

# Fatal injuries among urban children in South Africa: risk distribution and potential for reduction

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**Objective** To determine the leading causes of fatal injury for urban South African children aged 0–14 years, the distribution of those causes and the current potential for safety improvements.

**Methods** We obtained injury surveillance data from the National Injury Mortality Surveillance System 2001–2003 for six major South African cities varying in size, development and sociodemographic composition. We calculated age-adjusted rates, by sex, population group and city, for death from the five leading causes of fatal injury as well as population attributable risks (PARs).

**Findings** The leading causes of fatal injury in childhood included road traffic injuries – among vehicle passengers and especially among pedestrians – drowning, burns and, in some cities, firearm injuries. Large differences in PARs were observed, particularly for population groups and cities. Disparities between cities and between population groups were largest for deaths from pedestrian injuries, while differences between boys and girls were greatest for drowning deaths.

**Conclusion** In the face of the high variability observed between cities and population groups in the rates of the most common types of fatal injuries, a safety agenda should combine safety-for-all countermeasures – i.e. lowering injury rates for all – and targeted countermeasures that help reduce the burden for those at greatest risk.

Une traduction en français de ce résumé figure à la fin de l'article. Al final del artículo se facilita una traducción al español. الترجمة العربية لهذه الخلاصة في نهاية النص الكامل لهذه المقالة.

## Introduction

The health and lives of children from the African Region of the World Health Organization (WHO) are threatened not only by nutritional deficiencies and infectious diseases but also by injuries of various kinds.<sup>1,2</sup> The older the children are, the more injuries they are likely to sustain and the greater the share of their overall mortality and morbidity that will be due to injuries.<sup>3–5</sup> Regional figures show that in children aged 5–14 years, injuries account for 23% of deaths, with road traffic injuries – predominantly among pedestrians – as leading causes. Additionally, childhood deaths due to violence and wars in the region are almost as numerous as childhood deaths from such causes in the rest of the world combined.<sup>6,7</sup>

Injuries need to be understood in the context of both historical and current sociopolitical development. Although still largely rural, Africa is experiencing rapid urbanization, fuelled by both natural population growth and massive migration from rural to urban areas. With an urban growth rate of almost 5%, it is urbanizing faster than any other continent in the world.<sup>3,8</sup> Infrastructural development has not kept pace with this and about 30–60% of urban residents now live in slums and squatter settlements characterized by inadequate housing, poor sanitation, high unemployment and minimal medical and social services.<sup>8</sup>

As in other regions, inequalities in wealth and health both between and within countries are considerable. South Africa, where this study was conducted, is one of the most urbanized and economically developed countries in the region. However, vast socioeconomic disparities exist, manifested mainly – but not exclusively – in disparities between population groups. Despite efforts to redress such inequalities since the government policy of

apartheid was eliminated in 1994, high levels of unemployment, violence and crime persist.<sup>9</sup>

Against this background, living and commuting conditions are precarious for many children and the risk of childhood injury is high. Yet, we know little about the sociodemographic or geographic risk distribution for the leading injury causes or where the greatest potential for risk reduction lies. Fortunately, with the development in 1999 of the National Injury Mortality Surveillance System (NIMSS) across several regions of the country, data have become available on the demographic characteristics of the deceased, the time and place of injury, and the manner and external cause of death.<sup>10</sup> In this study, these data were used to address the following questions: (i) What are the leading causes of fatal injuries for urban South African children aged 0–14 years? (ii) What are the sociodemographic and geographic distributions of those injuries? (iii) What is the current potential for exposure reduction of fatal injuries among urban South African children?

## Methods

We obtained data from all cities with full coverage by the NIMSS, 2001–2003. These cities, among the largest in the country, represent 12.9 million people, or 50% of the country's total urban population.<sup>11</sup> Children aged 0–14 years, who number 3.4 million, comprise 26% of their population. With the names of their historical urban centres and total population size in 2001, these cities are: City of Cape Town Metropolitan Municipality (Cape Town; 2.9 million); City of Johannesburg Metropolitan Municipality (Johannesburg; 3.2 million); City of Tshwane Metropolitan Municipality (Pretoria; 2.0 million); eThekweni Metropolitan Municipality (Durban; 3.1 million); Nelson Man-

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Table 1. Distribution of the population aged 0–14 years and of all fatal injuries in children across sociodemographic groups for six South African cities,<sup>a</sup> 2001–2003

Characteristic	Population No. (%)	All injury deaths No. <sup>b</sup> (%)
<b>Sex</b>		
Female	1 654 421 (50.1)	1139 (39.4)
Male	1 646 769 (49.9)	1750 (60.6)
<b>Age in years</b>		
0–4	1 078 110 (32.7)	1318 (45.1)
5–9	1 090 825 (33.0)	822 (28.1)
10–14	1 132 254 (34.3)	783 (26.8)
<b>Population group<sup>c</sup></b>		
Indian/Asian	194 284 (5.9)	70 (2.4)
White	365 536 (11.1)	151 (5.2)
Coloured	587 940 (17.8)	455 (15.7)
African	2 153 429 (65.2)	2221 (76.7)
<b>Total</b>	<b>3 301 190 (100)</b>	<b>2923 (100)</b>

<sup>a</sup> Buffalo City, Cape Town, Durban, eThekweni, Johannesburg, Nelson Mandela and Tshwane.

<sup>b</sup> Total numbers may vary across variables because of missing data for sex and population group.

<sup>c</sup> Classification by population group as used by the South African government.

Data sources: South African Census 2001;<sup>11</sup> National Injury Mortality Surveillance System, 2001–2003.

dela Metropolitan Municipality (Port Elizabeth; 1 million) and Buffalo City Local Municipality (East London; 0.7 million).

Fatal injuries in the cities examined in this study account for 32–37% of the country's estimated annual 60 000–70 000 injury deaths.<sup>10</sup> Approximately 7% of those fatal injuries occur in children aged 0–14 years. The data on fatal injury cases included all four population groups used in South Africa: African, coloured (referring to mixed population group heritage), Indian/Asian and white.<sup>12</sup> They also included all manner of fatal injury: homicides, suicides, unintentional and undetermined. Deaths from medical and surgical complications (representing 80 deaths) were excluded from the study, given the particularities associated with their occurrence and prevention.

Table 1 shows the distribution of the 2923 fatal injuries considered thereafter across demographic groups, along with the population distribution of these groups extracted from the 2001 national census data. Among children in the six cities, the population is fairly evenly distributed across sex and age groups. The majority are African (65%), with Indian/Asians constituting the smallest population group (6%). A comparison between the proportions of population and of injuries clearly shows an imbalance, with excess proportions of injuries among males, children aged 0–4 years and African children.

We first compared the leading causes of fatal injury in children for each city. We then calculated the age-adjusted rates and population attributable risks (PARs), by sex, population group and city, for each of the top five causes of fatal injury for all cities combined. The PAR was calculated by subtracting the incidence in the unexposed ( $I_u$ ) from the incidence in the total population, exposed and unexposed ( $I_p$ ), and dividing the result by the incidence in the total population:

$$PAR = (I_p - I_u) / I_p$$

This allowed us to assess the percentage reduction in fatal injuries that could be achieved among children aged 0–14 if all

groups had the same exposure level as the group at lowest risk.<sup>13</sup> In other words, they represent how many lives could be saved if approaches were found to reduce the safety divide.

The study was approved by the Ethics Committee of the Medical Research Council of South Africa.

## Results

Approximately two-thirds of all children died from one of the top five causes of fatal injury (Fig. 1). Pedestrian injuries, drowning and burns ranked among the top three causes of death in all cities except Cape Town, where firearm-related deaths outnumbered those due to drowning. For Tshwane and Buffalo City, drowning deaths led, accounting for approximately one in four cases. For the other four cities, pedestrian deaths were most common. Firearm-related deaths were leading causes in Tshwane and Cape Town only, ranking fourth and third respectively. In the other cities, road traffic injuries with an unspecified road user (i.e. with no indication of whether the victim was a pedestrian, passenger or driver) contributed between 8.7% and 13.3% of fatally injured cases. In Buffalo City, sharp objects were among the top five leading causes of childhood fatal injuries (14.4% of cases).

Age-adjusted rates and PARs (expressed as percentages) by sex, population group and city are shown for each of the top five leading injury causes for the six cities combined (representing 1857 deaths) in Table 2. Differences between the rates of fatal injury in males and females varied by cause: they were greatest for drowning deaths, which

Fig. 1. Top five causes of fatal injury in children aged 0–14 years in six South African cities, 2001–2003

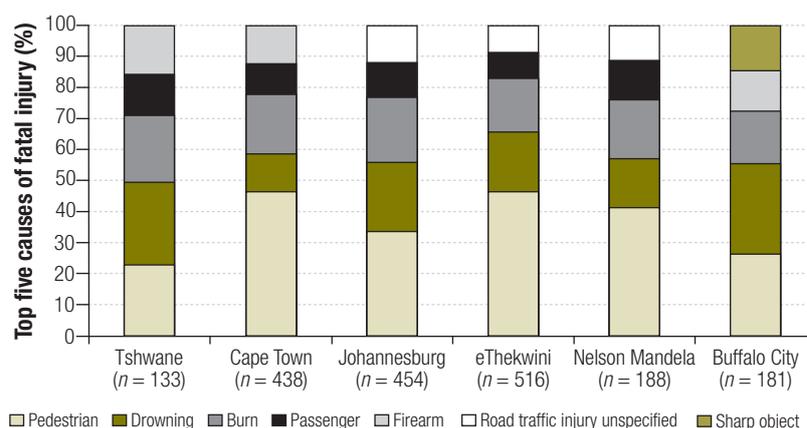


Table 2. Number of events,<sup>a</sup> age-adjusted death rates<sup>b</sup> and population attributable risks<sup>c</sup> for leading causes of fatal injury in children by sex, population group and city, South Africa, 2001–2003

	Pedestrian		Passenger		Drowning		Burn		Firearm	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
<b>Sex</b>										
Female	300	6.1	86	1.7	108	2.1	153	3.0	63	1.3
Male	453	9.2	99	2.0	265	5.3	206	4.1	109	2.2
<b>Population group<sup>d</sup></b>										
Indian/Asian	9	1.5	9	1.5	5	0.9	7	1.2	6	1.0
White	8	0.7	26	2.4	12	4.3	3	0.3	12	1.1
Coloured	138	7.9	38	2.1	35	2.0	47	2.7	34	1.9
African	600	9.4	111	1.7	281	4.3	305	4.5	121	1.9
<b>City</b>										
Tshwane	37	2.5	12	0.8	43	2.9	27	1.8	14	1.0
Cape Town	204	8.8	42	1.8	52	2.2	85	3.6	55	2.4
Johannesburg	153	7.0	51	2.3	100	4.2	95	4.0	44	2.0
eThekweni	240	9.4	43	1.7	99	3.8	89	3.4	32	1.3
Nelson Mandela	78	10.0	26	3.1	29	3.7	36	4.6	12	1.5
Buffalo City	48	8.4	14	2.4	52	9.2	31	5.4	16	2.8
<b>PAR</b>										
Sex	NA	20.5	NA	7.2	NA	42.2	NA	15.0	NA	26.9
Population group	NA	90.4	NA	16.9	NA	39.5	NA	47.5	NA	30.9
City	NA	67.0	NA	56.3	NA	40.6	NA	49.6	NA	45.1

NA, not applicable; PAR, population attributable risk.

<sup>a</sup> Total numbers may vary across variables because of missing data for sex and population group.

<sup>b</sup> Per 100 000.

<sup>c</sup> PARs (shown as percentages) are calculated using the group with the lowest rate as the reference, i.e. females for all causes; Indian/Asian children for passenger, drowning and firearm-related deaths; white children for pedestrian and burn deaths; Tshwane for pedestrian, passenger, burn and firearm deaths; Cape Town for drowning deaths. The formula used to calculate PARs was  $(I_p - I_u)/I_p$ , where  $I_u$  is the incidence in the unexposed and  $I_p$  the incidence in the total population (exposed and unexposed).

<sup>d</sup> Classification by population group as used by the South African government.

Data source: National Injury Mortality Surveillance System, 2001–2003.

were more than twice as common among males as females (5.3 and 2.1 per 100 000 respectively) but were negligible for motor vehicle passenger deaths (2.0 and 1.7 per 100 000 respectively). Except for the latter, African and coloured children had substantially higher fatal injury rates, especially as pedestrians, than white or Indian/Asian children.

The highest rates for pedestrian and passenger deaths were found in Nelson Mandela (10.0 and 3.1 per 100 000 respectively), while Buffalo City had the highest rates for drowning, burn and firearm-related deaths (9.2, 5.4 and 2.8 per 100 000, respectively). Tshwane had the lowest rates for all fatal injuries except drowning, which was lowest in Cape Town.

PARs for different fatal injuries varied considerably across sociodemographic groups. When sex was examined, the PAR was very low for fatal injury as a motor vehicle passenger but high for death from drowning. If all

children had the same exposure rate as girls, drowning deaths would fall by 42.2%. For population groups, PAR values were generally high; they were highest for fatal injury as a pedestrian (90.4%) and lowest for fatal injury as a motor vehicle passenger. PAR values of 30.9% for fatal injury with a firearm and 39.5% for fatal drowning and 47.5% for fatal burns indicate considerable potential for improvements if children from all population groups had the exposure rates of Indian/Asian or white children, respectively.

The rates of all fatal injuries showed substantial potential for reduction when the city with the lowest fatal injury rate was used as the exposure reference. PARs were higher for traffic injuries affecting pedestrians (67%) and motor vehicle passengers (56.3%); as many as two-thirds of pedestrian deaths could be avoided if all cities had the same exposure level as Tshwane. Even the lowest PAR showed a potential reduction of 40.6% of deaths

from drowning if all cities had the same exposure levels as Cape Town.

## Discussion

The five leading causes of fatal injury among children in urban South Africa account for as many as two-thirds of the deaths. Road traffic injuries, particularly those involving pedestrians – whose mode of transportation is characteristic of the poor – are common across cities.<sup>14</sup> Also important, although less frequent, are deaths from drowning,<sup>10</sup> burns<sup>15</sup> and, in some cities, firearm injuries.<sup>16</sup> PARs indicate substantial disparities, more so among population groups and cities than between girls and boys. The differences in PARs across injury causes highlight the varying contributions of and interactions between the environmental and social context, and individual attributes related to stage of child development, temperament and behaviour.<sup>17,18</sup>

## Safety-for-all prevention strategies

Numerous interventions for the prevention and control of violence and injuries have been evaluated and promoted as effective. These are listed in various reports, including some recently published WHO documents on road traffic crashes<sup>19</sup> and on injuries in general.<sup>20,21</sup> Even child-specific measures (e.g. car seats, safe drug packaging) have been compiled.<sup>22</sup>

One evidence-based safety-for-all approach is that of home safety education and visitation programmes to promote safe practices in the home.<sup>23</sup> Applied in South Africa, such programmes have effectively influenced the uptake of a range of safe practices (e.g. cooking safely, storing medicines and cleaning products out of reach of children), with resultant substantial hazard reductions.<sup>24</sup> When developing such programmes for economically and socially deprived groups and areas, it may be essential to act on major barriers to the uptake of safe practice, such as the affordability and accessibility of the products suggested and the readability of the instructions provided.<sup>23</sup> The distribution of child-resistant containers for the storage of paraffin in South Africa proved effective in reducing paraffin ingestion and provided evidence that families will use such devices when they are provided free of cost.<sup>25</sup>

Putting less demand on individual practice by reducing exposure to hazards in poor living and commuting environments is imperative. For pedestrian mortality, risk reduction counter-measures can include physical development changes (e.g. traffic separation, traffic calming), infrastructural changes such as improving public transport systems themselves<sup>14,26</sup> or offering alternatives to the street by creating attractive places for recreation (e.g. the Harlem Injury Prevention Program).<sup>27</sup>

## Equity oriented measures

Given the magnitude and variability of the burden of fatal injuries in children in South Africa, lowering rates requires not only safety-for-all counter-measures, but also targeted measures aimed at addressing inequalities in both the distribution of injuries among different socioeconomic

groups and structural safety in urban living and commuting arrangements.<sup>23,28</sup>

In South Africa, to strengthen disadvantaged communities a partnership with residents from townships in Johannesburg worked effectively to lobby the local government to provide a pedestrian bridge over a highway.<sup>22,29</sup> The South African government has also implemented several equity-oriented policies, including the National Housing Policy (providing over 2 million houses since 1994),<sup>30</sup> the National Electricity Basic Support Services Tariff Policy (which makes 50 kWh freely available to low-income households) and legislation that sets standards for kerosene-fuelled appliances.<sup>31</sup> A variety of positive effects on child injury reduction and safety enhancement in general can be expected from these measures, but evaluations are needed to fully assess them.

Socioeconomic and infrastructure-related data gathered by the South African Cities Network<sup>9</sup> for several cities, including those in this study, could be highly useful in evaluating the link between contextual factors and injury outcomes. For example, what specifically contributed to the better position of Tshwane for almost all childhood injury causes is unclear, but answering this question could certainly help reduce traffic-related, burn and firearm-related injuries.

## Strengths, limitations and future research

This study highlights the leading fatal injuries among children in urban areas of South Africa and, in so doing, presents key targets for prevention. The disparities across groups and areas reflected in the PARs show the potential for improvement within the country. In other words, if approaches were found within and outside the health sector to reduce the safety divide, many lives could be saved. Because of the wide coverage of urban areas in our study, the profile of childhood injuries in such areas, although variable, is likely to be well represented. This is an important issue given rapid urban growth.

While the study has provided broad targets for prevention, future research needs to examine the risk factors associated with each of the leading types of injuries and to

move beyond the use of sex and population group as measures of differences between groups. Data gathered at the neighbourhood level could help in this regard. It is also important to consider non-fatal injuries for prevention and public health.

Data reliability and validity are a concern both internationally and locally, especially in South Africa and for certain population groups. This could be a limitation of the current study if the data for some sociodemographic groups were more reliable than for others or if the bias were unevenly distributed across cities. Finally, small caseloads for some groups, particularly Indian/Asian children, reduce the robustness of the results.

## Conclusion

The five leading causes of fatal injury among children in urban South Africa include road traffic injuries, drowning, burns and, in some cities, firearm injuries. Among children, a high variability is observed between population groups and cities in the rates of fatal injury from the most common causes. There is a case for a safety agenda that combines safety-for-all counter-measures, aimed at lowering injury rates across the entire population, and targeted counter-measures that help reduce the burden for those at greatest risk. Tackling the five leading causes of fatal injury in childhood in urban South Africa could form part of the greater development agenda that the major cities have undertaken. ■

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**Competing interests:** None declared.

## الملخص

## الإصابات المميتة بين أطفال المدن في جنوب أفريقيا: توزيع الاختطار واحتمالات الحد منه

خاص- والغرق، والحروق، وهناك في بعض المدن إصابات الأسلحة النارية. ولوحظ وجود اختلافات شاسعة بين الأخطار المعزوة بين السكان، وبخاصة للفئات السكانية وللمدن. وكانت الاختلافات الشاسعة بين المدن، وبين المجموعات السكانية على أشدها بالنسبة للوفيات الناجمة عن إصابات المشاة، بينما كانت الاختلافات بين الصبيان والفتيات على أشدها في الوفيات الناجمة عن الغرق.

الاستنتاج في مواجهة التباين الشاسع الملحوظ بين المدن وبين الفئات السكانية في معدلات أنواع الإصابات المميتة الأكثر شيوعاً، يجب أن يجمع جدول أعمال السلامة جميع التدابير الوقائية للسلامة للجميع - أي خفض معدلات الإصابات للجميع - وأن يستهدف التدابير الوقائية التي تساعد على الحد من عبء المعرضين للخطر الأكبر.

الغرض تحديد الأسباب الرئيسية للإصابات المميتة لأطفال المدن في جنوب أفريقيا في الفئة العمرية 0-14 سنة، وتوزيع تلك الأسباب والاحتمالات الحالية لتحسين سبل السلامة.

الطريقة حسب الباحثون بيانات التردد في نظام التردد الوطني للإصابات المميتة في الأعوام 2001-2003 في ست مدن متباينة الحجم، والتطور، والتكوين الاجتماعي والديموغرافي في جنوب أفريقيا. وحسب الباحثون المعدلات المصححة حسب العمر، والجنس، والفئات السكانية، والمدن، للوفيات الناجمة عن خمسة أسباب رئيسية للإصابات المميتة وكذلك الأخطار المعزوة بين السكان.

الموجودات تضمنت الأسباب الرئيسية للإصابات المميتة في عمر الطفولة الإصابات المرورية على الطرق - بين راكبي السيارات، وبين المشاة على نحو

## Résumé

## Traumatismes fatals parmi les enfants urbains d'Afrique du Sud : distribution des risques et possibilités de les réduire

**Objectif** Déterminer les principales causes de traumatismes fatals pour les enfants urbains d'Afrique du Sud appartenant à la tranche d'âges 0-14 ans, la distribution de ces causes et les possibilités actuelles d'améliorer la sécurité.

**Méthodes** Nous avons obtenu des données de surveillance des traumatismes auprès du Système national de surveillance de la mortalité par traumatisme concernant la période 2001-2003 pour six grandes villes d'Afrique du Sud, différant par le nombre d'habitants, le stade de développement et la composition sociodémographique. Nous avons calculé les taux de mortalité ajustés pour l'âge par sexe, groupe de population et ville pour les cinq principales causes de traumatismes fatals, ainsi que les risques attribuables (RA) en population.

**Résultats** Parmi les principales causes de traumatismes fatals chez l'enfant, figuraient les accidents de la route - comme passagers de

véhicules et surtout comme piétons- les noyades, les brûlures et, dans certaines villes, les blessures par arme à feu. De grandes différences ont été observées dans les valeurs du RA en population, notamment entre certains groupes de population et la population des grandes villes concernées. Ces écarts atteignaient une valeur maximale pour les décès résultant de traumatismes chez des piétons, tandis que les disparités entre filles et garçons étaient les plus fortes pour les décès par noyade.

**Conclusion** Compte tenu des grandes variations relevées entre la population des villes et certains groupes de population dans la fréquence des types les plus courants de traumatismes fatals, un programme en faveur de la sécurité devrait combiner des contre-mesures visant la sécurité pour tous, c'est-à-dire la réduction des fréquences de traumatisme pour tous - et des contremesures ciblées, destinées à réduire la charge d'accidents pour les plus exposés.

## Resumen

## Lesiones mortales en niños de zonas urbanas de Sudáfrica: distribución de los riesgos y posibilidades de reducirlos

**Objetivo** Determinar las principales causas de lesiones mortales entre niños urbanos de Sudáfrica de 0 a 14 años, así como la distribución de esas causas y las posibilidades actuales de introducir mejoras en la seguridad.

**Métodos** Obtuvimos datos de vigilancia de lesiones a partir del Sistema Nacional de Vigilancia de la Mortalidad 2001-2003 para seis grandes ciudades de Sudáfrica de diverso tamaño, desarrollo y composición sociodemográfica. Calculamos las tasas de mortalidad ajustadas por edad, sexo, grupo de población y ciudad correspondientes a las cinco causas principales de lesiones mortales, así como los riesgos atribuibles poblacionales (RAP).

**Resultados** Las causas principales de lesiones mortales en la infancia abarcan los traumatismos causados por el tránsito -entre los pasajeros

de vehículos y sobre todo entre los peatones-, los ahogamientos, las quemaduras y, en algunas ciudades, las lesiones por arma de fuego. Se observaron grandes diferencias entre los RAP, especialmente en lo que atañe a los grupos de población y las ciudades. Las mayores disparidades entre ciudades y entre grupos de población correspondieron a las muertes de peatones, mientras que las mayores diferencias entre niños y niñas correspondieron a las defunciones por ahogamiento.

**Conclusión** Considerando la enorme variabilidad observada entre las ciudades y entre los grupos de población al estudiar las tasas de los tipos más comunes de accidentes mortales, las actividades orientadas a mejorar la seguridad deberían combinar contramedidas de seguridad para todos -esto es, reducir las tasas de lesiones en general- y contramedidas focalizadas que ayuden a reducir la carga entre quienes corren más riesgo.

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