Dislocation	25 Other
13 Joint injury - closed	

ABR. INJURY SCORE (AIS)

1 Minor	3 Severe
2 Moderate	4 Mortal

TREATMENT

1 Antiviral/Medication/HIF
2 Dressing/Simple PGP
3 Clean and suture
4 Observation/Traction
5 EVACUATION
6 Open operation
7 Amputation
8 Skin graft
9 Other

SIGNATURE: _____ HISTORY: _____

PULSE: _____ FMR: _____

TEMP: _____ EXAMINATION: _____

TET TOX: _____

Hb: _____

Wt: _____

HFBUS/CSA: _____

EMERGENCY DRUGS: _____