# Urban and rural differences in child injury deaths in South Africa: A one-year review

**Lu-Anne Swart**
*UNISA Institute for Social and Health Sciences, PO Box 1087, Lenasia, South Africa, swartl@unisa.ac.za, Tel: +27 11 857-1142, Fax: +27 11 857-1770*

**Hawabibi Laher**
*UNISA Institute for Social and Health Sciences, Johannesburg, South Africa*

**Mohamed Seedat**
*UNISA Institute for Social and Health Sciences and MRC-UNISA, Safety and Peace Promotion Research Unit (SAPPRU), Johannesburg, South Africa*

**G. Gantchev**
*Mpumalanga Forensic Pathology Services*

**Abstract**

Injury, a major cause of morbidity and mortality for children worldwide, is concentrated in low- to middle-income countries (LMICs). Despite the growing rate of childhood injury in LMICs, effective prevention and control remain inadequate owing to the lack of comprehensive epidemiological information on the external causes and magnitude of this problem. This population-based study examined whether the incidence and the pattern of fatal injuries among children differ in rural and urban areas of South Africa. The National Injury Mortality Surveillance System (NIMSS) was used to select cases for the period of 2007. Age- and gender-specific incidence rates for rural and urban children were computed for specific injury types. Following a cross-sectional method, we analysed all deaths among children below 15 years of age in Gauteng (urban) and Mpumalanga (rural) who died in 2007. For the year 2007, NIMSS recorded a total of 612 injury deaths among children in Mpumalanga (rural) and another 1 400 injury deaths among children in Gauteng (urban). Equally high overall injury death rates were found among children from Gauteng (31.7/100 000) and Mpumalanga (29.2/100 000). The study also revealed several differences with respect to the primary external causes of child injury-related deaths across the two provinces. In particular, passenger-related motor vehicle deaths were more evident among children in rural areas than in urban areas, while other unintentional (non-transport-related) deaths – specifically those associated with burns – were more common among urban children than among rural children.

Such differences may arise because of the many environmental and infrastructure-related differences that exist between rural and urban areas. Therefore, prevention and intervention efforts in South Africa should focus on the risk factors that are unique to urban and rural children respectively.

***Keywords:*** childhood, urban, rural, deaths

## INTRODUCTION

Globally, the magnitude and patterns of injury death and disability among children (see Peden, Oyegbite, Ozanne-Smith, Hyder, Branche, Fazlur Rahman, Rivara & Bartolomeos 2008) are influenced by factors such as stage of development, inexperience, and the physical and socioeconomic environments in which they live. Geography is as an important explanatory factor in accounts of injury variation. For instance, child injury death rates are higher in low- and middle-income countries than in high-income countries (UNICEF 2001). Within individual countries, the frequency and patterns of child injury

mortality vary between rural and urban areas, with several studies having reported variations in the frequency and type of injury occurring in rural versus urban areas (Boland, Staines, Fitzpatrick & Scallan 2005; Coyne-Beasley, Schoenbach & Herman-Giddens 1999; Du, Finch, Hayden & Hatfield 2007; Fingerhut, Ingram & Feldman 1998; Hwang, Stallones & Keefe 1997; Kmet & Macarthur 2006; Nance, Denysenko, Durbin, Branas, Stafford & Schwab 2002).

Studies conducted in Australia, Canada, Ireland and the United States of America (USA) have found that unintentional injury death rates, especially those related to motor vehicle injury deaths, are considerably higher among rural children than among their urban counterparts (Boland et al 2005; Du et al 2007; Hwang et al 1997; Kmet & Macarthur 2006). Rural children's vulnerability may be related to their challenging living environments (Boland et al 2005), the lack of access to medical care services and differences in behavioural norms (Zwerling, Peek-Asa, Whitten, Choi, Sprince & Jones 2005). The pattern is somewhat different for intentional injuries, where studies in the United States reveal that urban children are more susceptible to homicides and assaults, particularly those associated with firearms, compared with children living in rural or small urban areas (Coyne-Beasley et al 1999; Fingerhut et al 1998; Nance et al 2002).

Such studies highlight the need for childhood injury prevention strategies and interventions to be sensitive to geographic variations. However, most of our understanding of the influence of geography on childhood injury magnitude and patterns arises from studies conducted in high-income countries. Of the limited research conducted in LMICs, urban–rural differences appear to differ according to geographical region. For example, a review of community-based studies of unintentional injuries in children in Southeast Asian countries found that injury rates for road traffic incidents, drowning and burns were higher among rural than among urban children in all countries (Pant & Towner 2010). However, in a study examining injury patterns in rural and urban Uganda, the overall injury rate was higher in the urban setting (Kobusingye, Guwatudde & Lett 2001). Furthermore, road traffic injuries were the leading cause of death in the city, while drowning was the main cause in the rural setting. In another study conducted in Tanzania (Africa), transport-related nonfatal injuries were higher in the urban area of Dar es Salaam, while nonfatal injuries due to falls and cuts were higher among rural residents in Hai (Moshiro, Heuch, Åstrøm, Setel, Hemed & Kvåle 2005). This shows a need to consider low- to middle-income country particularities in geographical analyses of childhood injuries.

For instance, in South Africa, the rate of urbanisation has increased dramatically over the past few years, partly as a result of natural population growth and migration into urban areas. The 2001 Census indicated that the majority (56%) of South Africans lived in urban areas (Statistics South Africa 2006). In the context of rapid urbanisation, many children live in informal settlements, on the periphery of cities. These areas are characterised by inadequate housing, poor sanitation and high levels of unemployment and poverty (South African Cities Network 2011) – conditions that increase children's risk of injury. In South Africa, as in other low- and middle-income countries, rapid urbanisation has placed a strain on local and national authorities to provide basic services. The current rapid pace of urban growth typically exceeds the capacity of most cities to provide adequate services for their residents (Cohen 2006).

Despite the high level of urbanisation, most of South Africa's children (54%) reside in rural areas (Children's Institute 2007) where poverty is prevalent. About 54% of rural households experience poverty, in comparison with around 22% of urban households. In addition, within rural areas, access to important services and facilities, such as medical care, is often linked with long travelling distances, making it more expensive (Armstrong, Lekezwa & Siebrits 2008).

In an attempt to consider such particularities and help to improve geographically focused analysis, this article aims to compare the magnitude and patterns of childhood injury mortality in two South African provinces, namely Gauteng and Mpumalanga. Whereas Gauteng is defined as predominantly urban, Mpumalanga is mainly rural in nature. Although there are no agreed-upon universal criteria delineating rural and urban areas, they may be distinguished by differences along several dimensions, including infrastructure, social services, non-agricultural employment, income and population density (World Bank 2011).

Studies drawing on urban-based data systems show that in South Africa, road traffic injuries (particularly pedestrian incidents), burns, drowning and – in some cities – firearm injuries are among the leading causes of unnatural death for children aged 14 and younger (Matzopoulos 2004; Burrows, Van Niekerk & Laflamme 2010), while pedestrian injuries, burns, falls and poison ingestion are the leading causes of nonfatal injuries among children. In South African cities, injuries in general appear to be concentrated in low-income neighbourhoods characterised by a lack of infrastructure and resources, overcrowding and high levels of unemployment and poverty – conditions that are typical of informal settlements (Butchart, Kruger & Lekoba 2000; Van Niekerk, Seedat, Bulbulia & Kruger 2001). Poor housing, including the lack of clearly demarcated areas for cooking or washing, inadequate recreation space, the use of open fires and paraffin (kerosene) stoves and heaters – owing to the lack of electricity – and the lack of safe storage for paraffin and other harmful substances, are among the major hazards that place children at risk of burns, poisoning and fall-related injuries (Butchart et al 2000; Van Niekerk, Rode & Laflamme 2004). These high rates highlight the urgent need for intervention to reduce child injury deaths in South Africa. However, as already alluded to above, much of the analysis on childhood fatal injuries in South Africa is based on the National Injury Mortality Surveillance System (NIMSS), which assumed an urban concentration. Limited rural-based studies in South Africa suggest that major causes of injury mortality among rural children may differ somewhat from urban children. For example, a study conducted in a rural district of KwaZulu-Natal province found that road traffic incidents (mainly pedestrian) were the single most common cause of death among children (0–9 years), while from the age of 10 upwards, homicide dominated as the leading cause of injury death (Garrib, Herbst, Hosegood & Newell 2011). Similarly, in the rural region of Transkei in the Eastern Cape province, Meel (2006; 2008) found that motor vehicle accidents and homicides were the leading causes of injury death among children. Therefore, interventions to reduce child injury deaths in South Africa must take into account the unique needs of urban and rural children respectively.

In recent years, the NIMSS has expanded its coverage to include rural areas. In 2007 the NIMSS obtained full injury death coverage of two of South Africa's nine provinces, namely Gauteng and Mpumalanga. Even though full coverage was not continuous for subsequent years because of various institutional factors, the 2007 data present an empirical opportunity to examine urban–rural injury mortality rates of the general population across the two provinces (see Sherriff, Mackenzie, Swart, Seedat, Bangdiwala & Ngude, forthcoming). Therefore, our study specifically aims to compare the following: (1) the overall injury death rates and the distribution of unintentional and intentional injury deaths; (2) the top five external causes of injury death; (3) traffic mortality rates by road-user type; (4) non-traffic unintentional death rates by external cause; (5) homicide rates by external cause; and (6) suicide rates by external cause among children (0–14 years) across urban Gauteng and rural Mpumalanga in South Africa for the year 2007.

## METHODS

In South Africa, the Children's Act 38 of 2005 defines a child as a person under the age of 18 years, which is consistent with the definition specified in the United Nations International Convention on the Rights of the Child (1989). The literature on child injury, however, uses various ranges, such as 0–14 years, 0–17 years and 0–19 years (see Peden et al 2008; UNICEF 2001). In this study we specifically focus on children between the ages of 0 and 14 years, as – both locally and internationally – injuries assume a significant intentional dimension from the age of 15 years upwards (Matzopoulos 2004; Pinheiro 2006).

### Site information

Urban areas are defined as localities characterised by a threshold population of greater than 1 000 and a population density of greater than or equal to 500 per square kilometre. Following this definition, Statistics South Africa (2003b) classifies 88.5% of the population in Gauteng and 38.33% of the population in Mpumalanga as urban dwellers. (See table 1 for a description of selected population and housing characteristics of the two provinces).

Gauteng, a predominantly urban province, has the smallest land surface of the nine provinces in South Africa, covering just over 17 000 square kilometres. Despite its size, the province is highly urbanised, with three of South Africa's eight metropolitan municipalities being located in Gauteng, namely the City of Johannesburg, the City of Tshwane (Greater Pretoria) and the Ekurhuleni Metropolitan. The province contributes 33.5% to the national gross domestic product (GDP) (Statistics South Africa 2009). Gauteng has the second-largest population (8 837 178) (Statistics South Africa 2003a) of the nine provinces in South Africa, with a population density of 519.5 people per square kilometre. Mid-year population estimates for 2007 revealed that just over 2.5 million children (0 to 14 years) live in Gauteng, constituting just over a quarter of the total population (Statistics South Africa 2007).

Mpumalanga is the second-smallest province in South Africa, covering 79 490 square kilometres. The province is primarily rural, comprising coal mines, farmlands, forest plantations and nature reserves; it contributes 6.9% to the national GDP. With a population of 3 122 990 (Statistics South Africa 2003a), Mpumalanga has approximately 39.3 people per square kilometre. Just over 1.2 million children (0 to 14 years) live in Mpumalanga, constituting over a third of the total population (Statistics South Africa 2007).

Table 1 provides selected population and housing characteristics for Gauteng and Mpumalanga provinces. With respect to family structure, just over half (54.6%) of Gauteng's children live with their biological parents, while less than a third (30.8%) of Mpumalanga's children do so.

Unemployment and poverty levels are also higher in Mpumalanga than in Gauteng. Even though most (82.3%) of Gauteng children live in households with at least one employed adult, almost half (47.5%) are living below the poverty line. Around 12.4% also live in households where there is reported hunger. Conditions are different in Mpumalanga: less than two-thirds (64.7%) of children live in households where there is at least one employed adult. The vast majority (74.2%) live in income poverty, and 16.1% live in households where there is reported hunger.

Most of Gauteng's (96.0%) and Mpumalanga's (97.7%) school-age children attend school, with children living in Mpumalanga generally having further to travel to school than those living in Gauteng. Similarly, more children in Mpumalanga than in Gauteng live far from the nearest clinic. The availability and distribution of health services is also poorer in Mpumalanga than in Gauteng. For example, in 2007 the ratio of the population per qualified nurse in Mpumalanga was 359:1, compared with 182:1 in Gauteng (South African Nursing Council 2007).

Fewer of Gauteng's children (67.9%) than Mpumalanga's (79.8%) live in formal housing. Furthermore, around a third (30.6%) of Gauteng's children live in overcrowded households, compared with around a quarter (24.6%) in Mpumalanga. However, a higher percentage of children in Gauteng than in Mpumalanga have access to basic services, such as water on site (91.0% *vs* 71.8%) and basic sanitation (87.7% *vs* 52.2%), while slightly more children in Mpumalanga than in Gauteng have access to electricity (88.4% *vs* 82.0%). Household usage of wood for cooking is higher in Mpumalanga than in Gauteng, while the use of paraffin for cooking is higher in Gauteng.

With regard to road traffic, Gauteng has a considerably higher volume (55 vehicles per one kilometre of road) than Mpumalanga (8 vehicles per one kilometre of road). However, vehicle occupancy rates are much higher in Mpumalanga (8.54 persons per vehicle and 161 persons per passenger transport vehicle) than in Gauteng (3.36 persons per vehicle and 85 persons per passenger transport vehicle). In terms of mode of travel, 38.6% of Gauteng children travel on foot, 13.7% travel by car (as a passenger) and 12.2% travel by public transport, such as minibus-taxis and buses, while more than half (56.3%) of Mpumalanga children travel on foot, 3.4% travel by car (as a passenger) and 5.2% travel by public transport.

**Table 1: Selected population and housing characteristics of Gauteng and Mpumalanga provinces**

| Province | Gauteng | Mpumalanga |
|---|---|---|
| **Population**[a] | | |
| Total | 9 688 100 | 3 536 300 |
| Number of children (0-14years) | 2 544 000 | 1 232 500 |
| Male | 1 285 800 | 616 800 |
| Female | 1 258 200 | 615 700 |
| **Family structure** | | |
| Percentage of children (0–17 years) living with biological parents[b] | 54.6% | 30.8% |
| Percentage of children (0–17 years) living with biological mother only[b] | 31.7% | 42.4% |
| Child-headed households[b] | 0.2% | 0.6% |
| **Unemployment and poverty** | | |
| Percentage of children (0–17 years) living in households with an employed adult[b] | 82.3% | 64.7% |
| Percentage of children (0–17 years) living in income poverty[b] | 47.5% | 74.2% |
| Percentage of children (0–17 years) living in households where there is reported hunger[b] | 12.4% | 16.1% |
| **Access to health care services** | | |
| Percentage of children (0–17 years) living far from the nearest clinic[b] | 21.8% | 37.6% |
| Population per qualified nurse[f] | 186:1 | 294:1 |
| **Access to education** | | |
| Percentage of school-age children attending school[b] | 96.0% | 97.7% |
| Percentage of children (0–17 years) living far from the nearest primary school[b] | 11.1% | 16.7% |
| Percentage of children (0–17 years) living far from the nearest secondary school[b] | 17.1% | 32.5% |
| **Access to housing** | | |
| Percentage of children (0–17 years) living in formal housing[b] | 67.9% | 79.8% |
| Percentage of children (0–17 years) living in overcrowded households[b] | 30.6% | 24.6% |
| **Access to basic services** | | |
| Percentage of children (0–17 years) living in households with water on site[b] | 91.0% | 71.8% |
| Percentage of children (0–17 years) living in households with basic sanitation[b] | 87.7% | 52.2% |
| Percentage of children (0–17 years) living in households with electricity connection[b] | 82.0% | 88.4% |
| Percentage of households using wood for cooking[c] | 0.9% | 20.2% |
| Percentage of households using paraffin for cooking[c] | 10.3% | 6.4% |
| **Mode of travel** | | |
| Percentage of children (0–14 years) who travel on foot[d] | 38.4% | 53.0% |
| Percentage of children (0–14 years) who travel by car as passenger[d] | 14.6% | 3.4% |
| Percentage of children (0–14 years) who travel by minibus/taxi[d] | 6.8% | 2.1% |
| Percentage of children (0–14 years) who travel by busd | 3.5% | 2.4% |
| **Road traffice** | | |
| Number of vehicles per one kilometre of road[e] | 55 | 8 |
| Number of persons per vehicle (excluding trucks)[e] | 3.36 | 8.54 |
| Number of persons per passenger transport vehicle (minibuses and buses)[e] | 85 | 161 |

**Sources:**

(a) Statistics South Africa. (2007). Mid-year population estimates. P03022007.

(b) Pendlebury, S, Lake, L & Smith, C. (eds). (2009). *South African child gauge 2008/2009.* Cape Town: Children's Institute, University of Cape Town. (Children are defined as those individuals younger than 18 years.)

(c) Statistics South Africa. (2003). *Census in brief.*

(d) Statistics South Africa. (2003). Census 2001: *Community profiles database* [computer program], *version 1.* Cape Town.
(e) Road Traffic Management Corporation.
(f) South African Nursing Council. *Geographical distribution 2011.*

**Data source**

Data on all child (0–14 years) injury deaths occurring in Gauteng and Mpumalanga during the year 2007 were extracted from the National Injury Mortality Surveillance System (NIMSS) for this study. The NIMSS database is generated from mandatory investigations recorded at the medico-legal laboratories. For every non-natural death that enters the forensic medico-legal system, the forensic pathologists and forensic officers that contribute to the NIMSS complete a single data form to record the demographics of the victim, time and place of injury, external cause and apparent manner of death (e.g. homicide, suicide, accidental, undetermined). The NIMSS utilises the International Classification of Disease 9 (ICD 9) to identify the primary cause of death. The forensic officers or clerical staff enter the data into a computerised database. At the end of each year, the data from all of the participating medico-legal laboratories are sent to the Safety and Peace Promotion Research Unit, which is co-directed by the Medical Research Council and the University of South Africa and manages the NIMSS (Matzopoulos 2004).

**Data analysis**

The frequency and percentage of the apparent manner and external cause of death are presented to compare the distribution of unintentional, homicide and suicide deaths, as well as the top five external causes of injury death among children in both provinces. To compare traffic, non-traffic unintentional, homicide, and suicide child injury deaths, age- and sex-specific rates were computed for each province. Mid-year population estimates for the specific age group, sex and province were used to calculate the rates for 2007 (Statistics South Africa 2007) (see table 1 for population estimates). Whenever at least one of the provinces had more than 10 cases of a specific external cause of child injury death, differences between the rates (urban *vs* rural) were computed to draw a comparison between the two provinces. The formulas outlined by the Pennsylvania Department of Health's *Tools of the trade* were used to compute the 95% confidence interval directly for the difference between the two province rates to determine whether a significant difference exists. A 95% confidence limit (CL) was constructed for each of the two province rates (CL = 1.96 x (rate/square root of number of injury deaths)). Then the 95% confidence interval (CI) for the difference between the two rates (D) was computed using the following formula: CI = D ± square root of ($CL1^2$ + $CL2^2$) where: CL1 = confidence limit for Gauteng rate and CL2 = confidence limit for Mpumalanga rate. Confidence intervals (CIs) not containing the value 0 indicate that the difference between the province rates is significantly different with 95% confidence (Pennsylvania Department of Health, n.d.).

**RESULTS**

The NIMSS recorded a total of 800 child injury deaths in Gauteng and 360 in Mpumalanga for the year 2007. Total overall injury death rates were slightly higher among children in Gauteng (31.7/100 000) than among those in Mpumalanga (29.2/100 000). Of the child injury deaths in Gauteng, the overwhelming majority were unintentional (*n* = 712; 89.0%), followed by homicide (*n* = 72; 9.0%) and suicide (*n* = 16; 2.0%). A similar pattern was noted for Mpumalanga, where 87.5% (*n* = 315) of the child injury deaths were unintentional, 10.5% (*n* = 38) were homicide and 2.0% (*n* = 7) were suicide.

Figure 1 presents the top five causes of child injury death in Gauteng and Mpumalanga respectively. In Gauteng, child injury deaths were caused primarily by pedestrian injuries, followed by burns, drowning, passenger-related injuries and fall-related injuries, which together accounted for more than two-thirds (*n* = 558; 69.8%) of all child injury deaths in that province. In Mpumalanga, pedestrian injuries, followed by passenger-related deaths, drowning, burns and poisoning were

the main causes of child injury deaths. Over three-quarters (*n* = 278; 77.2%) of all the child injury deaths in Mpumalanga were the result of one of the top five causes of fatal injury.

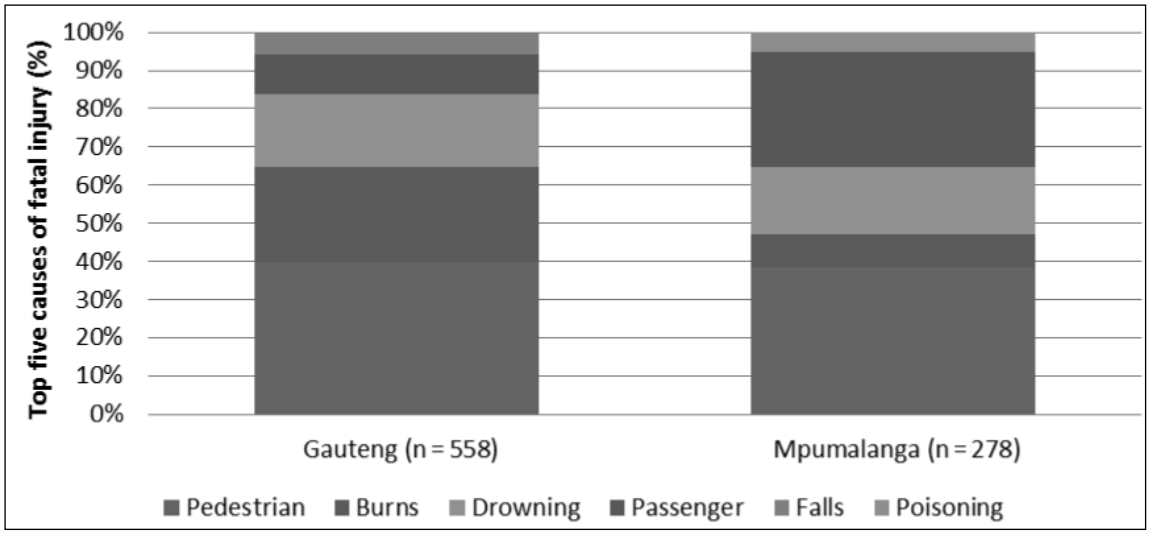


**Figure 1: Top five causes of fatal injury in children aged 0–14 years by province, 2007**

### Traffic-related injuries

Although the motor vehicle injury death rates were generally higher among Mpumalanga children, only female deaths were significantly higher in Mpumalanga (13.5/100 000) than in Gauteng (8.6/100 000) (see table 2). Pedestrian injuries were the leading cause of traffic mortality among male and female children in both provinces, with no significant differences between the rates for the provinces. However, for motor vehicle passenger deaths, the rates were significantly higher for both boys and girls in Mpumalanga (7.3/100 000 and 6.3/100 000) than in Gauteng (3.1/100 000 and 1.5/100 000). For both provinces, male pedestrian and passenger fatalities were higher than those for females.

**Table 2: Child traffic-related injury death rates/100 000 and rate ratios by province by external cause and sex, South Africa 2007**

| | Gauteng | | Mpumalanga | | | |
|---|---|---|---|---|---|---|
| | **N** | **Rate** | **N** | **Rate** | **Difference in rates** | **(95% CI)[a]** |
| **Children (0–14 yrs)** | | | | | | |
| ***Males*** | 211 | 16.4 | 120 | 19.5 | –3.0 | (–7.2 to 1.1) |
| Pedestrian | 145 | 11.3 | 65 | 10.5 | 0.7 | (–2.4 to 3.9) |
| Passenger | 40 | 3.1 | 45 | 7.3 | –4.2 | **–6.5 to –1.8** |
| Other | 24 | 1.9 | 9 | 1.5 | 0.4 | –0.8 to 1.6 |
| **Females** | 108 | 8.6 | 83 | 13.5 | –4.9 | **–8.2 to –1.6** |
| Pedestrian | 78 | 6.2 | 42 | 6.8 | –0.6 | –3.1 to 1.9 |
| Passenger | 19 | 1.5 | 39 | 6.3 | –4.8 | **–6.9 to –2.7** |
| Other | 11 | 0.9 | 2 | 0.3 | 0.5 | –0.1 to 1.2 |

[a] *Significant injury rate ratios are in bold.*

### Other unintentional injuries

The overall unintentional (non-transport-related) injury deaths were significantly higher among Gauteng boys (18.8/100 000) and girls (12.2/100 000) than among Mpumalanga boys (13.0/100 000) and girls (5.4/100 000) (see table 3). Among male children, the burns death rate was significantly higher for Gauteng (6.1/100 000) than for Mpumalanga (2.6/100 000).

**Table 3: Unintentional[a] injury death rates/100 000 and rate ratios comparing rural and urban children by external cause and gender, South Africa 2007**

| | Gauteng | | Mpumalanga | | | |
|---|---|---|---|---|---|---|
| | **N** | **Rate** | **N** | **Rate** | **Difference in rates** | **CI** |
| **Children (0–14 yrs)** | | | | | | |
| ***Males*** | 242 | 18.8 | 80 | 13.0 | 5.9 | **2.1 to 9.6** |
| Burns | 78 | 6.1 | 16 | 2.6 | 3.5 | **1.6 to 5.3** |
| Drowning | 74 | 5.8 | 35 | 5.7 | 0.1 | –2.2 to 2.4 |
| Poisoning | 16 | 1.2 | 11 | 1.8 | –0.5 | –1.8 to 0.7 |
| Electrocution | 16 | 1.2 | 5 | 0.8 | 0.4 | –0.5 to 1.4 |
| Falls | 22 | 1.7 | 2 | 0.3 | 1.4 | **0.5 to 2.2** |
| Medical procedure | 15 | 1.2 | 1 | 0.2 | 1.0 | **0.3 to 1.7** |
| Suffocation | 11 | 0.9 | 1 | 0.2 | 0.7 | **0.1 to 1.3** |
| Other | 10 | 0.8 | 9 | 1.5 | –0.7 | –1.7 to 0.4 |
| ***Females*** | 153 | 12.2 | 33 | 5.4 | 6.8 | **4.1 to 9.5** |
| Burns | 60 | 4.8 | 8 | 1.3 | 3.5 | **2.0 to 5.0** |
| Drowning | 32 | 2.5 | 14 | 2.3 | 0.3 | –1.2 to 1.8 |
| Poisoning | 14 | 1.1 | 3 | 0.5 | 0.6 | –0.2 to 1.4 |
| Electrocution | 4 | 0.3 | 1 | 0.2 | 0.2 | –0.3 to 0.6 |
| Falls | 10 | 0.8 | 0 | 0.0 | – | – |
| Medical procedure | 14 | 1.1 | 0 | 0.0 | – | – |
| Suffocation | 3 | 0.2 | 3 | 0.5 | –0.2 | –0.9 to 0.4 |
| Other | 16 | 1.3 | 4 | 0.6 | 0.6 | –0.3 to 1.5 |

[a] *Excludes traffic-related injury deaths*

The rates for deaths associated with falls, medical procedures and suffocation were also significantly elevated for Gauteng boys in comparison with Mpumalanga boys. Similarly, the burns death rate was significantly higher among Gauteng girls (4.8/100 000) than among girls in Mpumalanga (2.6/100 000).

Although no significant differences were noted across the two provinces, drowning was one of the leading causes of unintentional deaths among children, with the rates being more pronounced for male children than for female children in both provinces.

### Homicides

Compared with traffic and other unintentional injury death rates, homicide rates were generally low among children, with no significant differences between the provinces (see table 4). However, whereas blunt objects (1.2/100 000) were the leading external cause of male child homicides in Gauteng, firearms (1.1/100 000) were the leading contributor to male child homicides in Mpumalanga. Child female homicide rates for both provinces, on the other hand, were caused primarily by blunt objects and strangulation.

**Table 4: Homicide death rates/100 000 and rate ratios comparing urban and rural children (0–14 years) by external cause and gender, South Africa 2007**

| | Gauteng | | Mpumalanga | | | |
|---|---|---|---|---|---|---|
| | **N** | **Rate** | **N** | **Rate** | **Difference in rates** | **CI** |
| **Children (0–14 yrs)** | | | | | | |
| ***Males*** | 45 | 3.5 | 26 | 4.2 | –0.7 | –2.6 to 1.2 |
| Firearms | 11 | 0.9 | 7 | 1.1 | –0.3 | –1.3 to 0.7 |
| Sharp object | 4 | 0.3 | 3 | 0.5 | | |
| Blunt object | 16 | 1.2 | 4 | 0.6 | 0.6 | –0.3 to 1.5 |
| Strangulation | 2 | 0.2 | 4 | 0.6 | | |
| Other | 12 | 0.9 | 8 | 1.3 | –0.4 | –1.4 to 0.7 |
| ***Females*** | 27 | 2.1 | 12 | 1.9 | 0.2 | –1.2 to 1.6 |
| Firearms | 3 | 0.2 | 2 | 0.3 | | |
| Sharp object | 1 | 0.1 | 1 | 0.2 | | |
| Blunt object | 6 | 0.5 | 5 | 0.8 | | |
| Strangulation | 6 | 0.5 | 3 | 0.5 | | |
| Other | 11 | 0.9 | 1 | 0.2 | 0.7 | 0.1 to 1.3 |

**Suicides**

Suicides were relatively uncommon among children, with no significant difference noted across the two provinces (see table 5). The majority of suicides for both boys and girls in Gauteng and Mpumalanga were associated with hanging.

**Table 5: Suicide death rates/100 000 and rate ratios comparing rural and urban children (0–14 years) by external cause and gender, South Africa 2007**

| | Gauteng | | Mpumalanga | | | |
|---|---|---|---|---|---|---|
| | **N** | **Rate** | **N** | **Rate** | **Difference in rates** | **CI** |
| Children (0–14 yrs) | | | | | | |
| ***Males*** | 10 | 0.8 | 6 | 1.0 | –0.2 | –1.1 to 0.7 |
| Hanging | 8 | 0.6 | 5 | 0.8 | | |
| Other | 2 | 0.2 | 1 | 0.2 | | |
| ***Females*** | 6 | 0.5 | 1 | 0.2 | | |
| Hanging | 5 | 0.4 | 1 | 0.2 | | |
| Other | 1 | 0.1 | 0 | 0.0 | | |

## DISCUSSION

Child injury deaths appear to be a major problem in both urban and rural areas in South Africa, with the current study reporting equally high overall injury deaths rates among children from Gauteng (31.7/100 000) and Mpumalanga

(29.2/100 000). While the overwhelming majority of these child deaths were unintentional, the study revealed several differences with respect to the primary external causes of child injury-related deaths across the two provinces. In Gauteng the child injury death rate was primarily caused by pedestrian road traffic incidents, burns, drowning, motor vehicle passenger injuries and falls, while in Mpumalanga, pedestrian motor vehicle incidents, followed by motor vehicle passenger-related injuries, drowning, burns and poisoning were the primary causes of child injury deaths. Accordingly, pedestrian-related injury deaths and drowning among children are a problem across urban and rural areas. However, passenger-related motor vehicle injury deaths were more evident among children in rural than in urban areas, while other unintentional (non-transport-related) deaths, specifically those associated with burns, were more common among urban children than among rural children.

Consistent with previous research comparing rural and urban environments, the current study found that the incidence of motor vehicle passenger deaths among children is higher in rural than in urban areas (Zwerling et al 2005). Differences in transport usage and consequent traffic patterns between the two provinces may partly account for the variation in child motor vehicle passenger deaths. The much lower traffic volume in the more rural province of Mpumalanga, compared with the volume in urban Gauteng, suggests that travelling speeds in Mpumalanga are likely to be higher; consequently, motor vehicle collisions occurring in that province result in more severe injuries and deaths than do those collisions that occur in Gauteng. Furthermore, a larger proportion of children and adolescents in Mpumalanga travel long distances to access services such as health and education. Therefore, even though a lower percentage of Mpumalanga children may make use of motorised transport, they may nevertheless be more at risk for sustaining severe injuries as a motor vehicle passenger owing to higher travelling speeds for longer distances in Mpumalanga than in Gauteng. Furthermore, many of the vehicles transporting passengers in South Africa, such as minibus-taxis and buses, are not equipped with occupant restraints. Environmental and infrastructural factors, such as the increased number of heavy and long vehicles – especially large slow-moving trucks hauling coal, steel and timber – on Mpumalanga road networks, as well as poor road conditions and insufficient maintenance, may also contribute to passenger deaths in Mpumalanga. In addition, the limited availability of emergency services may also contribute to the higher fatality rates in Mpumalanga (Muellemam & Mueller 1996; Wylie & Kimball 1997). Rural motor vehicle accidents may not be witnessed; as a result, efforts to summon help may be significantly delayed. Response time may also be longer because of the distance that may have to be travelled in the event of a crash (Brodsky 1993; Young et al 1997; Zwerling et al 2005). Interventions to reduce motor vehicle passenger deaths in Mpumalanga should focus on motor vehicle travelling speeds and the improvement of road conditions to accommodate various types of vehicles sharing the roads. Finally, bringing basic services such as health care and education closer to where rural children live would minimise the need for motorised travel and thus reduce the incidence of childhood motor vehicle passenger deaths.

The increased risk of burn-related deaths among children in the primarily urban province of Gauteng may be attributed to the higher percentage of children living in informal settlements in and around the cities of Johannesburg, Ekurhuleni and Tswane than is the case with children in Mpumalanga. Inadequate housing facilities, overcrowding and poverty are among the conditions that place children living in informal settlements at risk of burn-related injuries. In particular, the use of low-cost paraffin and open fires for cooking, heating and lighting are among the major hazards that place children at risk (Van Niekerk, Rode & Laflamme 2004). Furthermore, the close proximity of shacks means that uncontained fires are likely to spread quickly through the informal settlement areas. Accordingly, child burn prevention initiatives in urban areas need to include a focus on general socioeconomic and environmental upliftment, particularly in these low-income informal areas (Van Niekerk et al 2004).

Despite the above differences in injuries noted among rural and urban children, the study also found injuries of which children from both provinces were equally at risk. In particular, pedestrian deaths were high among children from both provinces. Similarly, drowning appeared to be a specific problem for male children from both provinces. While efforts

to manage the injury problem among South African children require that the problem of pedestrian injury deaths and drowning be addressed, further research is needed to determine the unique risk profiles for both injury types for the two provinces so that appropriate interventions for prevention may be implemented.

## CONCLUSION

In conclusion, our findings have shown that the rates of urban and rural childhood deaths differ, which suggests that prevention and intervention programmes could be better targeted to the needs of specific geographic populations of South African children. However, the current study has several limitations that need to be addressed in further studies. First, the analysis was restricted to a single year of data; thus the rates reported in this study are based on small numbers of events that may fluctuate widely from year to year, and may therefore lack stability, as suggested by some of the wide confidence intervals. Accordingly, the analyses may have lacked power; consequently, significant differences in rates between the urban and rural areas may have been underestimated. The study is also limited in that the NIMSS does not provide an extensive picture of injury risk. In particular, information regarding the scene and circumstances of the injury event are also essential for understanding the injury risk profile for children in rural and urban areas. Therefore, further research (e.g. social, demographic and environmental factors) is needed to elaborate on the specific risks of rural and urban areas in South Africa so that prevention measures may be tailored to address and reduce the injury death rates among children.

## REFERENCES


Armstrong, P, Lekezwa, B & Siebrits, K. (2008). Poverty in South Africa: A profile based on recent household surveys. *Stellenbosch Economic Working Papers:* 04/08.

Boland, M, Staines, A, Fitzpatrick, P & Scallan, E. (2005). Urban-rural variation in mortality and hospital rates for unintentional injury in Ireland. *Injury Prevention,* 11, *3*8–42.

Brodsky, H. (1993). The call for help after an injury road accident. *Accident Analysis and Prevention,* 25, 123–30.

Burrows, S, Van Niekerk, A & Laflamme, L. (2010). Fatal injuries among urban children in South Africa: Risk distribution and potential for reduction. *Bulletin of the World Health Organization,* 88, 267–272.

Butchart, A, Kruger, J & Lekoba, R. (2000). Perceptions of injury causes and solutions in a Johannesburg township: Implications for prevention. *Social Science & Medicine,* 50, 331–44.

Children's Institute, University of Cape Town. *Children count – Abantwana babalulekile.*

Statistics on children in South Africa. Housing and services – Urban-rural distribution, 2007. Retrieved November 17, 2011, from http://www.childrencount.ci.org.za/indicator.php?id=3&indicator=13.

Cohen, B. (2006). Urbanization in developing countries: Current trends, future projections, and key challenges for sustainability. *Technology in Society,* 28, 63–80.

Coyne-Beasley, T, Schoenbach, VJ & Herman-Giddens, ME. (1999). The epidemiology of adolescent homicide in North Carolina from 1990 to 1995. *Archives of Pediatric Adolescent Medicine,* 153, 349–356.

Du, W, Finch, C, Hayden, A & Hatfield, J. (2007). Differences in injury rates in child motor vehicle passengers in rural and urban areas in New South Wales, July 2000 to June 2004. *Australian and New Zealand Journal of Public Health,* 31(5), 483–488.

Fingerhut, LA, Ingram, DD & Feldman, JJ. (1998). Homicide rates among US teenagers and young adults: Differences by mechanism, level of urbanization, race, and sex, 1987 through 1995. *Journal of American Medical Association,* 280(5), 423–427.

Garrib, A, Herbst, AJ, Hosegood, V & Newell, M. (2011). Injury mortality in rural South Africa 2000-2007: Rates and associated factors. *Tropical Medicine and International Health,* 16(4), 439–446.

Hwang, H, Stallones, L & Keefe, TJ. (1997). Childhood injury deaths: Rural and urban differences, Colorado 1980-8. *Injury Prevention,* 3, 35–37.

Kobusingye, O, Guwatudde, D & Lett, R. (2001). Injury patterns in rural and urban Uganda. *Injury Prevention,* 7(1), 46–50.

Kmet, L & Macarthur, C. (2006). Urban-rural differences in motor vehicle crash fatality and hospitalization rates among children and youth. *Accident Analysis and Prevention,* 38(1), 122–127.

Matzopoulos, R. (2004). *A profile of fatal injuries in South Africa. Fifth annual report 2003 of the National Injury Mortality Surveillance System.* Cape Town: MRC–UNISA Crime, Violence and Injury Lead Programme.

Meel, BL. (2006). Mortality of children in the Transkei region of South Africa. *The American Journal of Forensic Medicine and Pathology,* 24(2), 141–147.

Meel, BL. (2008). Unnatural deaths among children in the Transkei region of South Africa. *Medicine, Science and the Law,* 48(3), 232–236.

Moshiro, C, Heuch, I, Åstrøm, AN, Setel, P, Hemed, Y & Kvåle, G. (2005). Injury morbidity in an urban and rural area in Tanzania: An epidemiological survey. *BioMed Central Public Health,* 5(11).

Muelleman, RL & Mueller, K. (1996). Fatal motor vehicle crashes: Variations of crash characteristics within rural regions of different population densities. *Journal of Trauma,* 41, 315–320.

Nance, ML, Denysenko, L, Durbin, DR, Branas, CC, Stafford, PW & Schwab, CW. (2002). The rural-urban continuum: Variability in statewide serious firearm injuries in children and adolescents. *Archives of Pediatric Adolescent Medicine,* 156, 781–785.

Pant, PR & Towner, E. (2010). Systematic review of community-based studies of unintentional injuries in children in south east Asian countries. *Injury Prevention,* 16(Suppl 1 A123).

Peden, M, Oyegbite, K, Ozanne-Smith, J, Hyder, AA, Branche, C, Fazlur Rahman, AKM, Rivara, F & Bartolomeos, K. (eds). (2008). *World report on child injury prevention.* Geneva.

Pendlebury, S, Lake, L & Smith, C. (eds). (2009). *South African child gauge 2008/2009.* Cape Town: Children's Institute, University of Cape Town.

Pennsylvania Department of Health. (n.d.). Health Statistics and Research. *Tools of the trade.* Retrieved June 13, 2011, from http://www.portalstate.pa.us/portal/server.pt?open=514&objID=556449&mode=2.

Pinheiro, PS. (2006). *World report on violence against children.* Geneva.

Sherriff, B, Mackenzie, S, Swart, L, Seedat, M, Bangdiwala, SI & Ngude, RG. (forthcoming). A comparison of urban-rural injury mortality across two South African provinces.

South African Cities Network. (2011). *Towards resilient cities: A reflection on the first decade of a democratic and transformed local government in South Africa 2001–2010.* Johannesburg.

South African Nursing Council (SANC). (2007). Statistics. *Distribution by province of nursing manpower versus the population of South Africa, 2007.* Retrieved November 20, 2012, from http://www.sanc.co.za/stats.htm.

Statistics South Africa. (2003a). Census 2001: *Census in brief, Report No. 03-02-03* (2001). Pretoria.

Statistics South Africa. (2003b). Census 2001: *Investigation into appropriate definitions of urban and rural areas for South Africa: Discussion document, Report No. 03-02-20 (2001).* Pretoria.

Statistics South Africa (2006). *Migration and urbanisation.* Retrieved June 03, 2010, from http://www.statssa.gov.za/PublicationsHTML/Report-03-04-02/html/Report-03-04-02.html.

Statistics South Africa. (2007). *Mid-year population estimates 2007. Statistical release P0302.* Pretoria.

Statistics South Africa. (2009). *Gross domestic product: Annual estimates per region 1995–2007, Fourth quarter: 2008. Statistical release P0441.* Pretoria.

UNICEF. (2001). Innocenti Research Centre. A league table of child deaths by injury in rich nations. *Innocenti Report Card* No. 2.

Van Niekerk, A, Rode, H & Laflamme, L. (2004). Incidence and patterns of childhood burn injuries in the Western Cape, South Africa. *Burns,* 30, 341–347.

Van Niekerk, A, Seedat, M, Bulbulia, S & Kruger, DJ. (2001). Childhood injury in selected low-income South African neighbourhoods. *Institute for Social and Health Sciences Monograph Series,* 2(3), 3–19.

Wilkinson, D & Gunnell, D. (2000). Youth suicide trends in Australian metropolitan and non-metropolitan areas, 1988–1997. *Australian and New Zealand Journal of Psychiatry,* 34, 822–828.

World Bank. (2011). *World development indicators.* Washington.

Young, T, Torner, JC & Sihler, KC. (1997). Factors associated with mode of transport to acute care hospitals in rural communities. *Journal of Emergency Medicine,* 24, 189–98.

Zwerling, C, Peek-Asa, C, Whitten, PS, Choi, SW, Sprince, NL & Jones, MP. (2005). Fatal motor vehicle crashes in rural and urban areas: Decomposing rates into contributing factors. *Injury Prevention,* 11(1), 24–28.