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A retrospective study of the pre-hospital trauma burden managed by the Western Cape Government Emergency Medical Services

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ABSTRACT

Background: Trauma is one of the leading causes of premature death and disability in South Africa. There is a lack of data describing the pre-hospital trauma burden in sub-Saharan Africa. This study aimed to describe the epidemiology of common trauma emergencies managed by the Western Cape Government (WCG) emergency medical service (EMS) in South Africa.

Methods: The WCG EMS call centre registry was retrospectively analysed for all trauma patients managed between 01 July 2017 to 30 June 2018. A descriptive analysis of the data was performed using standard procedures for all variables. To date, this is the first analysis of this dataset or any pre-hospital trauma burden managed in the Western Cape of South Africa.

Results: The WCG EMS managed 492 303 cases during the study period. Of these, 168 980 (34.3%), or 25.5 per 1000 population, were trauma related. However, only 91 196 met the inclusion criteria for the study. The majority of patients (66.4%) were men between the socio-economically active ages of 21–40 years (54.0%). Assaults were the most common cause of trauma emergencies, accounting for 50.2% of the EMS caseload. The patient acuity was categorised as urgent in 47.5% of the cases, and 74.9% of the pre-hospital trauma burden was transported to a secondary level health care facility for definitive care.

Conclusion: This is the first report on the pre-hospital trauma burden managed in the Western Cape of South Africa. The Western Cape suffers a unique trauma burden that differs from what is described by the World Health Organization (WHO) or any other low- and middle-income countries (LMICs). It also provides the foundation for further research on emergency care needs in South Africa and support for Afrocentric health care solutions to address this public health crisis.

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BACKGROUND

A trauma-related fatality occurs every six seconds somewhere in the world.¹ This global health prob-

lem accounts for 10% of the global burden of disease and has become a leading cause of death and disability among children and young adults

in low- and middle-income countries (LMICs), as well as high-income countries (HIC).²⁻⁴ The burden of trauma is disproportionately borne by the 80% of the world's population residing in LMICs, who account for 90% of global trauma fatalities.^{1-3,5} Those residing in LMICs are three times more likely to die as a result of trauma than those in HICs.³

Africa, comprising predominantly LMICs, suffers the largest consequence of this burden and accounts for one-fifth of the global trauma mortality rate.^{1,6} In 2016, Africa had the highest mortality rates for transport-related accidents (26.6 per 100 000 people); nearly three times higher than Europe.³ Trauma was further identified as the leading cause for emergency medical service (EMS) activation in Africa.⁷ However, despite the trauma incidence in sub-Saharan Africa, the injury burden is poorly described.⁸ In South Africa, where the mortality rates are nearly double that of the global average, trauma is estimated to be the fourth leading cause of death.^{4,9} In 2017, 51 164 people died in South Africa due to trauma, compared to the 53 518 and 50 889 fatalities reported in 2016 and 2009, respectively.^{4,9} Despite this marginal improvement in South Africa, the World Health Organization (WHO) suggests that trauma has steadily increased and could become the fifth leading cause of death across all age groups globally by 2030.^{1,4,6} Therefore, immediate global action is required to address this public health crisis.

Most trauma fatalities in LMICs occur in the pre-hospital setting, yet many of these countries lack the infrastructure and capacity to deliver optimal pre-hospital emergency care.^{2,10} In the absence of an organised EMS, mortality rates are reported to be as high as 80% in LMICs' pre-hospital settings.^{10,11} This is particularly important as 61% of the African continent was previously reported to be without any formal EMS.⁷

Several studies have mentioned the significant role EMS play in reducing the trauma burden in LMICs.^{12,13} For instance, Disease Control Priorities in Developing Countries (DCP 1 & 2), aimed at establishing reasonable responses for the mounting trauma burden in LMICs, suggested that a reduction of up to 45% in mortality and 36% in morbidity rates could be realised by the development of EMS systems.^{11,12} In light of this, the WHO has classified EMS as a vital and integral component of any effective health care system.¹⁴

South Africa is an upper, middle-income country comprising nine provinces. The Western Cape is the third most populated province with a popula-

tion of approximately 7 million people, based on 2020 mid-year statistics.¹⁵ The Western Cape Government (WCG) EMS is a publicly funded service, providing free 24/7 emergency care and transportation throughout the Western Cape. In 2017, there were an estimated 500 000 EMS activations annually throughout the province.¹⁶ KwaZulu-Natal (KZN), the second most populated province in South Africa, is the only other province with published data describing the pre-hospital trauma burden.¹⁷

Based on this background, there is evidently a need to report on both fatal and non-fatal outcomes that could guide the development of Afro-centric pre-hospital trauma systems. At present, fatalities seem to be the only measurement used to describe the trauma burden in sub-Saharan Africa. Therefore, the aim of this study was to describe the pre-hospital trauma burden managed by the public sector EMS of the Western Cape in South Africa. In particular, we aimed to describe the (i) epidemiology, (ii) common types of trauma and associated dispatch priority, (iii) patient acuity, and (iv) level of definitive care commonly required.

DESIGN AND METHODS

Study Design

This study was a retrospective review of all trauma patients managed by the public sector EMS in the Western Cape province of South Africa between July 2017 and June 2018.

Study Population and Sample

The WCG EMS call centre registry contains computer-aided dispatch (CAD) and electronic patient care records (ePCR) for each case managed by the WCG EMS. The CAD system collects non-clinical data related to the physical resources allocated to each case, and the ePCR database collects patient demographics and clinical data. De-identified data were extracted from the WCG EMS call centre registry and included all cases (i) classified as trauma cases upon EMS activation, (ii) with complete CAD records, and (iii) corresponding complete ePCRs. Interfacility transfers and medical cases were excluded. The dataset of outcome measures included basic patient demographics, causes of injury/trauma, patient acuity, dispatch priority and level of definitive care required.

Methods

Patient demographics and the modality of trauma were categorised in accordance with the WHO injury and violence report.¹ Trauma modality was divided into five categories, namely assaults (vi-

olence inflicted by others), transport-related (all mediums of transport), intentional (self-inflicted), unintentional (with burns, environmental and drowning injuries as sub-groups where available), and other (occupational, falls or unknown) injuries.¹

Dispatch priority was defined as priority 1 (urgent), with the aim of getting an EMS resource to the patient within 15 minutes, or priority 2, allocated to less urgent cases, with the aim of arriving at the patient within a 60-minute window. Patient acuity, which was only determined once EMS arrived on the scene and physically assessed the patient, was characterised based on the South African Triage Scale (SATS) classification.¹⁸ Patient acuity was defined as either emergent (life-threatening), very urgent, urgent, non-urgent or dead.¹⁸ For the purpose of this study, community clinics and primary health care facilities were regarded as primary health care facilities; regional and district facilities as secondary health care facilities; and highly specialised tertiary and quaternary facilities as tertiary health care facilities.^{16,19} The date of incident was classified according to the season: autumn (March to May), winter (June to August), spring (September to November), and summer (December to February). Shift periods were defined as either day shift (07h00–19h00) or night shift (19h00–07h00), as these were the most common operational periods used at the time in the Western Cape.

Ethics approval for this study was granted by

the University of Cape Town Human Research Ethics Committee (HREC REF: 693/2018) and the WCG Department of Health EMS (WC-201810-034). Moreover, the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement checklist for cross-sectional studies was used to compile this manuscript.

Data Analysis

The data were processed and analysed with IBM SPSS version 25 (Armonk, NY: IBM Corp). Simple summary statistics were used to describe all variables. Continuous data were described using means and standard deviation, while categorical data were reported as proportions. The chi-square test was used to determine differences in distributions across variables. Statistical significance was considered at p-value < 0.05.

RESULTS

The WCG EMS had 492 303 activations during the study period, of which 168 980 (34.3%) were trauma related. Medical emergencies and inter-facility transfers made up the remaining case volume. Based on 2018 mid-year population estimates for the Western Cape, 25.5 per 1000 people were managed by the WCG EMS for a trauma-related emergency.¹⁵ Ultimately, 91 196 cases remained eligible for analysis after duplications, missing data and corresponding ePCR availability were excluded (Figure 1).

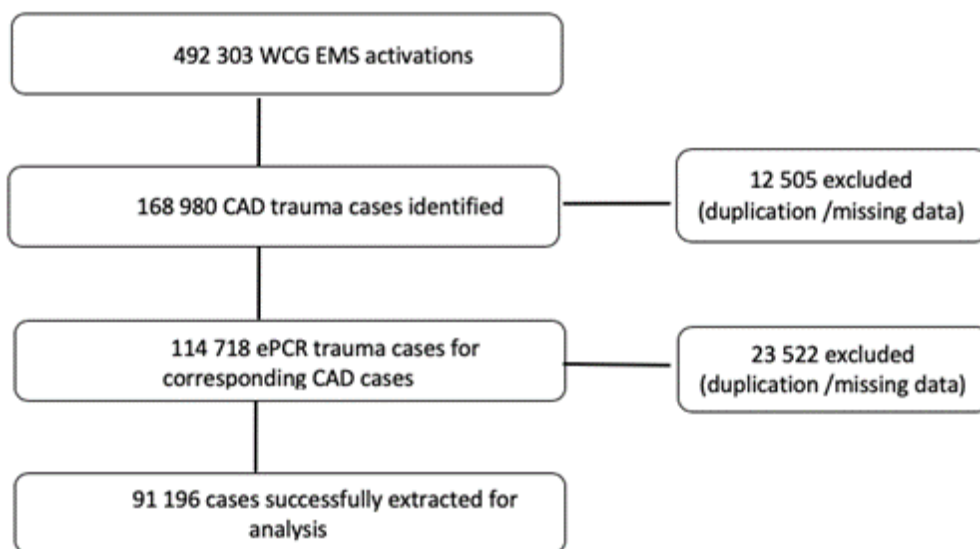


Figure 1: Flow Diagram Depicting Final Study Sample

CAD = Computer-aided Dispatch, ePCR = Electronic Patient Care Record, WCG EMS = Western Cape Government Emergency Medical Services

Table 1: Demographic Characteristics of Trauma Patients Managed by the Western Cape Government Emergency Medical Services n (%)

Characteristic	Assault	Intentional	Transport	Unintentional	Other	P-value	Total
Sex							
Male	34 036 (56.2)	3 185 (5.3)	11 813 (19.5)	10 449 (17.3)	1 043 (1.7)	<0.001	60 527 (66.4)
Female	11 716 (38.2)	4 157 (13.6)	6 114 (19.9)	8 175 (26.7)	507 (1.7)		30 669 (33.6)
Age							
≤ 20	6 988 (15.3)	2 200 (30.0)	3 314 (18.5)	6 734 (36.2)	331 (21.4)	<0.001	19 567 (21.5)
21–40	29 641 (64.8)	3 474 (47.3)	9 744 (54.4)	5 770 (31.0)	635 (41.0)		49 264 (54.0)
41–60	8 243 (18.0)	1 325 (18.0)	4 018 (22.4)	3 920 (21.0)	436 (28.1)		17 942 (19.7)
≥ 61	880 (1.9)	344 (4.7)	851 (4.7)	2 200 (11.8)	148 (9.5)		4 423 (4.8)
Season							
Autumn	11 549 (25.2)	1 902 (25.9)	5 123 (28.6)	4 878 (26.2)	323 (20.8)	<0.001	23 775 (26.1)
Winter	9 293 (20.3)	1 470 (20.0)	4 085 (22.8)	4 118 (22.1)	316 (20.4)		19 282 (21.1)
Spring	11 537 (25.2)	1 930 (26.3)	4 278 (23.8)	4 355 (23.4)	429 (27.7)		22 529 (24.7)
Summer	13 373 (29.2)	2 041 (27.8)	4 441 (24.8)	5 273 (28.3)	482 (31.1)		25 610 (28.1)
Shift							
Day	19 372 (42.3)	4 047 (55.1)	10 298 (57.4)	11 758 (63.1)	1192 (76.9)	<0.001	46 667 (51.2)
Night	26 380 (57.7)	3296 (44.9)	7 629 (42.6)	6 866 (36.9)	358 (23.1)		44 529 (48.8)
Total	45 752 (50.2)	7 343 (8.1)	17 927 (19.6)	18 624 (20.4)	1550 (1.7)		91 196

The mean (\pm standard deviation) age of all patients was 31.6 (\pm 15.8) years. Pre-hospital trauma patients were predominantly male (66.4%; $p < 0.0001$; Table 1); when stratified by age and sex, young men between the ages of 21–40 years constituted the largest stratum of the study sample ($n = 34\,436$; 37.7%). The paediatric population (< 13 years) accounted for 10.1% ($n = 9\,213$) of trauma patients.

Overall, 45 752 (50.2%) of the reviewed trauma emergencies resulted from assaults and accounted for 45.6%–54.8% of the monthly call volume across the study period. This equates to a rate of 691 assault-related public sector EMS activations per 100 000 people, based on population estimates during the study period for the Western Cape.¹⁵ Unintentional injuries, which included burns, drowning and environmental emergencies (among others), were the second most common cause of trauma emergencies (20.4%) for the overall sample, closely followed by transport-related trauma

(19.6%). Assault-related injuries were the most common cause of trauma among both men (56.2%) and women (38.2%) (Table 1), while the second most common cause of trauma emergencies among women was unintentional injuries (26.7%). For men, transport-related trauma (19.5%) was the second most common cause of trauma emergencies. Also, winter (21.1%) had a lower trauma call volume compared to summer (28.1%; $p < 0.001$).

The distribution of dispatch priority differed by trauma category ($p < 0.001$; Table 2). Transport-related trauma injuries were categorised as priority 1 cases 99.1% of the time, with 63.8% of intentional injuries categorised as priority 1. Interestingly, unintentional injuries (74.3%), assault (61.8%) and intentional injuries (36.4%) were more often dispatched as priority 2 cases. Following on-scene assessment, almost half of the sample was deemed urgent (47.5%) according to the SATS, followed by non-urgent cases (25.5%). The distri-

bution of SATS acuity differed by trauma category ($p < 0.001$). When stratified by SATS acuity, transport-related injuries had the highest relative proportion of emergent injuries (11.3%), with more than a third (37.1%) of these injuries being considered emergent or very urgent. Similarly, 36.9% of intentional injuries were considered emergent or very urgent, and assault cases reflected the highest

relative proportion of low acuity (non-urgent) patients (30.6%). Only 7.1% ($n = 6440$) of patients were transported to a tertiary facility for specialised care, while 74.9% ($n = 68\ 306$) and 17.4% ($n = 15\ 704$) of the sample were transported to secondary and primary level health care facilities, respectively. The remaining 0.8% ($n = 686$) died on the scene and were taken to the most appropriate mortuary.

Table 2: Distribution of Dispatch Priority and Triage Status by Trauma Emergency n (%)

Characteristic	Assault	Intentional	Transport	Unintentional	Other	P-value	Total
Priority							
Priority 1	17 419 (38.2)	4 668 (63.8)	17 763 (99.1)	4 790 (25.7)	575 (37.1)	<0.001	45 215 (49.5)
Priority 2	28 161 (61.8)	2 675 (36.4)	164 (0.1)	13 834 (74.3)	975 (62.9)		45 809 (50.2)
Pt Acuity							
Non-urgent	13 994 (30.6)	1 474 (20.1)	2 647 (14.8)	4 807 (25.8)	322 (20.8)	<0.001	23 244 (25.5)
Urgent	20 960 (45.8)	3 149 (42.9)	8 360 (46.6)	9 996 (53.7)	841 (54.3)		43 306 (47.5)
Very urgent	7185 (15.7)	2 110 (28.7)	4 629 (25.8)	3 091 (16.6)	305 (19.7)		17 320 (18.9)
Emergent	3217 (7.0)	599 (8.2)	2024 (11.3)	720 (3.9)	80 (5.2)		6 640 (7.3)
Dead	396 (0.9)	11 (0.1)	267 (1.5)	10 (0.1)	2 (0.1)		686 (0.8)
Total	45 752 (50.2)	7 343 (8.1)	17 927 (19.6)	18 624 (20.4)	1550 (1.7)		91 196

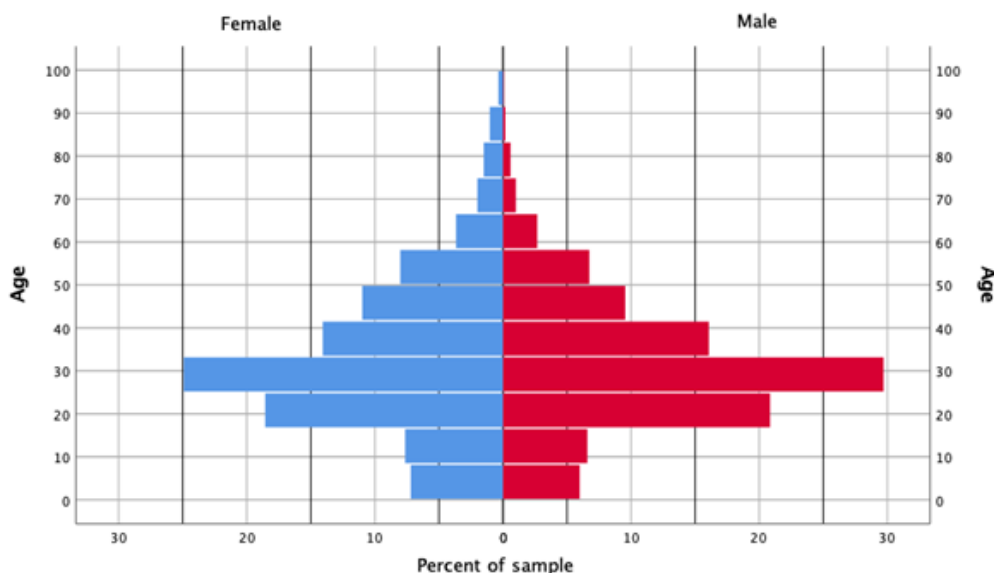


Figure 2: Population Pyramid by Sex: Trauma Burden Managed by the Western Cape Government Emergency Medical Services

In total, 0.8% (95% confidence interval: 0.7–0.9%; n=686) of trauma patients were triaged dead during the first assessment, equating to 752 on-scene deaths per 100 000 trauma activations managed by the WCG EMS (Table 3). Of these, most were men (70.4%), and those aged 21–40 years old (64.0%). Transport-related injuries had the highest relative proportion of patients triaged dead on scene (1.5%), although assault injuries accounted for the majority of deaths at triage (57.7%).

Table 3: Pre-hospital Mortality Patterns

Characteristic	n (%)
Mortality/Sex	
Female	203 (29.6)
Male	483 (70.4)
Mortality/Age	
< 20	56 (8.2)
21–40	439 (64.0)
41–60	167 (24.3)
≥61	24 (3.5)
Mortality/Date	
Autumn	66 (9.6)
Winter	212 (30.9)
Spring	242 (35.3)
Summer	166 (24.2)
Mortality/Cause of Injury	
Assault	396 (57.7)
Transportation Injury	267 (38.9)
Intentional Injury	11 (1.6)
Unintentional Injury	10 (1.5)
Other	2 (0.3)

DISCUSSION

This retrospective review provides the first description of the epidemiology of common trauma emergencies, patient acuity and disposition for the pre-hospital trauma burden managed in the Western Cape province of South Africa. In this study, we found that trauma constituted a substantial proportion (34%) of the WCG EMS caseload. A previous study in the KZN province of South Africa reported that trauma accounted for 1% of the province's EMS caseload.¹⁹ The findings of our study suggest a public sector EMS trauma activation rate of 25.5 per 1000 population, compared to 11.6 per 1000 population previously reported in KZN.¹⁹ These are both extraordinarily high compared to epidemiological studies from some HICs with reported trauma rates of between 19–30 per 100 000 population.^{20,21}

The most important finding of this study is the exceptionally high rates of assault injuries, which ac-

counted for 50.2% of the caseload managed. The magnitude of this occurrence can only truly be understood against the backdrop of global trends; accordingly, the WHO injury and violence report suggests that assault only accounts for 10% of the global trauma burden.¹ We noted that assault accounted for the highest proportion of trauma cases among all categories, particularly socio-economically active adult men, but interestingly, the majority (61.8%) of these cases were dispatched as priority 2. Targeted intervention strategies are thus required from a public health perspective to reduce the overwhelming nature of this burden on the WCG health care system and, subsequently, the economy.

Previous publications by the WHO reported homicide rates of 64.8 per 100 000 population for South Africa,²² which is nearly six times that of the African region.²³ The South African mortality statistics for 2016 describe the Western Cape as the province with the highest proportion of non-natural causes of death in South Africa, with an assault mortality rate superseding that of transportation incidents almost fourfold.⁴ The findings of our study are also reinforced by similar trends reported in the KZN province of South Africa, where assaults were the most common trauma-related emergency managed by EMS.¹⁷ However, the frequency of pre-hospital assault activations in KZN (39.7%) was considerably lower than the 50.2% in our study.¹⁷

The current study, performed at a local, provincial level, does not resemble the global findings of the 2018 WHO global status report on road safety; it reported "transportation" was the leading cause of death for people aged 5–29 years worldwide.³ Similarly, other studies from both HICs and LMICs reported transport-related injuries as a significant burden rather than assault.^{5,13,24} The findings of our study are, however, reinforced by similar trends and associations reported in the KZN province of South Africa, where assaults were more common than transport-related injuries.¹⁹ These reports, in conjunction with the fact that the Western Cape pre-hospital trauma burden comprises 30–50% more assault emergencies than other reports from sub-Saharan Africa, bolster the label of "knife capital of the world" that has befallen the Western Cape in recent years.^{4,17,19,24}

In the current study, unintentional injuries (20.4%) and transport-related injuries (19.6%) each accounted for approximately one-fifth of the trauma caseload. Interestingly, almost all transport-related injuries were dispatched as priority 1 calls, and these injuries had the highest relative proportion of emergent cases (11.3%) compared to other types

of trauma, resulting in a large resource burden on the EMS system. According to the WHO reports, Africa experiences the highest transport-related fatality rates in the world, and its citizens are three times more likely to die as a result thereof.³ Moreover, the highest proportion of transport-related injuries occurred during the autumn months, recognised in South Africa as a period of excessive transport fatalities as a result of the Easter and school holiday festive period.²⁵ Despite the current prevention efforts, transport-related injuries remain a large part of the trauma burden in the Western Cape, and our results suggest a need for continued intervention programmes during the festive periods. The WHO has recognised transport-related injuries as a global problem, and echoed these sentiments on a global platform by emphasising strategies to reduce this burden.³

Unintentional injuries, including burns, drowning and environmental injuries, represent an under-recognised burden on the health care system in the Western Cape. The majority of patients suffering unintentional injuries in this study were men (56%). We also found that all subcategories (burns, drowning and environmental), except occupational-related injuries, were more prevalent in the younger age groups. These findings are supported by local and international reports that describe drowning and burns to occur frequently in children, and the largest proportion of this burden is borne by LMICs.^{1,26,27} Almost three-quarters (74.3%) of unintentional injuries were categorised as priority 2 calls, and the majority of cases (80%) were considered to be lower-acuity calls (non-urgent – urgent). Furthermore, most unintentional injuries were managed by EMS during day shifts (63.1%) when exposure to leisure and occupation-related activities are likely to be higher. Given the highly preventable nature of unintentional injuries and the significant burden these incidences place on the WCG EMS, the development of policy and strategies to reduce these injuries may have a significant impact on the trauma burden managed by the WCG EMS.

We found that young men between the ages of 21–40 years (37.7%) accounted for the largest proportion of the trauma burden. These findings are consistent with previous publications based on epidemiological studies from LMICs, parts of South Africa, and health care facilities in the Western Cape.^{17,24,28} However, it is interesting to note that 56% of intentional injuries (excluding assault) in this study occurred among women, despite women only accounting for a third of the study sample. According to the WHO, intentional injury has not only been described as one of the leading

causes of trauma-related mortality among women worldwide, but has also been reported to likely supersede that of homicides by 2020.²³ In the current study, assaults were the most common emergencies experienced among women. This finding is likely attributed to the exceptionally high rate of gender-based violence experienced in South Africa over the past decade.^{22,29} Our findings support the statement by the WHO that 45% of women in Africa will face some form of assault.³⁰ While this study offers insight into the trauma burden experienced by woman and children, additional research is required to understand the nature of this burden and inform policy, practise and mitigating interventions. Furthermore, robust and implementable clinical practice guidelines are essential to improve pre-hospital response to the trauma burden.

LIMITATIONS

This study had several limitations. This review was based on secondary data, appearing on a call registry of an organisation that had recently introduced real-time electronic capturing of data. A substantial portion of the pre-hospital trauma burden was not included in this analysis due to incomplete or missing corresponding ePCR records. In addition, this study offers a limited degree of generalisability, as the WCG EMS call registry data are likely to under-represent the province's true pre-hospital trauma burden since private EMS providers in the Western Cape were not included in this study.

CONCLUSION

This study provided the first description of the pre-hospital trauma burden managed by WCG EMS. In contrast to WHO reports,^{1–3} assaults were the leading cause of trauma emergencies among men and women. Furthermore, the province's unique trauma burden is dissimilar to those reported by other LMICs and global trends. The key findings of this study revealed a high burden of assault, unintentional injury, and transport-related injuries, and provide a benchmark against which to compare provincial data throughout South Africa and future trends.

In addition to highlighting the need to explore the determinants of assault-related emergencies and evaluate current interventions aimed at reducing this burden, this study provided the foundation for further research into emergency care needs in South Africa in order to support Afrocentric health care solutions. The study also offered preliminary epidemiological data describing the Western Cape's pre-hospital trauma burden and reflected

the key areas requiring further investigation and intervention. In particular, the need to explore the pre-hospital trauma burden managed by all EMS providers in the Western Cape, and on a larger scale, South Africa, was emphasised.

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CONFLICTS OF INTEREST

The authors report no conflicts of interest.

AUTHOR CONTRIBUTIONS

NA conceptualised of the study design and was primarily responsible for data extraction, analysis, interpretation, and preparation of the manuscript. CS, MM and PN provided input on the study's design, data analysis, interpretation and manuscript preparation.

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