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Non-fatal injuries among boys and girls presenting to Red Cross War Memorial Children's Hospital, Cape Town

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Background. In South Africa (SA), road traffic injuries, homicides and burns are the leading causes of injury-related deaths among children. Injury-related deaths are well documented for SA, but this is not the case for non-fatal injuries.
Objectives. To describe the non-fatal injuries sustained among children aged 0 - 13 years, to identify any significant sex differences by age group, cause of injury, admission status and injury severity.
Methods. The trauma unit database from 1997 to 2016 at Red Cross War Memorial Children's Hospital, Cape Town, was utilised for this analysis. The prevalence of injuries and the boy/girl ratios with 95% confidence intervals (CIs) were reported.
Results. Analysis indicated significant differences by sex for individual injury causes (transport, assault, burns, falls and other injuries), age group, injury severity and admission status. Moderately severe injuries were largely caused by burns, while severe injuries were mostly transport related. Boys had significantly higher proportions of all injury causes. The boy/girl ratio was lowest for assault (1:18), where significantly more girls aged 1 - 3 and 4 - 6 years were injured. Rape/sexual assault was 5.5 times higher for girls, with a significantly higher proportion of moderate-severity injuries (87%; 95% CI 84.7 - 89.4).
Conclusion. The study findings call for a more targeted prevention response for boy and girl children. Interventions should be targeted at the prevention of burns, traffic collisions and interpersonal violence, in particular sexual assaults against girls.

S Afr Med J 2022;112(7):465-471. https://doi.org/10.7196/SAMJ.2022.v112i7.16303

Paediatric injuries are a growing concern globally, especially in low- and middle-income countries (LMICs), where they are associated with significant morbidity and mortality.[1] Injuries can also result in disability, with short-term or lifelong consequences. LMICs in the African region are affected by high rates of child injury mortality, particularly from road traffic crashes and violence.[2] Data to characterise the causes associated with childhood fatal and non-fatal injuries in these countries are very scarce, however, and sex disaggregation is not routinely undertaken during analysis.

Interpersonal violence and road traffic injuries are the 8th and 9th leading causes of death for all South Africans,[3] each with a rate of ~35 per 100 000 population in 2012.[4] These injuries contribute greatly to premature mortality in South Africa (SA).[3,5-7] A 2014 child death review pilot study of two mortuaries in Western Cape and KwaZulu-Natal provinces for deaths <18 years found that 42.6% of all childhood deaths were non-natural.[8] Most of these deaths are due to road traffic injuries, which were found to be the second leading cause of death after HIV for children aged 5 - 14 years.[5]

Analysis of a nationally representative study of injury mortality conducted in 2009[9] found a higher likelihood of unintentional injury deaths among children aged 0 - 14 years and significantly higher unintentional injury mortality rates among children aged 0 - 4 years in urban areas compared with rural areas.[10] However, reducing injury deaths is not likely to be a high priority for SA policy makers, as communicable diseases still lead the cause-of-death profile for children aged 0 - 4 years.[3,5] However, appropriate interventions are needed to reduce these preventable injuries and deaths.

Injury-related deaths are quite well documented in SA, but this is not the case for non-fatal injuries. Furthermore, sex disaggregation is not routinely conducted or linked to prevention activities. This article therefore aims to describe the injury profile for boys and girls, by age and severity, for the main causes of injuries sustained over two decades (1997 - 2016). Using the Red Cross War Memorial Children's Hospital (RCWMCH) database for childhood injuries, we hope to answer the question 'who is injured' using a gender lens, and glean how this information can be used to build more specific intervention strategies to reduce the high rates of injuries in children.[11-14]

Methods

Data source and variables

Data from 1997 to 2016 were sourced from RCWMCH, a state-funded paediatric tertiary-level hospital affiliated to the University

of Cape Town. RCWMCH primarily treats children aged 0 - 13 years and serves suburbs in the southern part of Cape Town. It also receives severely injured children referred from further afield. The hospital's database is managed by ChildSafe (https://www.childsafe.org.za/), a non-governmental organisation focusing on child injury research, advocacy, community education and cause-specific injury prevention programmes. Ethical approval was obtained from the University of Cape Town Human Research Ethics Committee (ref. no. HREC/REf:085/2010 (amendment)) and the University of Oxford Tropical Research Ethics Committee (ref. no. OxTREC: 530-18).

A routine trauma unit record form is used to capture age, sex, cause and mechanism of injury, place of occurrence, clinical presentation, severity, anatomy (i.e. brain, face, thorax, hand, etc.), pathology (concussion, laceration, pneumothorax, fracture, etc.), admission status (not admitted, admitted to trauma unit, admitted to ward/intensive care unit (ICU)) and treatment (dressings, clean and suture, open operation, etc.) for all injured children aged 0 - 13 years who present to the hospital accident and emergency unit.

For the injury cause categories, the related mechanisms include the following: *transport*, comprising motor vehicle passenger and pedestrian injuries, and bicycle- and motorcycle-related injuries; *assault*, comprising blunt objects, sharp (penetrating) objects, rape/sexual assault, and other mechanisms such as human bite; *burn-related* injuries, comprising flame, fluid, heat contact, electrical, chemical, explosion and other burns; *falls*, comprising falls from beds, stairs, attendants' arms, playground equipment, mobiles and other heights and levels; and *other injuries*, comprising injuries arising from being struck by or against an object or caught between objects, sharp (penetrating) instruments, firearms, machinery, dog and other bites, immersion/drowning, suffocation, food and other foreign body ingestion, and other mechanisms not specified. The injury severity categories were coded numerically, for minor, moderate, severe and death (1 - 4), on the trauma unit record form and selected by each patient's attending doctor. The level of severity was recorded for a maximum of the four most severe injuries, according to the anatomy and pathology of the recorded injury.

Each record is de-identified, and the data are captured into an Excel spreadsheet, version 2016 (Microsoft Corp., USA), by volunteers at ChildSafe. For the purposes of analysis, cases were stratified into age groups that delineate important developmental stages and target groups for cause-specific injury prevention programmes and policies, viz. <1 year, 1 - 3 years, 4 - 6 years, 7 - 9 years and 10 - 13 years.

Statistical analysis

The prevalence of injuries, 95% confidence intervals (CIs) and boy/girl ratios with 95% CIs were reported by sex. Results were reported by age group, cause of injury, mechanism of injury, injury severity, admission status, and combinations thereof. Where the injury severity score was missing for the primary injury, the missing values were substituted with the severity score of the second most severe injury for analysis. We conducted a *post hoc* analysis of assault and sex, because sex differences for assault were different from all other injury mechanisms when examined by age group. Univariate and bivariate analysis for selected combinations of age, cause, severity, admission status, and assault type were undertaken.

The responses for the various outcomes (cause, severity, assault mechanism, admission status) were modelled using a generalised linear model (GENMOD procedure) in SAS 9.4 (SAS Institute Inc., USA). The distribution of the response was binomial and was specified in the form of a ratio of two variables denoting injuries/total number in the subgroup for each sex. A log link was used to obtain the injury prevalence by subgroup and sex, and the reference category for all models was girls, to report the ratio for boys v. girls.

Results

Between 1997 and 2016, there were 132 387 injury cases recorded. Falls were the leading cause of injury, followed by other injuries, transport, burns and assault. The highest caseloads were observed among 1 - 3-year olds (*n*=46 604 cases), followed by the 4 - 6-year old group (*n*=34 190 cases). There were significant differences in injury characteristics by sex (Table 1). Overall, the boy/girl ratio was 1.59 (95% CI 1.58 - 1.60). The boy/girl ratio increased with each age group from 1.15 (95% CI 1.11 - 1.20) among children <1 year of age to 2.18 for children aged 10 - 13 years, where more than two-thirds of injuries were among boys (68.6%; 95% CI 67.9 - 69.2).

Boys had significantly higher risk than girls across all age groups, injury causes, severity levels and admission status (Table 1). The largest boy/girl risk ratio (2.18) was in the oldest age group (10 - 13 years), and the risk ratio was smallest (1.15) in children aged <1 year. For cause of injury, the boy/girl risk ratio was lowest for assault (1.18) and burns (1.35). Boys had significantly more moderate, severe and fatal injuries than girls. Most injuries were minor: most children were seen and discharged. Fewer than one-fifth were admitted to the trauma unit, 7.4% were admitted to a ward or ICU, and only <0.2% died of their injuries.

Stratified analysis by age group indicated that falls were the leading cause of injury across all age groups (Table 2). Boys were at significantly higher risk for transport-related injuries, burns, falls and other injuries in the 1 - 3- and 4 - 6-year age groups. However, the assault risk for girls was higher than for boys in the younger age groups <1, 1 - 3 and 4 - 6 years. This finding was significant for girls in the 1 - 3-year (60.7%; 95% CI 58.1 - 63.5) and 4 - 6-year (55.0%; 95% CI 52.5 - 57.6) age groups. For the 7 - 9- and 10 - 13-year age groups, boys were at significantly higher risk for all injury cause groups. The boy/girl risk ratio was most pronounced for assault in the oldest age group. Analysis for severity of injury by cause indicated that, of all the injury cause categories, transport-related injuries had the most severe/fatal injuries among both sexes. For assault, unlike every other cause category, there was no significant difference in fatality risk between boys and girls.

These sex differences are also reflected in the analysis of injury severity and admission status by the specific mechanism of assault (Table 3). Boys had significantly more blunt-force injuries (70.5%; 95% CI 68.8 - 72.2) than girls (29.5%; 95% CI 27.8 - 31.3). This was followed by rape/sexual assault, where girls (84.7%; 95% CI 82.9 - 86.5) had significantly more injuries than boys (15.3%; 95% CI 13.6 - 20.4). This higher magnitude of rape/sexual assault for girls persisted from the ages of 1 to 13 years. When considering assault mechanism and injury severity, boys had significantly more blunt assaults of minor severity (70.1%; 95% CI 67.8 - 72.5) and moderate severity (71.1%; 95% CI: 68.5 - 73.8) and more severe/fatal assaults (67.6%; 95% CI: 57.6 - 79.4) than girls. However, girls had significantly more injuries associated with rape/sexual assault of minor severity (82.0%; 95% CI 79.2 - 84.9) and moderate severity (87.0%; 95% CI 84.7 - 89.4) than boys. In addition, girls had more severe or fatal rape/sexual assault injuries. Analysis of assault mechanism by admission status indicated that significantly more girls who had injuries associated with rape/sexual assault (88.1%; 95% CI 85.7 - 90.5) were admitted to the trauma unit compared with boys (11.9%; 95% CI 9.7 - 14.6).

Table 1. Characteristics of injuries sustained by children aged 0 - 13 years, by sex, 1997 - 2016

	Boys, *n* (%; 95% CI)	Girls, *n* (%; 95% CI)	Total, *N*	Boy/girl ratio (95% CI)
Overall	81 303 (61.4; 61.2 - 61.7)	51 084 (38.6; 38.3 - 38.9)	132 387	1.59 (1.58 - 1.60)
Age group (years)				
<1	2 441 (53.6; 52.1 - 55)	2 117 (46.4; 45.0 - 47.9)	4 558	1.15 (1.11 - 1.20)
1 - 3	26 183 (56.2; 55.7 - 56.6)	20 421 (43.8; 43.4 - 44.3)	46 604	1.28 (1.27 - 1.30)
4 - 6	21 166 (61.9; 61.4 - 62.4)	13 024 (38.1; 37.6 - 38.6)	34 190	1.63 (1.60 - 1.65)
7 - 9	16 665 (65.7; 65.1 - 66.3)	8 698 (34.3; 33.7 - 34.9)	25 363	1.92 (1.88 - 1.95)
10 - 13	14 746 (68.6; 67.9 - 69.2)	6 764 (31.5; 30.8 - 32.1)	21 510	2.18 (2.13 - 2.23)
Cause of injury				
Transport	12 643 (64.5; 63.8 - 65.2)	6 960 (35.5; 34.8 - 36.2)	19 603	1.82 (1.78 - 1.86)
Assault	2 976 (54.1; 52.8 - 55.4)	2 526 (45.9; 44.6 - 47.3)	5 502	1.18 (1.13 - 1.22)
Burn	9 095 (57.5; 56.7 - 58.3)	6 719 (42.5; 41.7 - 43.3)	15 814	1.35 (1.32 - 1.38)
Fall	34 085 (62.3; 61.9 - 62.7)	20 620 (37.7; 37.3 - 38.1)	54 705	1.65 (1.63 - 1.67)
Other injuries*	22 504 (61.2; 60.7 - 61.7)	14 259 (38.8; 38.3 - 39.3)	36 763	1.58 (1.55 - 1.60)
Injury severity				
Minor	45 780 (60.4; 60.0 - 60.7)	30 070 (39.6; 39.3 - 40.0)	75 850	1.52 (1.51 - 1.54)
Moderate	33 369 (62.8; 62.4 - 63.2)	19 785 (37.2; 36.8 - 37.6)	53 154	1.69 (1.67 - 1.71)
Severe	1 845 (64.4; 62.6 - 66.1)	1 022 (35.7; 33.9 - 37.4)	2 867	1.81 (1.71 - 1.91)
Died	154 (63.4; 57.6 - 69.7)	89 (36.6; 31.0 - 43.2)	243	1.73 (1.43 - 2.09)
Admission status				
Not admitted	59 318 (61.0; 60.7 - 61.3)	37 985 (39.0; 38.7 - 39.4)	97 303	1.56 (1.55 - 1.58)
Admitted to trauma unit	16 101 (63.8; 63.2 - 64.4)	9 147 (36.2; 35.6 - 36.8)	25 248	1.76 (1.73 - 1.79)
Admitted to ward/ICU	5 881 (59.8; 58.9 - 60.0)	3 950 (40.2; 39.2 - 41.2)	9 831	1.49 (1.45 - 1.53)

CI = confidence interval; ICU = intensive care unit.
*Other injuries included injuries arising from being struck by or against an object or caught between objects, sharp (penetrating) instruments, firearms, machinery, dog and other bites, immersion/drowning, suffocation, food and other foreign body ingestion, and other mechanisms not specified.

Most of the blunt assaults and rape/sexual assaults occurred inside and around their home for both boys and girls (Fig. 1). Blunt assaults at school/daycare centres and public places were more prevalent for boys. Rape/sexual assault inside other people's homes was more prevalent for girls.

Discussion

Our study indicates significant sex differences by age group, cause of injury and severity among injured children presenting to RCWMCH in Cape Town. Although boys had significantly higher risks across all age groups and causes than girls, higher severity of rape/sexual assault was seen among young girls.

These results have policy and practice implications that need to be addressed in order for SA to meet a number of the Sustainable Development Goal (SDG) targets, including a reduction in the number of deaths/injuries from road traffic crashes (SDG 3.6), eliminating all forms of violence against women and girls (SDG 5.2), and ending abuse and all forms of violence and torture of children (SDG 16.2) by 2030.[15]

As with previous analyses, most injuries sustained by children presenting to RCWMCH were related to falls.[12,13] Significantly more boys presented than girls, and those aged 1 - 3 and 4 - 6 years were the most common attendees, which is not unexpected because this is the age at which children tend to start to socialise as toddlers and participate in higher-risk behaviour. Falls are, however, very amendable to several proven prevention strategies. Increasing supervision for the 4 - 6-year age group is essential, alongside establishing playground safety standards, maintaining equipment and surface material and legislating for window guards.[16-18] Low-cost modifications of these interventions should be possible, even in LMICs. Other interventions such as supportive home visitation, education for at-risk families and mass media campaigns[1,19] should also be introduced.

Transport injuries were more common among boys than girls across all age ranges and were associated with the highest number of severe and fatal injuries, probably because, as has been documented previously, most children were injured as pedestrians or unrestrained passengers.[20] In SA many children are transported to school in minibus taxis or on the back of 'bakkies' (pick-up trucks), neither of which are equipped with appropriate safety restraints. In addition, many children seen at RCWMCH come from low-income suburbs where there are few amenities for them to play safely, and many of them also walk to school unaccompanied on busy streets. Prevention strategies should therefore focus on these two high-risk groups by implementing, for example, a maximum speed limit in residential areas or near schools and play areas,[21] restraining young passengers with child restraint seats, and adult supervision.[22] The authors propose that the age limitation for child car restraints and booster seats be increased from <3 years up to the age of 7 years,[23] and that the documented barriers to the uptake of child restraints in the city, and factors that would facilitate them, be addressed by local government.[24]

Boys sustained significantly more burn-related injuries than girls for all age groups, with 1 - 3-year-old boys accounting for most cases. This is possibly related to young boys being more likely than girls to explore their surroundings as they become mobile. More than two-thirds of burn-related injuries were of moderate severity, which can cause scarring and disability, leading to lifelong physical and psychological consequences. These injuries usually result in long hospital stays with costly treatment regimens to aid physical and emotional functioning. Burn-related injuries are preventable, but are strongly associated with poverty in Cape Town and throughout SA.

Table 2. Cause of injury by sex, age and severity, 1997 - 2016

	Boys, *n* (%; 95% CI)	Girls, *n* (%; 95% CI)	Total, *N*	Boy/girl ratio (95% CI)
Cause of injury and age (years)				
Transport				
<1	114 (50.2; 44.1 - 57.2)	113 (49.8; 43.7 - 56.7)	227	1.01 (0.84 - 1.21)
1 - 3	2 489 (62.6; 61.1 - 64.1)	1 490 (37.5; 36.0 - 39.0)	3 979	1.67 (1.59 - 1.75)
4 - 6	3 998 (65.5; 64.3 - 66.7)	2 105 (34.5; 33.3 - 35.7)	6 103	1.90 (1.83 - 1.98)
7 - 9	3 381 (65.0; 63.8 - 66.3)	1 818 (35.0; 33.7 - 36.3)	5 199	1.86 (1.78 - 1.94)
10 - 13	2 644 (65.0; 63.5 - 66.5)	1 425 (35.0; 33.6 - 36.5)	4 069	1.86 (1.77 - 1.95)
Assault				
<1	103 (47.0; 40.9 - 54.1)	116 (53.0; 46.8 - 60.0)	219	0.89 (0.74 - 1.07)
1 - 3	479 (39.3; 36.6 - 42.1)	741 (60.7; 58.1 - 63.5)	1 220	0.65 (0.59 - 0.70)
4 - 6	643 (45.0; 42.5 - 47.7)	786 (55.0; 52.5 - 57.6)	1 429	0.82 (0.76 - 0.88)
7 - 9	805 (62.7; 60.2 - 65.5)	478 (37.3; 34.7 - 40.0)	1 283	1.68 (1.55 - 1.83)
10 - 13	944 (70.1; 67.7 - 72.6)	402 (29.9; 27.5 - 32.4)	1 346	2.35 (2.15 - 2.57)
Burn				
<1	460 (58.9; 55.5 - 62.5)	321 (41.1; 37.8 - 44.7)	781	1.43 (1.29 - 1.59)
1 - 3	6 102 (257.8; 56.8 - 58.7)	4 464 (42.3; 41.3 - 43.2)	10 566	1.37 (1.33 - 1.41)
4 - 6	1 316 (56.7; 54.7 - 58.8)	1 004 (43.3; 41.3 - 45.3)	2 320	1.31 (1.24 - 1.39)
7 - 9	675 (54.9; 52.2 - 57.8)	554 (45.1; 42.4 - 48.0)	1 229	1.22 (1.12 - 1.32)
10 - 13	522 (58.9; 55.8 - 62.3)	364 (41.1; 38.0 - 44.5)	886	1.43 (1.30 - 1.58)
Fall				
<1	1 264 (53.0; 51.0 - 55.0)	1 122 (47.0; 45.1 - 49.1)	2 386	1.13 (1.06 - 1.19)
1 - 3	10 037 (56.7; 56.0 - 57.4)	7 673 (43.3; 42.6 - 44.1)	17 710	1.31 (1.28 - 1.34)
4 - 6	9 200 (63.0; 62.2 - 63.8)	5 398 (37.0; 36.2 - 37.8)	14 598	1.70 (1.66 - 1.75)
7 - 9	7 173 (66.9; 66.0 - 67.8)	3 550 (33.1; 32.2 - 34.0)	10 723	2.02 (1.96 - 2.08)
10 - 13	6 372 (69.1; 68.1 - 70.0)	2 852 (30.9; 30.0 - 31.9)	9 224	2.23 (2.16 - 2.31)
Other injury				
<1	500 (52.9; 49.8 - 56.2)	445 (47.1; 44.1 - 50.4)	945	1.12 (1.03 - 1.23)
1 - 3	7 076 (53.9; 53.1 - 54.8)	6 053 (46.1; 45.3 - 47.0)	13 129	1.17 (1.14 - 1.20)
4 - 6	6 009 (61.7; 60.7 - 62.7)	3 731 (38.3; 37.4 - 39.3)	9 740	1.61 (1.56 - 1.66)
7 - 9	4 631 (66.8; 65.7 - 68.0)	2 298 (33.2; 32.1 - 34.3)	6 929	2.01 (1.94 - 2.09)
10 - 13	4 264 (71.2; 70.1 - 72.4)	1 721 (28.8; 27.6 - 29.9)	5 985	2.48 (2.37 - 2.59)
Cause of injury and severity				
Transport				
Minor	6 680 (64.0; 63.1 - 65.0)	3 754 (36.0; 35.1 - 36.9)	10 434	1.78 (1.73 - 1.83)
Moderate	5 268 (65.3; 64.3 - 66.3)	2 802 (34.7; 33.5 - 36.0)	8 070	1.88 (1.82 - 1.94)
Severe/fatal	672 (63.3; 60.4 - 66.2)	390 (36.7; 33.9 - 39.7)	1 062	1.72 (1.57 - 1.89)
Assault				
Minor	1 591 (56.1; 54.3 - 57.9)	1 246 (43.9; 42.1 - 45.8)	2 837	1.28 (1.21 - 1.35)
Moderate	1 299 (52.0; 50.1 - 54.0)	1 197 (48.0; 46.0 - 50.0)	2 496	1.09 (1.03 - 1.15)
Severe/fatal	84 (50.9; 43.8 - 59.1)	81 (49.1; 42.0 - 57.3)	165	1.04 (0.84 - 1.29)
Burn				
Minor	2 433 (56.3; 54.9 - 57.8)	1 888 (43.7; 42.2 - 45.2)	4 321	1.29 (1.23 - 1.35)
Moderate	6 303 (57.7; 56.8 - 58.6)	4 624 (42.3; 41.4 - 43.3)	10 927	1.36 (1.33 - 1.40)
Severe/fatal	339 (64.1; 60.1 - 68.3)	190 (35.9; 32.1 - 40.3)	529	1.78 (1.57 - 2.03)
Fall				
Minor	20 204 (60.5; 60.0 - 61.0)	13 193 (39.5; 39.0 - 40.0)	33 397	1.53 (1.51 - 1.56)
Moderate	13 248 (65.0; 64.4 - 65.7)	7 126 (35.0; 34.3 - 35.6)	20 374	1.86 (1.82 - 1.90)
Severe/fatal	532 (69.4; 66.2 - 72.7)	235 (30.6; 27.5 - 34.1)	767	2.26 (2.02 - 2.54)
Other injury				
Minor	14 872 (59.8; 59.2 - 60.4)	9 989 (40.2; 39.6 - 40.8)	24 861	1.49 (1.46 - 1.52)
Moderate	7 251 (64.2; 63.4 - 65.1)	4 036 (35.8; 34.9 - 36.7)	11 287	1.80 (1.75 - 1.85)
Severe/fatal	372 (63.4; 59.6 - 67.4)	215 (36.6; 32.9 - 40.7)	587	1.73 (1.53 - 1.96)

CI = confidence interval.

Although the South African Bureau of Standards (SABS) enacted a national standard for the safe use of paraffin stoves in 2006, the quality of the manufacturing of these stoves does not appear to be strictly monitored.[25] The key feature of the SABS-approved stove is a self-extinguishing mechanism if the appliance is tilted, but this is reported to malfunction. Suggested intervention strategies for this

Table 3. Assault mechanism by sex, age, severity and admission status, 1997 - 2016

	Boys, *n* (%; 95% CI*)	Girls, *n* (%; 95% CI*)	Total, *N*	Boy/girl ratio† (95% CI)
Assault mechanism				
Blunt	1 879 (70.5; 68.8 - 72.2)	787 (29.5; 27.8 - 31.3)	2 666	2.39 (2.24 - 2.54)
Sharp (penetrating)	384 (68.2; 64.5 - 72.2)	179 (31.8; 28.2 - 35.9)	563	2.15 (1.88 - 2.45)
Rape/sexual	233 (15.3; 13.6 - 20.4)	1 289 (84.7; 82.9 - 86.5)	1 522	0.18 (0.16 - 0.20)
Other	480 (63.9; 60.6 - 67.4)	271 (36.1; 32.8 - 39.7)	751	1.77 (1.59 - 1.98)
Age (years) and assault mechanism				
<1				
Blunt	73 (51.8; 44.2 - 60.7)	68 (48.2; 40.7 - 57.2)	141	1.07 (85.0 - 1.36)
Sharp (penetrating)	7 (33.3)	14 (66.7)	21	
Rape/sexual	1 (5.9)	16 (94.1)	17	
Other	22 (55.0; 41.6 - 72.8)	18 (45.0; 32.0 - 63.4)	40	1.22 (0.79 - 1.90)
1 - 3				
Blunt	288 (57.6; 53.4 - 62.1)	212 (42.4; 38.3 - 47.0)	500	1.36 (1.20 - 1.54)
Sharp (penetrating)	58 (51.8; 43.3 - 61.9)	54 (48.2; 39.8 - 58.4)	112	1.07 (0.83 - 1.40)
Rape/sexual	47 (11.0; 8.4 - 14.4)	381 (89.0; 86.1 - 92.0)	428	0.12 (0.09 - 0.16)
Other	86 (47.8; 41.0 - 55.7)	94 (52.2; 45.4 - 60.1)	180	0.91 (0.74 - 1.13)
4 - 6				
Blunt	380 (67.5; 63.7 - 71.5)	183 (32.5; 28.9 - 36.6)	563	2.08 (1.82 - 2.37)
Sharp (penetrating)	66 (59.5; 51.0 - 69.3)	45 (40.5; 32.4 - 50.8)	111	1.47 (1.12 - 1.93)
Rape/sexual	88 (15.0; 12.4 - 18.2)	498 (85.0; 82.1 - 87.9)	586	0.18 (0.15 - 0.21)
Other	109 (64.5; 57.7 - 72.1)	60 (35.5; 29.0 - 43.5)	169	1.82 (1.44 - 2.29)
7 - 9				
Blunt	510 (78.1; 75.0 - 81.3)	143 (21.9; 19.0 - 25.3)	653	3.57 (3.07 - 4.15)
Sharp (penetrating)	90 (73.8; 66.4 - 82.0)	32 (26.2; 19.5 - 35.2)	122	2.81 (2.05 - 3.86)
Rape/sexual	64 (20.4; 16.4 - 25.4)	250 (79.6; 75.3 - 84.2)	314	0.26 (0.20 - 0.32)
Other	141 (72.7; 66.7 - 79.2)	53 (27.3; 21.7 - 34.4)	194	2.66 (2.08 - 3.40)
10 - 13				
Blunt	627 (77.6; 74.8 - 80.5)	181 (22.4; 19.7 - 25.5)	808	3.46 (3.03 - 3.96)
Sharp (penetrating)	163 (83.2; 78.1 - 88.6)	33 (16.8; 12.3 - 23.0)	196	4.94 (3.60 - 6.78)
Rape/sexual	33 (18.9; 13.9 - 25.6)	142 (81.1; 75.6 - 87.2)	175	0.23 (0.17 - 0.32)
Other	121 (72.5; 66.0 - 79.6)	46 (27.5; 21.5 - 35.2)	167	2.63 (2.02 - 3.42)
Assault mechanism and injury severity				
Blunt				
Minor	1 028 (70.1; 67.8 - 72.5)	438 (29.9; 27.6 - 32.3)	1 466	2.35 (2.16 - 2.56)
Moderate	803 (71.1; 68.5 - 73.8)	326 (28.9; 26.4 - 31.6)	1 129	2.46 (2.23 - 2.72)
Severe/fatal	48 (67.6; 57.6 - 79.4)	23 (32.4; 23.2 - 45.3)	71	2.09 (1.44 - 3.03)
Sharp (penetrating)				
Minor	167 (68.4; 62.9 - 74.5)	77 (31.6; 26.2 - 38.0)	244	2.17 (1.77 - 1.66)
Moderate	196 (67.6; 62.4 - 73.2)	94 (32.4; 27.5 - 38.3)	290	2.09 (1.73 - 2.51)
Severe/fatal	21 (72.4)	8 (27.6)	29	
Rape/sexual				
Minor	124 (18.0; 15.3 - 21.1)	566 (82.0; 79.2 - 84.9)	690	0.22 (0.19 - 0.26)
Moderate	101 (13.0; 10.8 - 15.6)	676 (87.0; 84.7 - 89.4)	777	0.15 (0.12 - 0.18)
Severe/fatal	7 (13.2)	46 (86.8)	53	
Other				
Minor	272 (62.2; 57.9 - 67.0)	165 (37.8; 33.5 - 42.6)	437	1.65 (1.43 - 1.90)
Moderate	199 (66.3; 61.2 - 71.9)	101 (33.7; 28.7 - 39.5)	300	1.97 (1.65 - 2.35)
Severe/fatal	8 (66.7)	4 (33.3)	12	
Assault mechanism and admission status				
Blunt				
Not admitted	1 314 (71.3; 69.2 - 73.4)	530 (28.7; 26.8 - 30.9)	1 844	2.48 (2.29 - 2.68)
Admitted to trauma unit	501 (67.7; 64.4 - 71.2)	239 (32.3; 29.1 - 35.9)	740	2.10 (1.87 - 2.35)
Admitted to ward/ICU	64 (78.1; 69.6 - 87.5)	18 (22.0; 14.6 - 33.0)	82	3.56 (2.33 - 5.43)
Sharp (penetrating)				
Not admitted	235 (67.7; 63.0 - 72.8)	112 (32.3; 27.7 - 37.6)	347	2.10 (1.77 - 2.48)
Admitted to trauma unit	111 (65.3; 58.5 - 72.9)	59 (34.7; 28.2 - 42.7)	170	1.88 (1.49 - 2.38)
Admitted to ward/ICU	38 (82.6; 72.4 - 94.3)	8 (17.4; 9.3 - 32.7)	46	4.75 (2.50 - 9.04)

Continued ...

Table 3. (continued) Assault mechanism by sex, age, severity and admission status, 1997 - 2016

	Boys, *n* (%; 95% CI*)	Girls, *n* (%; 95% CI*)	Total, *N*	Boy/girl ratio† (95% CI)
Rape/sexual				
Not admitted	146 (18.2; 15.7 - 21.1)	657 (81.8; 79.2 - 84.5)	803	0.22 (0.19 - 0.26)
Admitted to trauma unit	83 (11.9; 9.7 - 14.6)	615 (88.1; 85.7 - 90.5)	698	0.14 (0.11 - 0.17)
Admitted to ward/ICU	4 (19.0)	17 (81.0)	21	
Other				
Not admitted	351 (64.8; 60.9 - 68.9)	191 (35.2; 31.4 - 39.5)	542	1.84 (1.61 - 2.09)
Admitted to trauma unit	115 (60.9; 54.3 - 68.2)	74 (39.2; 32.8 - 46.8)	189	1.55 (1.26 - 1.92)
Admitted to ward/ICU	14 (70.0)	6 (30.0)	20	

CI = confidence interval; ICU = intensive care unit.
*95% CI not calculated for small caseloads.
†Boy/girl ratio not included for small caseloads.

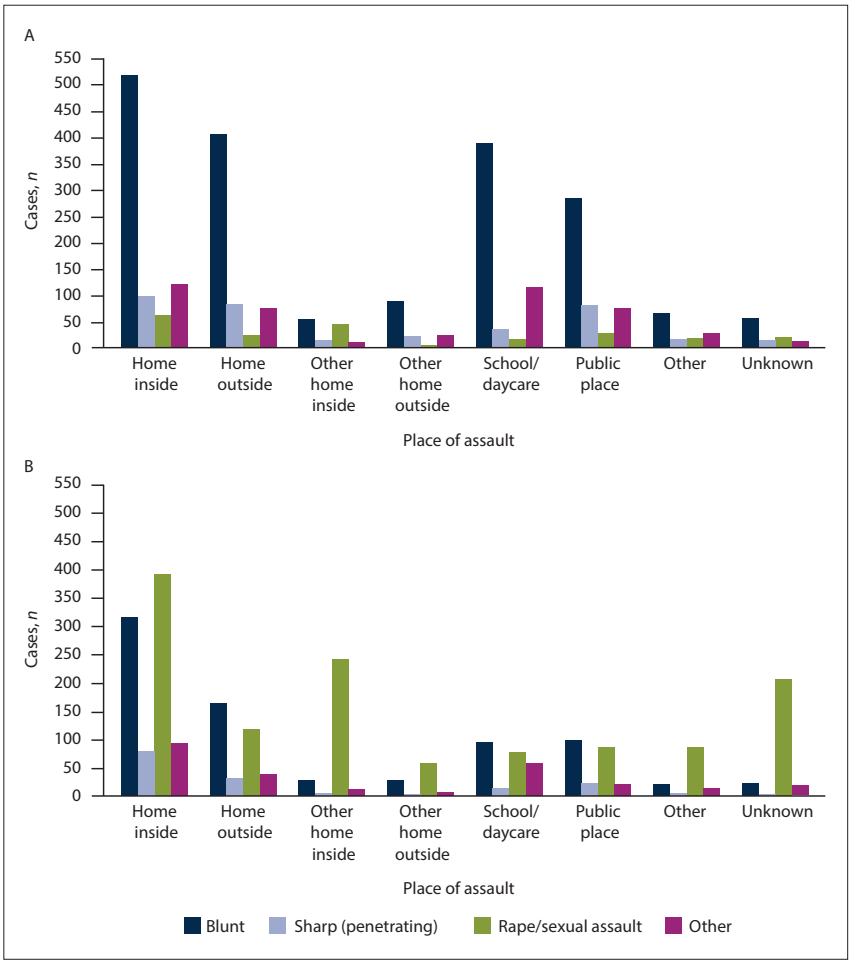


Fig. 1. Place and type of assault for (A) boys (N=2 961) and (B) girls (N=2 503) aged 0 - 13 years, 1997 - 2016.

environment include greater enforcement of home appliance standards and support from government to purchase safer, but more costly, liquefied petroleum gas for cooking and heating.[25,26] Additional burn prevention strategies could include setting and enforcing laws on smoke alarms and hot-water temperatures and providing first-aid training on how to treat burns.[1]

Significantly more girls than boys aged 1 - 3 and 4 - 6 years were assaulted, and this often occurred inside/outside homes, at schools/daycare centres and in public places. A national survey to estimate child maltreatment in SA[27] reported that 44.6% of 15 - 17-year-old respondents had experienced some form of child maltreatment in their lives. This included witnessing family violence, physical and emotional violence, neglect and sexual violence, with 15 - 17-year-old girls reporting higher lifetime prevalence than boys. National estimates for child homicide[28,29] indicated that sexual assault and abuse-related homicides were most common among girls in the 1 - 4-year age group,[28] which corresponds to the findings of the present study. Interventions to prevent sexual assault are needed at an early age, as national evidence shows that it may lead to substance misuse, high-risk sexual behaviour, post-traumatic stress disorder, and depression and anxiety in adolescence.[30] Prevention strategies that have been put forward include substance abuse interventions, caregiver support to develop warm and caring relationships with children, and non-violent approaches to managing children's behaviour.[30] Putting such strategies into place would require enhanced intersectoral co-ordination in SA, particularly with regard to reporting, medical treatment, psychosocial support to victims, and timely prosecution of offenders.[28] The World Health Organization's handbook on selecting, implementing and monitoring effective violence prevention policies and programmes[31] should be used as a guide to respond to violence against children in SA.

Study limitations

RCWMCH only treats children aged ≤13 years who seek treatment at a public hospital. The results are therefore not representative of the entire Cape Town population, or even subdistricts of the hospital's catchment area. We could therefore not calculate population-based rates. However, although hospital-based data remain the most robust data to study sex differences among injured children in SA, there is still a need to improve the granularity of the current database. For instance, while information on restrained and unrestrained children is recorded, the data do not clarify whether an appropriate restraint was used and whether the child was correctly and securely strapped. Likewise, more specific details about assault cases could be captured in order to better target prevention strategies. Finally, the injury

severity scoring system used at RCWMCH is not internationally recognised and therefore cannot be used to compare with many other studies that use the Abbreviated Injury Scale or the Injury Severity Score (ISS). With this in mind, the trauma form is currently being modified to a digital version, which will include the internationally recognised ISS, to record the injury severity based on six different body regions.[32]

Conclusion

This analysis reiterates the importance of conducting sex analysis on data, as it can uncover important biases and inequities that could have an impact on the policies and practices implemented in resource-poor settings[33] to prevent childhood injuries and to alleviate the burden on clinical staff. It has highlighted the need to develop interventions targeted at the prevention of burns, interpersonal violence and transport injuries among boys and sexual assaults among girls. In addition, it has highlighted priority age groups for these interventions. The importance of understanding the factors driving the differences for sexual assault among children is an area that warrants further in-depth investigation.

Declaration. None.

Acknowledgements. The authors thank the RCWMCH medical staff, and the members of ChildSafe who capture the data on an annual basis.

Author contributions. SvA provided the data. EM, MP and MMP cleaned the data. EM, MP and EJ provided analysis with input from MMP, KH and RM. MP, MMP, KH, RM and EJ drafted the manuscript, with review and final approval by all contributors, except for EM, who passed away on 10 March 2019.

Funding. A small grant from The George Institute's Global Women's Health Program Research Funding Grant (2018).

Conflicts of interest. None.

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Accepted 7 April 2022.