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ORIGINAL SCIENTIFIC REPORT

Association Between Gender, Surgery and Mortality for Patients Treated at Médecins Sans Frontières Trauma Centre in Kunduz, Afghanistan

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Abstract

Introduction There is paucity of literature describing type of injury and care for females in conflicts. This study aimed to describe the injury pattern and outcome in terms of surgery and mortality for female patients presenting to Médecins Sans Frontières Trauma Centre in Kunduz, Afghanistan, and compare them with males.

Materials and Methods This study retrospectively analysed patient data from 17,916 patients treated at the emergency department in Kunduz between January and September 2015, before its destruction by aerial bombing in October the same year. Routinely collected data on patient characteristics, injury patterns, triage category, time to arrival and outcome were retrieved and analysed. Comparative analyses were conducted using logistic regression.

Results Females constituted 23.6% of patients. Burns and back injuries were more common among females (1.4% and 3.3%) than among males (0.6% and 2.0%). In contrast, open wounds and thoracic injuries were more common among males (10.1% and 0.6%) than among females (5.2% and 0.2%). Females were less likely to undergo surgery (OR 0.60, CI 0.528–0.688), and this remained significant after adjustment for age, nature of injury, triage category, multiple injuries and delay to arrival (OR 0.80, CI 0.690–0.926). Females also had lower unadjusted odds of mortality (OR 0.49, CI 0.277–0.874), but this was not significant in the adjusted analysis (OR 0.81, CI 0.446–1.453).

Conclusion Our main findings suggest that females seeking care at Kunduz Trauma Centre arrived later, had different injury patterns and were less likely to undergo surgery as compared to males.

Introduction

Approximately 4.5 million people die globally from injuries every year, accounting for 8% of global deaths [1]. About 90% of those deaths occur in low- and middle-income countries (LMIC) [2]. While most injuries, both globally and in LMIC, are due to road traffic injuries, self-harm, non-conflict-related interpersonal violence, falls and drowning, an increasing proportion is due to conflict [3]. Studies have documented that over 35% of casualties in armed conflicts are civilian [4–7]. The tendency in modern conflicts to directly target civilians, including aerial attacks on schools and hospitals, may explain the increasing burden of civilian trauma [8–10]. An example is the 2018 deliberate target of thousands of civilians in the conflict in

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eastern Ghouta, Syria [11]. Studies indicate that among civilians, females are twice as likely to die from air bombardments and other ordnance and have almost five times the odds of dying from chemical weapons as compared to males [12]. However, despite these findings and the fact that up to 22% of civilian casualties are female, there are few studies investigating trauma care outcomes for females [6, 7, 12–14].

In 2011, the international, independent, medical humanitarian organization Médecins Sans Frontières (MSF) opened Kunduz Trauma Centre (KTC) in northern Afghanistan [15–18]. KTC provided essential trauma services free of charge until it was destroyed by a US airstrike in October 2015, resulting in 42 deaths and 30 injured including both staff and patients [16, 17]. There have been several publications using data from Kunduz, but to date there have been no studies specifically investigating female patients [19–22]. In addition, studies on outcome in terms of surgery and mortality are either inconclusive or lack presentation of gender differences [21, 23, 24]. This study utilized existing data from KTC to gain critical knowledge on how females as a group were affected by trauma in this conflict setting. The aim was to describe the injury pattern, frequency of surgery and mortality for female patients seeking care at the emergency department (ED) at MSF Trauma Centre in Kunduz and to compare with male patients.

Materials and methods

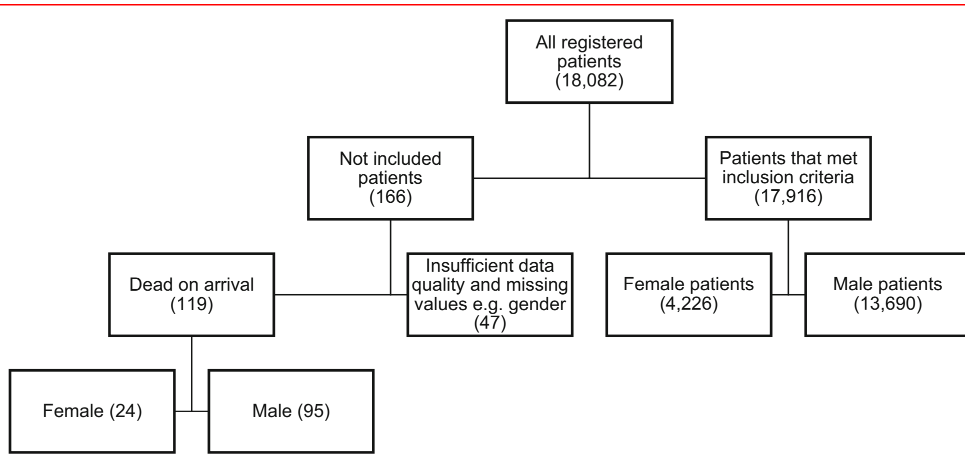
KTC was located in Kunduz city, Afghanistan's fifth largest city, situated in the province of Kunduz with one million inhabitants [25]. Prior to the establishment of KTC, trauma patients had to travel to either Kabul, Afghanistan or Pakistan to receive trauma care [26]. The distance to Kabul, the nearest of the two, is over 330 km [27]. During its functional years (2011–2015), more than 15,000 surgeries were performed and around 68,000 emergency consultations were conducted at the centre [17].

The study included all patients ≤ 80 years of age treated at KTC between 1 January 2015 and 18 September 2015. Due to incompleteness of available data, patients who presented prior to this time period were not included in our study. A total of 18,082 patient visits were recorded at the ED during the study period. Patients with missing data (n = 47) or who were dead on arrival (n = 119) were excluded (see Fig. 1).

Surgery and mortality were chosen as outcome measures owing to inconsistent results from previous studies measuring these outcomes [21, 23, 24]. Further, previous studies from KTC indicated that there were limitations in the availability of other variables collected at the centre [19, 22]. Injury pattern included cause of hospitalization, nature of injury, body region of injury and presence of multiple injuries. Covariates included age, nature of injury, triage category (see "Appendix"), multiple injuries and delay to arrival, all but the first selected as they are determinants for injury severity scoring. The covariates were used to characterize the study sample and to adjust the association between gender and outcome in regression analyses. Surgery was defined as all procedures performed, from minor wound treatment to major laparotomies in an operating room and requiring anaesthesia. Mortality was defined as all patients who were alive on arrival but later died while in care at the centre.

This study utilized routinely collected patient data which were recorded using a standardized form used across all MSF missions. The data were entered in a logbook and then transferred into an electronic database (Microsoft Excel) on a monthly basis. The database was then transmitted to the MSF headquarters in Brussels where it was

Fig. 1 Study sample: patients treated at the emergency department of Kunduz trauma centre and included in the study



reviewed for accuracy. Discrepancies were addressed and corrected after contact with program personnel involved in data entry.

Statistical analysis was performed using R 3.3.2. (The R Foundation, R Core Team, 1020 Vienna, Austria) [28]. Descriptive and inferential statistical analyses were performed according to the type of variables considered. First, an unadjusted analysis using logistic regression was used for mortality and surgery, with gender as the only independent variable. Second, an adjusted analysis was conducted in which age, nature of injury, triage category, multiple injuries and delay to arrival were added as independent variables. Values were given as mean (SD) or median (IQR) when applicable. Confidence intervals were set at 95% with a 5% significance.

Results

A total of 17,916 patients were included in this study, out of which 23.6% were female (Fig. 1, Table 1). Age ranged from between < 1 to 80 years, and 70.7% were under the age of 30. Children (< 15 years) represented 35.5% of all patients while 4.8% were over the age of 60. The median age was 20 years (IQR 8.0–40.0) for females and 19 years (IQR 11.0–30.0) for males.

A total of 53.3% were triaged as yellow on arrival (female 57.6%, male 52.0%). The percentage of patients triaged as red or orange was lower for females (21.8%) than for males (30.8%). A lower percentage of females arrived within the first hour after injury as compared to males (19.1% vs. 25.7%), and a higher percentage arrived more than one day after injury (26.6% vs. 18.9%).

A total of 6.9% of females were hospitalized due to violence-related injuries (assault, bombs, guns, knives and mines), corresponding to half that for males (14.0%). Non-conflict-related injuries for both genders included road traffic injuries (16.2%), burns (0.8%) and a large proportion (70.6%) of unspecified injuries entered as “Accident–Others”.

A total of 101 patients (0.6%) died. Of those, 13 (12.9%) were female, representing 0.3% of all females seeking care. In our study population, 1741 (9.7%) patients underwent surgery, out of which 283 (16.3%) were female. Thus, 6.7% of all females underwent surgery compared to 10.7% of males. The percentage of burns among females was more than double that of men (1.4% vs. 0.6%). Males had almost double the percentage of open wounds as compared to females (10.1% vs. 5.2%). Back injuries were more common in females (3.3% vs. 2.0%), while men had a three times higher risk of injuries to the thorax (0.6% vs. 0.2%). Multiple surgical interventions were conducted in 36% of all female patients and for 42% of male patients.

In both the unadjusted and adjusted analyses for surgery (Table 2 and Table 3), females had significantly lower odds of undergoing surgery compared to males (unadjusted OR of 0.60, $p < 0.001$, CI 0.53–0.69, adjusted OR 0.80, $p = 0.003$, CI 0.69–0.93). The analysis also showed that females had a lower unadjusted odds ratio of dying (OR 0.49, $p = 0.016$, CI 0.28–0.87) (Table 4). However, when adjusted, this was no longer significant (OR 0.81, $p = 0.47$, CI 0.45–1.45) (Table 5).

Discussion

Our main findings suggest that female trauma patients arrived later than men, had a different injury pattern and were less likely to undergo surgery. The cause of hospitalization showed a surprisingly small proportion of conflict-related injuries in this high-intense conflict area. One explanation could be that patients in challenging contexts may hesitate to report their injuries as being due to assault but it could also be explained by impaired access and that patients might have died before arrival. Our results also showed that the proportion of conflict-related injuries in females was half compared to males. This could be explained by the way of warfare where females are less involved. However, although “Accident–Others” is not a group of violent trauma, the largeness and width of the group add uncertainty to all results under “cause of hospitalisation” and no certain conclusion can therefore be drawn based on this category. The differences in injury patterns between genders were consistent with other studies from similar as well as different settings to Kunduz [7, 12, 29]. However, overall, gender differences in categories describing injury pattern, i.e. nature of injury and body region of injury, were small.

Due to local traditions prevailing in Afghanistan, females have limited movement outside the household and depend on males for transportation to KTC. These factors might explain why fewer females visited the ED, as well as the differences in injury pattern (double the percentage of burns could be explained by them doing more of the cooking), and it might also explain why females arrived later than men to the hospital. However, only 24.1% of all patients arrived at KTC within an hour of injury, indicating that there were significant limitations in the overall access to KTC. Another factor that indicates impaired access in Kunduz is the very low mortality of 0.6% which is only a third of the median mortality rate demonstrated in a WHO systematic review of EDs in LMICs (1.8%, IQR 0.2–5.1) [30]. To enable comparison with trauma care studies, the in-patient hospital mortality was calculated and found to be 2.8% (see Table 6). However, beyond ascertaining that a death had occurred in the ED, or following admittance to

Table 1 Characteristics of patients treated at the emergency department in Kunduz

	Female	Male	Total
n (%)	4226 (23.6)	13690 (76.4)	17916 (100)
Age categories (%)			
< 15	1642 (38.9)	4712 (34.4)	6354 (35.5)
15–29	955 (22.6)	5357 (39.1)	6312 (35.2)
30–44	743 (17.6)	2159 (15.8)	2902 (16.2)
45–59	568 (13.4)	923 (6.7)	1491 (8.3)
60–80	318 (7.5)	539 (3.9)	857 (4.8)
Age [median (IQR)]	20.00 (8.00, 40.00)	19.00 (11.00, 30.00)	20.00 (10.00, 30.00)
Triage categories (%)			
Red	124 (2.9)	712 (5.2)	836 (4.7)
Orange	798 (18.9)	3510 (25.6)	4308 (24.0)
Yellow	2434 (57.6)	7117 (52.0)	9551 (53.3)
Green	870 (20.6)	2351 (17.2)	3221 (18.0)
Delay to arrival (%)			
≤ 1 h	808 (19.1)	3514 (25.7)	4322 (24.1)
≤ 6 h	566 (13.4)	2150 (15.7)	2716 (15.2)
≤ 1 day	1726 (40.8)	5432 (39.7)	7158 (40.0)
> 1 day	1126 (26.6)	2594 (18.9)	3720 (20.8)
Cause of hospitalization[a]			
Accident–Others[b]	3401 (80.5)	9254 (67.6)	12655 (70.6)
Accident–Traffic	490 (11.6)	2406 (17.6)	2896 (16.2)
Accident–Burns	39 (0.9)	98 (0.7)	137 (0.8)
Violence–Gunshot	95 (2.2)	746 (5.4)	841 (4.7)
Violence–Bombs	90 (2.1)	552 (4.0)	642 (3.6)
Violence–Assault	90 (2.1)	457 (3.3)	547 (3.1)
Violence–Knives	17 (0.4)	131 (1.0)	148 (0.8)
Violence–Mine	4 (0.1)	46 (0.3)	50 (0.3)
Nature of injury (%)			
Fracture	1550 (36.7)	4964 (36.3)	6514 (36.4)
Contusion or superficial	1643 (38.9)	4828 (35.3)	6471 (36.1)
Others trauma related	582 (13.8)	1701 (12.4)	2283 (12.7)
Open wound	219 (5.2)	1386 (10.1)	1605 (9.0)
Internal organ injury	75 (1.8)	312 (2.3)	387 (2.2)
Others non-trauma	48 (1.1)	215 (1.6)	263 (1.5)
Burn	59 (1.4)	83 (0.6)	142 (0.8)
Sprains and strains	23 (0.5)	79 (0.6)	102 (0.6)
Dislocation	17 (0.4)	76 (0.6)	93 (0.5)
Unclassified	10 (0.2)	46 (0.3)	56 (0.3)
Body region of injury (%)			
Upper extremity	1878 (44.4)	5834 (42.6)	7712 (43.0)
Other lower extremity	1723 (40.8)	5636 (41.2)	7359 (41.1)
Other head, face or neck	295 (7.0)	1058 (7.7)	1353 (7.6)
Back	141 (3.3)	278 (2.0)	419 (2.3)
Unclassifiable by site	58 (1.4)	272 (2.0)	330 (1.8)
Abdomen	49 (1.2)	220 (1.6)	269 (1.5)
Traumatic brain injury	33 (0.8)	155 (1.1)	188 (1.0)
Hip/pelvis	29 (0.7)	88 (0.6)	117 (0.7)
Thorax	7 (0.2)	81 (0.6)	88 (0.5)
Buttock	13 (0.3)	68 (0.5)	81 (0.5)

Table 1 continued

	Female	Male	Total
Multiple injuries (%)			
Yes	190 (4.5)	929 (6.8)	1119 (6.2)
Surgery (%)			
Yes	283 (6.7)	1458 (10.7)	1741 (9.7)
Number of surgeries (%)			
1	181 (64.0)	846 (58.0)	1027 (59.0)
2	64 (22.6)	377 (25.9)	441 (25.3)
> 2	38 (13.4)	235 (16.1)	273 (15.7)
Died (%)			
Yes	13 (0.3)	88 (0.6)	101 (0.6)

[a]Cause of hospitalization: is given to everyone at the ED and not only those requiring surgery

[b]Accident–Others includes foreign objects, natural catastrophes, hurricanes, earthquakes, spontaneous and stress fractures, work and domestic accidents, sport and game injuries, etc

Table 2 Logistic regression results showing unadjusted risk for surgery between females and males

	OR	95% CI	*p* value
(Intercept)	0.119	0.113–0.126	< 0.001
Gender			
Male	1.000		
Female	0.603	0.528–0.688	< 0.001

the hospital, the data did not provide sufficient detail to calculate 24 h- and 30-day mortality. The in-patient hospital mortality of 2.8% is significantly lower than the mortality rates described in a US military medical facility in Afghanistan, where non-war-related conditions had a 3.6% mortality and war-related mortality was 5.11% [31]. Moreover, the in-hospital mortality in KTC is almost three times lower than the in-hospital mortality of 18 level 1 trauma centres in the USA [32]. This implies that the most critically injured patients in Kunduz may have died prior to reaching KTC, indicating a significant gap in prehospital care and availability of rapid transport.

The adjusted odds of surgery remained significantly lower in females as compared to males. This finding suggests that females were less likely to undergo surgery even if they had as severe trauma and the same type of injuries as their male counterparts. Our data do not allow us to determine the cause of this difference, but future prospective research should attempt to assess this. We can only speculate to why the OR is lower for females after adjustment. It could be that all indicators for severity were not considered during the adjusted analysis for risk of surgery or that the adjustment itself had flaws. The literature reveals conflicting conclusions with respect to surgical interventions for females. In our study, females represented 16.3% of all surgeries. This is in accordance with a study by Forrester et al. [23] where females in a number of MSF hospitals around the world accounted for between 16 and 41% of the operative interventions. Andersson et al. [24] found that females tended to be younger and required more surgeries than male patients when assessing at the female surgical outcome rather than the female percentage of all surgeries. However, our results still indicate a lower surgical rate for females.

This study is subject to a number of limitations. First, since the study was retrospective, it was limited to existing data with risk of bias and unmeasured confounding, as well as errors in data entry. Second, the unknown causes of injury in the group “Accident–Others” are a source of inaccuracy. Third, given the austere environment in which this facility operated, transcription errors may have occurred. However, due to the random nature of this type of error, any impact on the results of this study is likely to be limited. Fourth, no measurement for injury severity was used due to limitations in our data. Fifth, two different triage systems were used, SATS regularly and START when there were mass casualty incidents (MCI). Only approximately 100 patients were MCI’s and therefore triaged using START minor errors in our results cannot be excluded. Lastly, there was no provision made in the data regarding whether patients are civilian or combatant, which could have provided additional insight concerning reasons for gender differences. Despite above, we still think the

Table 3 Logistic regression results showing risk for surgery between females and males after adjustment of injury severity

	OR	95% CI	*p* value
(Intercept)	0.130	0.044–0.389	< 0.001
Gender			
Male	1.000		
Female	0.800	0.690–0.926	0.003
Age categories			
< 15	1.000		
15–29	1.390	1.214–1.592	< 0.001
30–44	1.328	1.126–1.565	0.001
45–59	1.177	0.949–1.460	0.138
60–80	1.082	0.832–1.406	0.557
Triage categories			
Red	1.000		
Orange	0.350	0.293–0.418	< 0.001
Yellow	0.095	0.078–0.116	< 0.001
Green	0.063	0.046–0.087	< 0.001
Delay to arrival			
≤ 1 h	1.000		
≤ 6 h	1.408	1.209–1.639	< 0.001
≤ 1 day	0.796	0.684–0.926	0.003
> 1 day	1.206	1.009–1.441	0.040
Nature of injury			
Burn	1.000		
Contusion or superficial	1.086	0.364–3.242	0.883
Dislocation	5.541	1.625–18.891	0.006
Fracture	6.919	2.348–20.387	< 0.001
Internal organ injury	8.025	2.661–24.199	< 0.001
Open wound	4.710	1.587–13.974	0.005
Others non-trauma	1.090	0.286–4.150	0.900
Others trauma related	0.950	0.315–2.868	0.927
Sprains and Strains	0.262	0.013–5.245	0.381
Unclassified	2.499	0.460–13.566	0.289
Multiple injuries			
No	1.000		
Yes	1.299	1.095–1.542	0.003

Table 4 Logistic regression results showing unadjusted risk of death between females and males

	OR	95% CI	*p* value
(Intercept)	0.007	0.005–0.008	< 0.001
Gender			
Male	1.000		
Female	0.492	0.277–0. 874	0.016

Table 5 Logistic regression results showing risk of death between females and males after adjustment of injury severity

	OR	95% CI	*p* value
(Intercept)	0.146	0.007–3.017	0.211
Gender			
Male	1.000		
Female	0.805	0.446–1.453	0.471
Age categories			
< 15	1.000		
15–29	1.037	0.598–1.798	0.898
30–44	1.496	0.832–2.689	0.179
45–59	1.894	0.919–3.907	0.084
60–80	3.309	1.502–7.290	0.003
Triage categories			
Red			
Orange	0.031	0.017–0.057	< 0.001
Yellow	0.001	0.000–0.010	< 0.001
Green	0.004	0.000–0.042	< 0.001
Delay to arrival			
≤ 1 h			
≤ 6 h	0.909	0.562–1.471	0.699
≤ 1 day	0.984	0.571–1.697	0.955
> 1 day	1.095	0.443–2.711	0.844
Nature of injury			
Burn			
Contusion or superficial	0.056	0.001–2.757	0.147
Dislocation	1.967	0.035–110.836	0.742
Fracture	0.595	0.030–11.756	0.733
Internal organ injury	0.970	0.048–19.468	0.984
Open wound	0.470	0.023–9.573	0.624
Others non-trauma	0.441	0.007–27.044	0.697
Others trauma related	0.809	0.040–16.249	0.890
Sprains and strains	5.303	0.102–274.768	0.407
Unclassified	0.000	0.000–0.000	< 0.001
Multiple injuries			
No			
Yes	1.324	0.853–2.054	0.211

Table 6 Number of deaths at "In Patient Department"

	Female	Male	*p* value	Total
n (%)	432 (15.9)	2281 (84.1)		2713 (100)
Died (%)				
n (%)	8 (1.9)	68 (3.0)	0.252	76 (2.8)

results are accurate and provide essential information that may help to improve trauma care for females in conflict settings.

Further research into what particular risks females are subject to is essential to guide preventative measures. The extent to which our results are generalizable is uncertain, and our understanding of female trauma patients in conflicts would therefore gain from additional studies in this setting. Moreover, working to improve systematic trauma surveillance in-country will allow for future retrospective studies to determine the epidemiology of female trauma patients. These are all crucial to guide public health interventions to improve the situation for females in conflict areas. The issue of systematic, high-quality data collection which enables both programmatic and scientific research in conflict environments is an urgent one. To enable quality studies yielding actionable results to the benefit of civilians in conflict environments, the authors recommend implementing data collection systems which provide more detailed patient data. However, merely including more variables is of little value if data collection routines are not followed. Therefore, any measure to improve systematic data collection must be coupled with the incentives, manpower and IT infrastructure needed to ensure consistent data collection. MSF is aware of this and efforts are constantly being done to improve the reliability and the accuracy of collected data [33].

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval Studies conducted in resources scarce, complex conflict environments include several ethical considerations. We are convinced that research can shed light on the problems the populations are exposed to. But careful ethical considerations are needed. This study was retrospective and did not affect the treatment of any patient. The specific group studied did not gain from this study, but increased knowledge of trauma care in conflicts is crucial to adapt and improve care. This research fulfilled the exemption criteria set by the Médecins Sans Frontières Ethics Review Board for a posteriori analyses of routinely collected clinical data and thus did not require by the MSF Ethical Review board. It was conducted with permission from Medical Director, Operational Centre Brussels, Médecins Sans Frontières. This research also received approval from the Institutional Review Board of the Afghanistan Ministry of Public Health (ref 444796).

Appendix: Triage Colour

During normal activities in the ED, the SATS (**S**outh **A**frican **T**riage **S**cale) is used. The SATS colour code is the following:

Red	Immediate *emergency* management is required (resuscitation room)
Orange	*Very urgent* management is required within 10 min
Yellow	*Urgent* management is required within 1 h
Green	Management within 4 h is required, but no urgency
Blue	Dead on arrival

In case of a MCI,[1] MSF recommends the START scale (**S**imple **T**riage **a**nd **R**apid **T**reatment). The START colour code is the following:

Red	Required *immediate* medical attention[a]
Yellow	Required *delayed* medical attention within 6 h
Green	Required *minimal* medical attention when all higher priority patients have been treated/evacuated
Black	Dead on arrival[b]

[a]Considered the same as Red and Orange in SATS

[b]Considered the same as Blue in SATS

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[1] MCI: Multiple/mass casualty incident.

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