Injury 50 (2019) 2220–2227

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

# Assault-injured youth in the emergency centres of Khayelitsha, South Africa: Baseline characteristics & opportunities for intervention ☆

Sarah Leeper[a,*], Sa'ad Lahri[b], Justin Myers[c], Mehul Patel[c], Priscilla Reddy[d], Ian B.K. Martin[e], Daniël J. van Hoving[f]

[a] University of Maryland Medical Center, Emergency Medicine, 110 S Paca St 6th Fl, Suite 200 Baltimore, 21201-1595 MD, USA
[b] Khayelitsha Hospital, Emergency Medicine Khayelitsha, South Africa
[c] University of North Carolina at Chapel Hill School of Medicine, Emergency Medicine Chapel Hill, NC, USA
[d] Human Sciences Research Council Pretoria, South Africa
[e] Medical College of Wisconsin, Emergency Medicine Milwaukee, WI, USA
[f] University of Stellenbosch, Division of Emergency Medicine, Faculty of Medicine and Health Sciences, Cape Town, South Africa

ARTICLE INFO

*Article history:*
Accepted 4 October 2019

*Keywords:*
Violence
Global health

ABSTRACT

*Introduction:* Violence is a leading cause of death worldwide for youth age 15–29. A growing body of literature has described assault-injured youth in United States emergency centres, identifying risk factors for re-injury and mortality, and developing targeted interventions. Despite the fact that low- and middle-income countries are disproportionately affected by violence, little research on assault-injured youth exists in these settings.

*Methods:* Survey and chart review of 14 to 24-year-old assault-injured patients and non-assault-injured controls to 24-hour emergency centres in Khayelitsha, South Africa over 15 weeks. Patient enrollment occurred 7pm Friday to 7am Monday. Multivariable logistic regression was used to estimate associations of behavioral and other factors with assault injury.

*Results:* In total 513 patients were enrolled: 324 assault-injured patients and 189 controls (131 medical, 58 unintentional injuries). Overall 28% were female ($n = 146$) and 72% were male ($n = 367$). The mean age was 20.5 years.

Assault-injured patients of both genders were more likely than controls to give a 30-day history of drinking any alcohol (OR 6.3) and binge drinking (OR 6.7). They were also more likely to report any physical fight (OR 4.4) or any physical fight requiring medical care in the past 6 months (OR 5.08), and lifetime history of arrest (OR 5.1) or conviction (OR 6.7).

Drugs and/or alcohol were used by victims prior to 78% of the assaults. Significant differences were not detected between females (76%) and males (79%).

Overall, 47% of assault-injured youth and 15% of controls reported a history of a fight requiring medical treatment in the past 6 months.

*Discussion:* Violence is a chronic and recurring disease, suggesting opportunities for interventions during health care contacts. Our population of assault-injured youth demonstrated significant rates of alcohol use and binge drinking, as well as alcohol use prior to the assault. Future secondary violence prevention initiatives should consider targeting alcohol use and abuse.



## Introduction

Violence is a leading cause of death worldwide for young men and women age 15–29 [1]. In 1996, the World Health Organization (WHO) declared violence "a major and growing public health problem across the world," and endorsed the prevention of violence as "a public health priority" [2].

In large urban centres in the US, a growing body of literature has characterized youth trauma as a "chronic, recurrent" disease with recurrence rates as high as 44% and 5-year mortality rates up to 20% [3,4]. Many studies have been successful in identifying risk factors for re-injury and mortality and implementing evidence-based, targeted intervention programs to address these risk factors [5,6].

☆ We dedicate this paper to the tireless staff of the Khayelitsha Hospital and Site B emergency centres, and to the patients they serve.

* Corresponding author.
*E-mail address:* SLeeper@som.umaryland.edu (S. Leeper).

https://doi.org/10.1016/j.injury.2019.10.014
0020-1383/

Research is ongoing to determine ideal location for these interventions, but many favour an Emergency Centre (EC) based model, based on the premise that emergency visits after assault injuries may represent a "teachable moment," [7] and may be one of the few contacts this population has with a health care provider prior to a fatal injury [8].

Unfortunately, in low and middle-income countries, which bear the vast burden of this epidemic, there is a great paucity of literature on youth violence. Khayelitsha township outside of Cape Town has the dubious distinction of recording one of the world's highest mortality rates among young men due to violence (451/100,000) [9], approximately 25 times the global average for this highest-risk demographic group [10]. Trauma surveillance data from community, district, and referral hospitals in the Cape Town area suggests that emergency centres are seeing a high volume of violently injured young people [11–13]. However, to date there have been no studies on this specific population, no data on risk factors for re-injury and mortality, and no targeted intervention programs.

This study aims to: 1. Describe the population of assault-injured youth and a control group of non-assault injured peers seen in the emergency centre of Khayelitsha Hospital and in a 24-hour community health centre (we will collectively refer to these as "Khayelitsha emergency health care centres") and 2. Explore risk and protective factors for assault injuries that could inform future targeted interventions.

In this study, we present baseline data of a prospective follow-up study designed to measure rates of re-injury and death for assault-injured youth within 1 year of an index EC visit, compared to their non-assault-injured peers.

## Methods

Khayelitsha township is a dense, rapidly expanding urban settlement about 30 km from the Cape Town city center. Population estimates range from 500,000 – 1 million people, with half of the households living in informal dwellings [14]. Many households lack access to basic services like electricity, running water, and adequate sanitation [15]. Within the Cape Town Metro district, Khayelitsha has the highest rates of all-cause mortality – the four leading causes of death are homicide, HIV/AIDS, tuberculosis and road traffic injuries - and the lowest median income per family [9,15].

On weekends and after-hours, when most healthcare facilities are closed, it is served by just two 24-hour public health facilities. Khayelitsha Hospital (KH) is a 240-bed district-level hospital with a busy emergency centre. Site B Community Health Centre is a provincial primary health facility that contains a small trauma unit due to the high burden of violence in the community.

This cross-sectional study was conducted at these two emergency facilities over 15 weeks between August – November 2016. All assault-injured youth 14–24 years old presenting for care between Friday, 7pm and Monday, 7am were eligible for inclusion. A comparison group of non-assault-injured youth (i.e., seen for medical complaints or unintentional injury) was matched for gender. Exclusion criteria included sexual assault, child abuse, suicide attempt or primary psychiatric complaint, any patient with altered mental status due to clinically significant intoxication or head injury. Patients who were altered on arrival could be re-evaluated by research assistants if their treating physician determined that they had returned to baseline during their emergency centre stay.

Youth 14–24 were asked to provide informed consent. We received ethics approval for the independent consent of minors age 14–18 per South African Department of Health Ethical Research Guidelines. We did adhere to South African mandatory reporting provisions for children <18 years, including physical abuse, neglect, and sexual abuse/assault.

Research participants completed electronic surveys using a tablet. Participants with limited literacy had questions read aloud by the research assistants. Surveys were available in English and isiXhosa. Research assistants completed an electronic form with basic demographic, contextual, and medical data based on a paper chart review.

Questions for the patient surveys were primarily drawn from the South African National Youth Risk Behaviour Survey (YRBS). This survey was piloted in 2002 in five provinces (including the Western Cape), refined for face and construct validity, and subsequently administered nationally in 2002, 2008, and 2011 in each of the 11 official languages [16]. Many survey responses from YRBS were converted into dichotomous variables for analysis.

Additional questions were drawn from locally validated surveys when possible, including the Survey on Substance Use, Risk Behaviour and Mental Health among Grade 8–10 Learners in Western Cape Provincial Schools [17], and South Africa's first national population-based HIV/AIDS behavioural risks, sero-status and media impact survey (*SABSSM*) [18]. Special attention was paid to factors identified in US urban centres that were prevalent in their populations, and/or predictive of high rates of re-injury or mortality (drug/alcohol use, mental health issues, etc.) [19]. Questions on assault context were drawn from the The Time Line Follow Back – Aggression Module (TLFB-AM), which has successfully been used in similar US-based studies [19]. Intent to retaliate was assessed by asking: "Not all fights are over after someone gets hurt. Do you think you will hurt someone because of this fight?" [20].

We used descriptive statistics of baseline demographic and social characteristics to summarize assault-injured youth and controls (all and by complaint type). Bivariate associations of potential behavioral risk or protective factors with case-control status were estimated with odds ratios (ORs) and 95% confidence intervals (CIs). Among the assault-injured, $\chi^2$ tests were used to compare assault and clinical characteristics between males and females.

Ethics approval was obtained from the IRB and Office of Human Research Ethics of the University of North Carolina at Chapel Hill, University of Stellenbosch Health Research Ethics Committee (HREC), and institutional approval from the Western Cape Provincial Research Health Committee and the Cape Town City Health Department.

## Results

A total of 516 patients were enrolled during the study period. Three charts had significant missing data and were excluded, leaving 513 for analysis. Although every effort was made to enrol cases and controls on a 1:1 gender-matched basis, assault-injured male patients were oversampled due to lack of non-assault-injured patients presenting for care. Non-assault-injured females were slightly oversampled. (Fig 1).

Reflecting the demographics of Khayelitsha Township, the vast majority of patients identified as Black and spoke Xhosa as their primary language (Table 1). Assault-injured patients were predominantly male (80%), and had a mean age of 20.8. Seventy-five percent of assault-injured patients were triaged "urgent" or above on the South African Triage Scale [22].

Assault-injured patients were significantly less likely than non-assault injured patients to be enrolled in any educational institution (OR 0.5 [95% CI 0.34–0.72]) and be members of a religious group or church (OR 0.11 [95% CI 0.07–0.17]). Assault-injured patients were significantly more likely than controls to give a positive 30-day history of drinking any alcohol (OR 6.20 [95%

**Table 1.**
Demographics.

| | Assault-injured ($n = 324$) | Non-assault-injured: all ($n = 189$) | Non-assault-injured: medical complaint ($n = 126$) | Non-assault-injured: unintentional injury ($n = 63$) |
|---|---|---|---|---|
| Gender | | | | |
| Male, *n* (%) | 259 (80%) | 108 (57%) | 68 (54%) | 40 (63%) |
| Female, *n* (%) | 65 (20%) | 81 (43%) | 58 (46%) | 23 (37%) |
| Age (yr) | | | | |
| Mean (SD) | 20.8 (2.5) | 19.8 (3.2) | 20 (3.2) | 19.2 (3.0) |
| Under 18 | 39 (12%) | 58 (31%) | 38 (30%) | 20 (32%) |
| 18 and Over | 285 (88%) | 131 (69%) | 88 (70%) | 43 (68%) |
| Primary language | | | | |
| Xhosa, *n* (%) | 317 (98%) | 176 (93%) | 115 (91%) | 61 (97%) |
| English, *n* (%) | 2 (<1%) | 8 (4%) | 8 (6%) | 0 |
| Other, *n* (%) | 5 (2%) | 5 (3%) | 3 (2%) | 2 (3%) |
| Race | | | | |
| Black, *n* (%) | 317 (98%) | 185 (98%) | 124 (98%) | 61 (97%) |
| Coloured*, *n* (%) | 2 (<1%) | 4 (2%) | 2 (2%) | 2 (3%) |
| Indian, *n* (%) | 1 (<1%) | 0 | 0 | 0 |
| Other, *n* (%) | 3 (1%) | 0 | 0 | 0 |
| South African Triage Scale Category | | | | |
| Red (Emergency) | 8 (2%) | 4 (2%) | 4 (3%) | 0 (0%) |
| Orange (Very Urgent) | 38 (12%) | 28 (15%) | 21 (17%) | 7 (11%) |
| Yellow (Urgent) | 203 (63%) | 83 (44%) | 50 (40%) | 33 (52%) |
| Green (Routine) | 71 (22%) | 65 (34%) | 48 (38%) | 17 (27%) |
| Not recorded | 4 (1%) | 9 (5%) | 3 (2%) | 6 (10%) |

* "Cape Coloured" refers to a heterogeneous South African ethnic group with a diverse ancestry. The term "Coloured" is treated as a neutral description in Southern Africa and is not regarded as derogatory as it is in many Western countries.

**Table 2.**
Risk & protective factors for assault injury.

| | Assault ($n = 324$) | Control ($n = 189$) | Odds ratio (95% CI) |
|---|---|---|---|
| Education | | | |
| Currently in school (any – university, trade school, etc.) | 95 (29%) | 86 (46%) | **0.5 (0.34–0.72)** |
| Household, finances, & Employment | | | |
| Homeless in the past 30 days | 41 (13%) | 10 (5%) | **2.59 (1.27–5.31)** |
| Household does not have enough money for things like food & clothes | 143 (44%) | 67 (35%) | 1.44 (0.99–2.08) |
| Currently employed | 103 (32%) | 52 (28%) | 1.23 (0.83–1.82) |
| Religious affiliation | | | |
| Member of religious group (any church or denomination) | 121 (37%) | 160 (85%) | **0.11 (0.07–0.17)** |
| Sexual orientation | | | |
| Identifies as LGBT | 20 (6%) | 5 (3%) | 2.42 (0.89–6.56) |
| Mental health | | | |
| Met criteria for depression in the past 6 months | 94 (29%) | 51 (27%) | 1.11 (0.74–1.65) |
| Attempted suicide in the past 6 months | 38 (12%) | 24 (13%) | 0.91 (0.53–1.58) |
| Tobacco, Alcohol, & Other Drugs | | | |
| Smoked cigarettes in the past 30 days | 187 (58%) | 48 (25%) | **4.01 (2.70–5.95)** |
| Drank any alcohol in the past 30 days | 253 (78%) | 69 (37%) | **6.20 (4.17–9.21)** |
| Drank 5 or more drinks within a few hours in the past 30 days | 238 (73%) | 55 (29%) | **6.74 (4.52–10.05)** |
| Smoked marijuana ever | 124 (38%) | 36 (19%) | **2.64 (1.72–4.04)** |
| Used methamphetamines ever | 45 (14%) | 14 (7%) | **2.02 (1.07–3.78)** |
| Carrying a weapon | | | |
| Carried a gun in the past 30 days | 29 (9%) | 5 (3%) | **3.62 (1.38–9.51)** |
| Carried a knife in the past 30 days | 65 (20%) | 13 (7%) | **3.40 (1.82–6.35)** |
| Previous fights | | | |
| Threatened or injured with a weapon in the past 6 months | 158 (49%) | 39 (21%) | **3.66 (2.42–5.54)** |
| Threatened or injured someone else with a weapon in the past 6 months | 66 (20%) | 10 (5%) | **4.58 (2.29–9.15)** |
| Been in a physical fight in the past 6 months | 173 (53%) | 39 (21%) | **4.41 (2.91–6.67)** |
| Injured in a physical fight in the past 6 months requiring medical treatment | 152 (47%) | 28 (15%) | **5.08 (3.22–8.02)** |
| Gang involvement | | | |
| Been a member of a gang in the past 6 months | 39 (12%) | 10 (5%) | **2.45 (1.19–5.03)** |
| Approached to join a gang in the past 6 months | 66 (20%) | 18 (10%) | **2.43 (1.39–4.24)** |
| Contact with the criminal justice system | | | |
| Arrested ever | 99 (31%) | 15 (8%) | **5.10 (2.66–9.10)** |
| Slept in jail ever | 85 (26%) | 11 (6%) | **5.76 (2.98–11.11)** |
| Convicted of any crime ever | 58 (18%) | 6 (3%) | **6.65 (2.81–15.74)** |

*Note.* Bold indicates significant results.

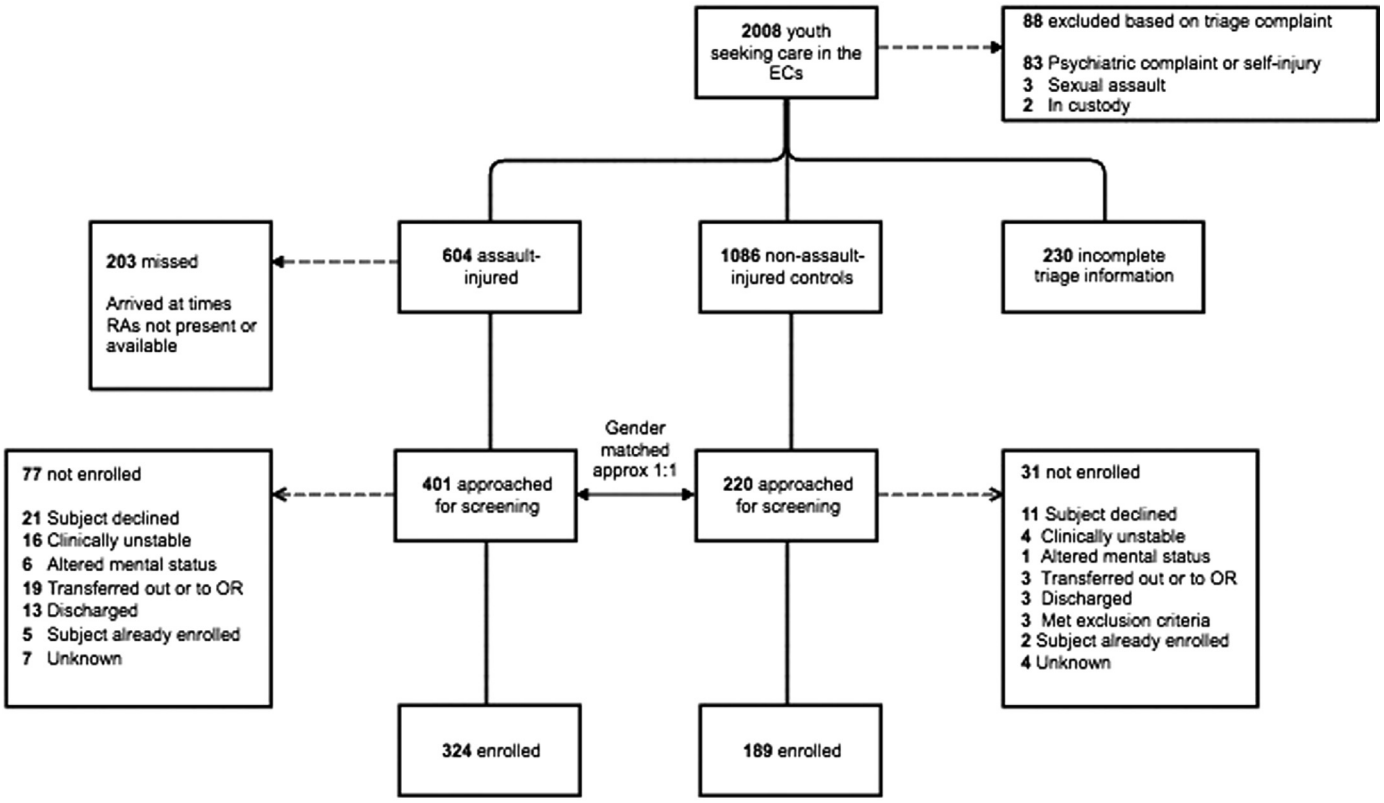


**Fig. 1.** Study flowchart.

CI 4.17–9.21]), binge drinking (OR 6.74 [95% CI 4.52–10.05]), and smoking cigarettes (OR 4.01 [95% CI 2.70–5.95]). They were also significantly more likely to report any physical fight (OR 4.41 [95% CI 2.91–6.67]) or any physical fight requiring medical care in the past 6 months (OR 5.08, [95% CI 3.22–8.02]), and lifetime history of arrest (OR 5.10 [95% CI 2.66–9.10]) or conviction (OR 6.65 [95% CI 2.81–15.74]). These differences were consistent across genders.

There were no significant differences found between cases and controls on measures of current employment (OR 1.23 [95% CI 0.83–1.82]), household financial distress - "Not enough money for things like food and clothes" (OR 1.44 [95% CI 0.99–2.08]), depression symptoms in the past 6 months (OR 1.11 [95% CI 0.74–1.65]), or suicide attempt in the past 6 months (OR 0.91 [95% CI 0.53–1.58]).

Use of questions from a widely used, locally validated survey allows comparison with larger population data. Fig. 3a shows rates of several selected characteristics reported by our study cohort and participants in the Youth Risk Behavioural Survey 2011 from the Western Cape Province, where Khayelitsha is located [21]. The prevalence of binge-drinking in our assault-injured cohort was over twice the rate reported by the general population (73% vs 35%). Fig. 3b demonstrates significantly higher rates of substance abuse prior to assault in our cohort when compared to a similar cohort from the US [33].

We collected information on assault context and clinical presentation of assault-injured patients by gender (Table 3). The majority of injuries overall were caused by stabbing (71%), and involved the use of weapons, most commonly a knife or other sharp object (69%). Gunshot wounds were rare (just 5% of all injuries).

One quarter of assault-injured patients anticipate violent retaliation as a consequence of their injury. Seventy-nine percent of patients endorsed alcohol and/or drug use prior to the assault. Significant differences were not detected between women and men (76% vs. 79%, $p = 0.59970$). Assault-injured females were significantly more likely than males to report assaults occurring at home (25% vs. 11%, $p = 0.00375$), with a "struck by/against" mechanism (35% vs. 12%, $p = 0.00001$), and without any weapons used (29% vs. 12%, $p = 0.00080$). They were also more likely to list a "current/past romantic partner" as the assailant (26% vs. <1%, $p < 0.0001$).

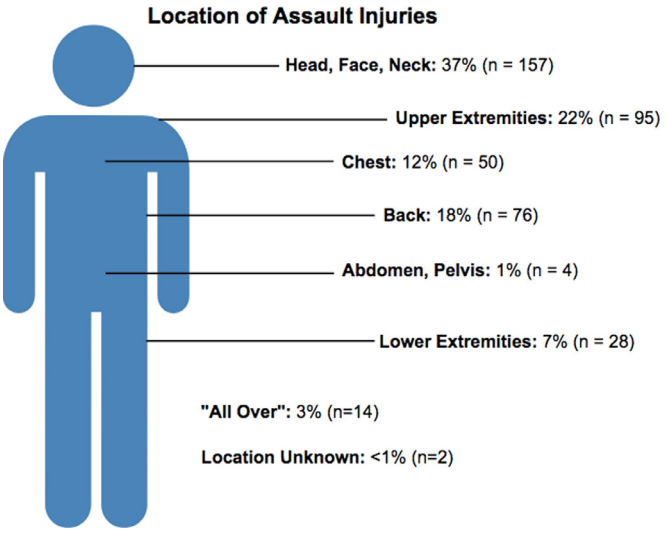


**Fig. 2.** Location of assault injuries.

The head/face/neck area was most commonly injured ($n = 157$, 37%), followed by the upper extremities ($n = 95$, 22%) and the chest/back $n = 126$, 30%) (Fig. 2). Injuries to the abdomen/pelvis were rare ($n = 4$, 1%).

**Table 3**
Gender differences in assault mechanism & context.

| | Assault-injured males ($n=259$) | Assault-injured females ($n=65$) | *P*-value |
|---|---|---|---|
| Assailant | | | |
| Current or past romantic partner (Intimate partner violence) | **1 (<1%)** | **17 (26%)** | **<0.0001** |
| Acquaintance | **46 (18%)** | **3 (5%)** | **0.00995** |
| Friend | 41 (16%) | 9 (14%) | 0.69146 |
| Family member | 14 (5%) | 2 (3%) | 0.49189 |
| Gang member | 34 (13%) | 3 (5%) | 0.07071 |
| Stranger | 77 (30%) | 14 (22%) | 0.20209 |
| I don't know/Other | 46 (18%) | 17 (26%) | 0.14757 |
| Mechanism | | | |
| Struck by/against | **30 (12%)** | **23 (35%)** | **0.00001** |
| Cut/pierce | 190 (73%) | 40 (62%) | 0.08239 |
| Cut/pierce AND Struck by/against | 5 (2%) | 0 (0%) | 0.25146 |
| Gunshot wound | 15 (6%) | 0 (0%) | 0.04400 |
| Unknown | 9 (3%) | 2 (3%) | 1.00 |
| Weapon used* | | | |
| No weapons used | **30 (12%)** | **19 (29%)** | **0.00080** |
| Firearm | **15 (5%)** | **0 (0%)** | **0.00100** |
| Knife or other sharp object (panga, broken glass, etc.) | 188 (73%) | 37 (57%) | 0.01262 |
| Blunt object (brick, stick) or whip (belt, sjambok) | 53 (20%) | 8 (12%) | 0.13787 |
| Other/Unknown | 21 (8%) | 5 (8%) | 1.00 |
| Location of assault | | | |
| Home | **28 (11%)** | **16 (25%)** | **0.00375** |
| Street | **175 (68%)** | **28 (43%)** | **0.00023** |
| School | 3 (1%) | 0 (0%) | 0.41899 |
| Shop | 5 (2%) | 1 (2%) | 01.00 |
| Bar | 24 (9%) | 10 (15%) | 0.15427 |
| Other/No response | 24 (9%) | 10 (15%) | 0.15427 |

## Discussion

### *Key results*

This study described the population of assault-injured youth in the 24-hour emergency centres of Khayelitsha township, including demographics and other baseline characteristics, risk and protective factors associated with assault injury, and clinical and contextual features of the assault injuries. Alcohol use, binge drinking, history of assault injury, and criminal history may be markers for assault injury. Nearly half (47%) of assault-injured youth had received medical care for an assault injury in the 6 months prior to the study, suggesting opportunities for targeted interventions in health care settings.

### *Limitations*

All survey data were self-reported, thus we are unable to determine the extent of under- or over-reporting. However, numerous studies on the methodology of the YRBS in other settings demonstrate that the data are of acceptable quality [23]. We attempted to reduce social desirability response bias by asking participants to complete the survey privately and anonymously on a tablet.

It is possible that there existed bias in convenience sampling. Preliminary triage register reviews suggested that the majority of assault-injured patients present on weekends/overnights and so we opted to focus data collection on these high-volume times. However, this method resulted in exclusion of both assault-injured and non-assault-injured youth who presented to the emergency centres during weekdays, and likely significantly underestimates the amount of school-based violence. We had hoped to enrol assault-injured patients and non-assault-injured patients on a 1–1 basis. However, the overwhelming majority of male patients age 14–24 presenting during our recruitment times were assault-injured. Assault-injured males outnumbered non-assault-injured males presenting for care over 2:1 (259 assaults, 108 controls). These data may have been affected by our recruitment window, however, it remains a sobering measure of the high rates of interpersonal violence amongst young men in Khayelitsha. We did not experience the same difficulty with female participants - in fact female controls were oversampled slightly (65 assaults, 81 controls).

More severely injured patients – those with altered mental status or clinically unstable – were excluded from the study, however this represented only 4.3% (27/621) of patients screened. Our refusal rate was low at 5.2% (32/621), so nonparticipation bias is likely negligible.

### *Generalisability*

Our study was conducted in a uniquely high-risk community (Khayelitsha township) [9]. Some of our findings parallel trends seen in other communities in the US, such as high prevalence of alcohol use and high rates of recurrent violence [24]. A meta-analysis of studies of youth violence in LMICs ranks as some of the strongest correlates of youth violence many of the factors identified in our study: male sex, smoking, drinking alcohol, using illicit drugs, criminal victimization, conduct problems (in our cohort: contact with the criminal justice system), deviant/delinquent peers (in our cohort: gang involvement). This supports the generalisability of our results to other LMIC settings [34].

### *Interpretation*

#### *Alcohol use/binge drinking*

High rates of alcohol use, specifically binge drinking (defined as 5 or more drinks in one sitting), were reported by our cohort. Of all patients who reported any alcohol use in the past 30 days ($n=322$), a startling 91% of those report binge drinking ($n=293$). These rates were consistently high when calculated separately for males (92%), females (88%), assault-injured patients (94%), and control patients (80%).

The WHO reports a clear relationship between alcohol consumption and injury risk in low-middle income countries. In a multicountry survey of emergency centre patients, South Africa

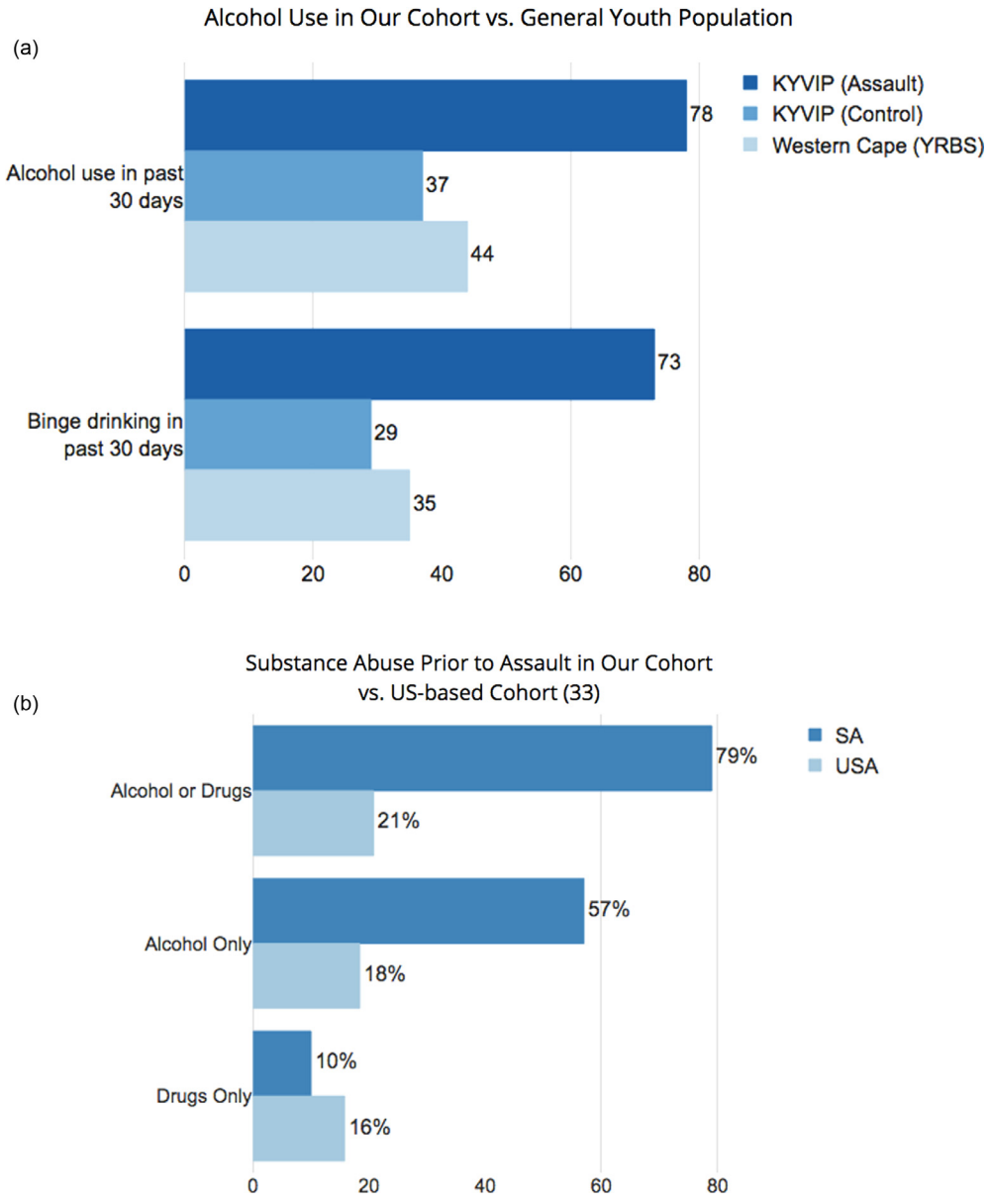


**Fig. 3.** (a) Risk behaviors in our cohort vs general youth population, Western Cape SA [21] (b) Risk behaviors in our cohort vs US-based assault-injured youth [33].

had the highest proportion of participants who reported consuming alcohol before their injury (45%), and "a strong association was seen between heavy drinking patterns and injury" [25].

Brief emergency centre interventions for alcohol misuse show mixed but promising results. A recent systematic review of 34 studies concluded that individuals who received a brief intervention were significantly less likely to have an alcohol-related injury at 6 or 12 months post-intervention than individuals who did not receive the intervention [26]. A recent study in Cape Town Emergency Centres (including those involved in our study) found that screening and brief intervention for substance use are feasible to implement in this setting and reduced risk for substance-related problems and depression at 3-month follow-up [27]. Whether this would translate into decreased recurrence of alcohol-related assault-injuries is not clear but warrants further investigation.

*Gender-based fight characteristics: the role of IPV & sexual violence*

We noted significant differences between assault characteristics for male and female assault-injured youth. Females were more likely to be injured at home, and by a current or previous romantic partner. Intimate partner violence (IPV) is widespread in South Africa, which has one of the highest rates of intimate femicide in the world (8.8/100,000 women) [28]. This problem is not limited to adults - surveys of Western Cape school learners in grades 8–11 show that 10.3% of females have been physically hurt by their boyfriends within the past six months [21]. More research is required, but this data suggests that assault-injured females may benefit from interventions targeted at intimate partner violence (IPV). Use of alcohol and/or drugs prior to assault was consistently high across genders (76% in females vs 79% in males), suggesting that substance use interventions may be helpful in both groups.

Our study was not designed to evaluate sexual violence – in Khayelitsha, sexual assaults are seen at dedicated clinical sites separate from the emergency centres. Globally, 30–56% of women who have experienced any violence by an intimate partner reported both physical and sexual violence, suggesting that our assault-injured population is likely at risk for both [29]. Targeted questioning during future research will be helpful in developing appropriate risk reduction interventions.

*Future interventions*

Many US violence intervention programs are inpatient-based, that is, reliant on case managers interacting with patients while they are hospitalized in a trauma unit (6). However, this approach may not be appropriate in all settings. Although we did not record the disposition of patients in our study, prior research at our clinical sites documents high discharge rates - in Cape Town community health centres overall, 91.5% of all patients are discharged home, with 6.9% alone referred to a higher level of care [13]. EC-based interventions are critical for capitalizing on the "teachable moment," particularly to prevent reinjury related to revenge or retaliation [30].

Several US-based studies [31,32] show that adolescents seeking emergency centre care for any reason have elevated rates of risk behaviors when compared to their peers, suggesting that EC-based violence prevention initiatives should consider offering screening and interventions all youth.

The Youth Risk Behavioral Survey is administered nationally to grades 8, 9, 10 and 11 learners in the nine provinces, and provides rates of risk behaviors in the general population. Compared to all youth in the Western Cape Province where Khayelitsha is located, our assault-injured population had higher rates of many risk behaviors – over twice the youth population rate of binge drinking, for example. However, our control population actually had lower rates of risk behavior than the general youth population (Fig. 3). Our ongoing follow-up study will evaluate EC recidivism for violent injury and death in the assault-injured and non-assault-injured groups, providing more clarity on how to identify high risk individuals and develop targeted violence prevention initiatives.

## Funding

Funding for this study was provided by the University of North Carolina Department of Emergency Medicine Global Health & Leadership Fellowship.

## Declaration of Competing Interest

None.

## CRediT authorship contribution statement

**Sarah Leeper:** Conceptualization, Writing - original draft, Writing - review & editing. **Sa'ad Lahri:** Conceptualization, Supervision, Data curation, Writing - original draft, Writing - review & editing. **Justin Myers:** Conceptualization, Writing - original draft, Writing - review & editing. **Mehul Patel:** Conceptualization, Data curation, Writing - original draft, Writing - review & editing. **Priscilla Reddy:** Conceptualization, Writing - original draft, Writing - review & editing. **Ian B.K. Martin:** Conceptualization, Writing - original draft, Writing - review & editing. **Daniël J. van Hoving:** Conceptualization, Writing - original draft, Writing - review & editing.

## Acknowledgments

We thank Mr. Ashley Kuiler. Sr. Sindiswa Lamani, Mr. David Binza, and other administrators at our research sites for their kind cooperation. We recognize the extraordinary efforts of our data collectors: Vuyiseka Shumana, Siphokazi Nyebelele, Vuyisile Ntsomi, Nelson Vuyane, and Sibulele Ntoni, without whom this research would not have succeeded. Enkosi kakhulu.

## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.injury.2019.10.014.

## References

[1] World Health Organization. Injuries and violence: the facts 2014; 2014. Available from http://apps.who.int/iris/bitstream/10665/149798/1/9789241508018_eng.pdf .
[2] Krug EG, Mercy JA, Dahlberg LL, Zwi AB. The world report on violence and health. The Lancet 2002;360(9339):1083–8.
[3] Sims DW, Bivins BA, Obeid FN, Horst HM, Sorensen VJ, Fath JJ. Urban trauma: a chronic recurrent disease. J Trauma Acute Care Surg 1989;29(7):940–7.
[4] Dowd MD. Consequences of violence: premature death, violence recidivism, and violent criminality. Pediatr Clin North Am 1998;45(2):333–40.
[5] Snider C, Lee J. Youth violence secondary prevention initiatives in emergency departments: a systematic review. CJEM 2009;11(2):161–8.
[6] Mikhail JN, Nemeth LS. Trauma center based youth violence prevention programs: an integrative review. Trauma Violence Abuse 2016;17(5):500–19.
[7] Johnson SB, Bradshaw CP, Wright JL, Haynie DL, Simons-Morton BG, Cheng TL. Characterizing the teachable moment: is an emergency department visit a teachable moment for intervention among assault-injured youth and their parents? Pediatr Emerg Care 2007;23(8):553–9.
[8] Snider CE, Lee JS. Emergency department dispositions among 4100 youth injured by violence: a population-based study. CJEM 2007;9(3):164–9.
[9] Groenewald P, Bradshaw D, Daniels J, Matzopoulos R, Bourne D, Blease D, et al. Cause of death and premature mortality in Cape Town. Cape Town South Afr Med Res Counc [Internet] 2008:2001–6. Available from https://www.westerncape.gov.za/Text/2008/11/cause_of_death_and_premature_mortality_in_cape_town_5_november_2008.pdf .
[10] W.H.O.. Global status report on violence prevention; 2014. [Internet]. WHO. [cited 2017 Jun 8]. Available from http://www.who.int/violence_injury_prevention/violence/status_report/2014/report/report/en/ .
[11] Nicol A, Knowlton LM, Schuurman N, Matzopoulos R, Zargaran E, Cinnamon J, et al. Trauma surveillance in Cape Town, South Africa: an analysis of 9236 consecutive trauma center admissions. Jama Surg 2014;149(6):549–56.
[12] Schuurman N, Cinnamon J, Walker BB, Fawcett V, Nicol A, Hameed SM, et al. Intentional injury and violence in Cape Town, South Africa: an epidemiological analysis of trauma admissions data. Glob Health Action 2015;8. doi:10.3402/gha.v8.27016.
[13] Wallis LA, Twomey M. Workload and casemix in Cape Town emergency departments: original article. S Afr Med J 2007;97(12):1276–80.
[14] Statistics South Africa. South African census, 2011.
[15] Khayelitsha Commission. Towards a safer Khayeltisha. 2014.
[16] Reddy SP, James S, Sewpaul R, Koopman F, Funani NI, Sifunda S, et al. Umthente uhlaba usamila-the 2nd south African national youth risk behaviour survey 2008. Cape Town South Afr Med Res Counc. 2010.
[17] Morojele N, Myers B, Townsend L, Lombard C, Plüddemann A, Carney T, et al. Survey on substance use, risk behaviour and mental health among grade 8–10 learners in Western Cape provincial schools, 2011. Cape Town South Afr Med Res Counc. 2013.
[18] Shisana O, Rehle T, Simbayi LC, Zuma K, Jooste S, Zungu N, et al. South African national HIV prevalence, incidence and behaviour survey, 2012; 2014. Available from http://repository.hsrc.ac.za/handle/20.500.11910/2490 .
[19] Cunningham R, Knox L, Fein J, Harrison S, Frisch K, Walton M, et al. Before and after the trauma bay: the prevention of violent injury among youth. Ann Emerg Med 2009;53(4):490–500.
[20] Wiebe DJ, Blackstone MM, Mollen CJ, Culyba AJ, Fein JA. Self-reported violence-related outcomes for adolescents within eight weeks of emergency department treatment for assault injury. J Adolesc Health 2011;49(4):440–2.
[21] Reddy SP, James S, Sewpaul R, Sifunda S, Ellahebokus A, Kambaran NS, et al. Umthente uhlaba usamila: the 3rd South African national youth risk behaviour survey 2011; 2013. Available from http://repository.hsrc.ac.za/handle/20.500.11910/2487 .
[22] Twomey M, Wallis LA, Thompson ML, Myers JE. The South African triage scale (adult version) provides reliable acuity ratings. Int Emerg Nurs 2012;20(3):142–50.
[23] Brener ND, Kann L, Shanklin S, Kinchen S, Eaton DK, Hawkins J, et al. Methodology of the youth risk behavior surveillance system—2013. MMWR Recomm Rep 2013;62(1):1–20.
[24] Cheng TL, Schwarz D, Brenner RA, Wright JL, Fields CB, O'Donnell R, et al. Adolescent assault injury: risk and protective factors and locations of contact for intervention. Pediatrics 2003;112(4):931–8.
[25] World Health Organization. Alcohol and injury in emergency departments: summary of the report from the who collaborative study on alcohol and injuries; 2007. Available from http://apps.who.int/iris/bitstream/10665/43581/1/9789241594851_eng.pdf .
[26] Landy MSH, Davey CJ, Quintero D, Pecora A, McShane KE. A systematic review on the effectiveness of brief interventions for alcohol misuse among adults in emergency departments. J Subst Abuse Treat 2016 Feb 1;61:1–12.
[27] Sorsdahl K, Stein DJ, Corrigall J, Cuijpers P, Smits N, Naledi T, et al. The efficacy of a blended motivational interviewing and problem solving therapy intervention to reduce substance use among patients presenting for emergency services in South Africa: a randomized controlled trial. Subst Abuse Treat Prev Policy 2015;10(1):46.
[28] Abrahams N, Mathews S, Martin LJ, Lombard C, Jewkes R. Intimate partner femicide in South Africa in 1999 and 2009. PLoS Med 2013;10(4):e1001412.
[29] Moreno-Garcia C, Jansen H, Ellsberg M, Heise L, Watts C. WHO multi-country study on women's health and domestic violence against women. WHO-Multi Ctry Study Womens Health Domest Violence Women 2005.

[30] Spivak HR, Prothrow-Stith D. Addressing violence in the emergency department. Clin Pediatr Emerg Med 2003 Jun 1;4(2):135–40.
[31] Lowenstein SR, Koziol-McLain J, Thompson M, Bernstein E, Greenberg K, Gerson LW, et al. Behavioral risk factors in emergency department patients: a multisite survey. Acad Emerg Med 1998;5(8):781–7.
[32] Wilson KM, Klein JD. Adolescents who use the emergency department as their usual source of care. Arch Pediatr Adolesc Med 2000;154(4):361–5.
[33] Cunningham RM, Ranney M, Newton M, Woodhull W, Zimmerman M, Walton MA. Characteristics of youth seeking emergency care for assault injuries. Pediatrics 2014;133(1):e96–e105.
[34] O.S. de Ribera, N. Trajtenberg, Y. Shenderovich, et al. Correlates of youth violence in low- and middle income countries: a meta-analysis. Aggression and Violent Behavior, Available online 2 September 2019 (In press).