Sex disparities among persons receiving operative care during armed conflicts

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Background. *Armed conflict increasingly involves civilian populations, and health care needs may be immense. We hypothesized that sex disparities may exist among persons receiving operative care in conflict zones and sought to describe predictors of disparity.*

Methods. *We performed a retrospective analysis of operative interventions performed between 2008 and 2014 at Médecins Sans Frontières Operation Center Brussels conflict projects. A Médecins Sans Frontières Operation Center Brussels conflict project was defined as a program established in response to human conflict, war, or social unrest. Intervention- and country-level variables were evaluated. For multivariate analysis, multilevel mixed-effects logistic regression was used with random-effect modeling to account for clustering and population differences in conflict zones.*

Results. *Between 2008 and 2014, 49,715 interventions were performed in conflict zones by Médecins Sans Frontières Operation Center Brussels. Median patient age was 24 years (range: 1–105 years), and 34,436 (69%) were men. Patient-level variables associated with decreased interventions on women included: American Society of Anesthesiologists score (*$P = .003$*), degree of urgency (*$P = .02$*), mechanism (*$P < .0001$*), and a country's predominant religion (*$P = .006$*). Men were 1.7 times more likely to have an operative intervention in a predominantly Muslim country (*$P = .006$*).*

Conclusion. *Conflict is an unfortunate consequence of humanity in a world with limited resources. For most operative interventions performed in conflict zones, men were more commonly represented. Predominant religion was the greatest predictor of increased disparity between sexes, irrespective of the number of patients presenting as a result of traumatic injury. It is critical to understand what factors may underlie this disparity to ensure equitable and appropriate care for all patients in an already tragic situation. (Surgery 2017;■:■-■.)*

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Armed conflict, defined as a struggle or clash between organized groups within nations or between nations to achieve limited political or military objectives, increasingly does not respect distinctions between combatants and civilians.[1,2] All too often uninvolved populations suffer most. Women, children, and the elderly may be especially vulnerable to poor access to operative health care during armed conflict. Despite international humanitarian laws mandating care for the wounded and prohibiting attacks on health care infrastructure, such care is often lacking and attacks are increasingly common.[3]

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During armed conflict, 2 major factors impact health care systems and patient care.[4] First, an influx of injured patients can overwhelm the health care system as a direct result of intentional violence. Second, these conflict regions either lack health care infrastructure to begin with, or have lost them due to conflict. Without a strong health care system, civilians and combatants are left with inadequate local care and outside assistance is often needed.

Médecins Sans Frontières (MSF, Doctors Without Borders) is an international medical humanitarian organization, founded in 1971 to lend assistance to populations in distress, victims of armed conflict or of natural or man-made disasters. MSF provides emergency and elective operative services in both conflict and nonconflict settings.[5] MSF Operational Center Brussels (MSF-OCB) is 1 of 5 operational centers that deploys surgeons, obstetricians, and anesthetists from all over the world to augment or establish health care missions.[5] Each mission in a country may consist of one, or many, projects to provide health care. MSF provides direct patient care with expatriate perioperative expertise and trains national staff to build capacity and ensure the sustainability of effective care; this care is provided free of charge.[5]

Currently, nearly 1% of the world population is either internally or externally displaced as a result of conflict—the greatest number of such persons in world history.[6] The health care needs in such settings are high, and the estimated operative needs are immense.[7] Limited literature exists on the operative needs of civilians during armed conflict, and none look specifically at the issue of sex disparity.[7-9] We hypothesized that sex disparities may exist among persons receiving operative care in conflict zones, and regional characteristics predictive of greater disparity may exist. Our goal was to analyze patients who received operative care at MSF-OCB facilities in conflict zones between 2008 and 2014 and assess this group for differences based on sex. A secondary goal was to determine if any variables were predictive of sex disparities.

METHODS

All interventions performed in an operating theater managed by an MSF-OCB project between January 2008 and December 2014 were recorded using standardized patient surgical records (PSR). Designed for operational needs assessments by MSF, PSR variables included age, sex, American Society of Anesthesia (ASA) physical status score, operative indication, procedure(s) performed, procedure order and urgency, perioperative death, and project site. The PSR was entered monthly into a database (Excel; Microsoft, Redmond, WA) and transmitted to MSF-OCB headquarters in Brussels, Belgium. Data were reviewed, and missing data or questions corrected after reconciliation. The procedure for data acquisition and confirmation was previously described in detail.[10]

MSF-OCB conflict projects were defined as programs established in response to human conflict, war, or social unrest. Disaster projects were defined as programs established in response to natural disaster. Interventions were stratified by country and by project. Countries were categorized by World Health Organization (WHO) subregion, human development index (HDI) group, percent of gross domestic product (GDP) spent on health care, female literacy rate, and predominant religion. WHO epidemiological regions have been defined previously.[11] The HDI 2010 report was used for country stratification.[12] Countries were considered literate if literacy in the female population was greater than or equal to 50% in accordance with the United Nations Education For All goals.[13] Countries' percent of GDP allocated to health care was categorized into quartiles.[14] Predominant religion of a country was defined as either the religion with the greatest frequency or with a frequency greater than 50%.[14]

Operative procedure and indication classification groups have been previously defined.[10] Urgent interventions were defined as acute emergencies necessitating operation within 24 hours. Delayed interventions were defined as moderately urgent operations able to be postponed for up to several days. An elective intervention was defined as a nonurgent intervention. A patient was considered to experience perioperative death if they died in the operating theater or recovery suite.

Inclusion criteria were any operative intervention performed at MSF-OCB conflict projects between January 2008 and December 2014. Exclusion criteria were (1) interventions performed at dedicated maternal health projects, filariasis projects, or prison projects; (2) cause of intervention listed as fetal-maternal, postpartum hemorrhagic complications, or other obstetrical complications; and (3) a procedure listed as gynecology and obstetrics or circumcisions.

Each intervention had up to 3 procedure codes listed. For interventions with more than one procedure code listed, the first procedure code listed was considered the primary intervention. Interventions were considered as trips to the

operating room and could occur more than once for a patient. If interventions were performed more than one time, any interventions after the index operation were considered secondary interventions. These definitions have been provided elsewhere.[15]

For univariate analysis, Wilcoxon rank sum χ^2 was used as appropriate. $P < .1$ on bivariate analysis was considered sufficient for inclusion into multivariate modeling. For multivariate analysis, multilevel mixed-effects logistic regression was used with random-effect modeling to account for clustering at both project and country level. Factors not contributing to the model were eliminated and the model refit. Each excluded variable was re-evaluated individually in the context of the full model to see if these excluded variables were important individually in the context of the remaining variables. Statistical analysis was performed using STATA (Version 14.1; StataCorp LLC, Texas). Retrospective descriptions of deidentified, routinely collected data met MSF Ethical Review Board exemption criteria. Secondary data analysis was approved by the Stanford University Institutional Review Board.

RESULTS

Between 2008 and 2014, 106,416 operative interventions were performed at MSF-OCB missions. After applying exclusion criteria, 49,715 (47%) interventions were included (Fig 1). Interventions were performed at 26 projects in 12 countries (Fig 2). Most occurred in low HDI countries in the African and Eastern Mediterranean WHO regions (Table I). Among persons undergoing interventions, median age was 24 years (range: 1–105 years), 34,436 (69%) interventions were performed on men, and 33,201 (67%) interventions were index interventions. Projects in Afghanistan, the Democratic Republic of the Congo, Pakistan, and South Sudan performed the most interventions (Table II).

Most persons undergoing interventions were 25–54 years old and had ASA scores of II or less. Men commonly presented with higher ASA scores than women ($P < .0001$). Men required urgent operations more frequently than women, and as the degree of urgency decreased, the proportion of interventions performed on women increased ($P < .0001$). Women more commonly required secondary interventions (n = 4,751, 12%) than men (n = 11,514, 5%; $P < .0001$). Men more frequently underwent interventions for trauma ($P < .0001$). In particular, vehicular, firearm, landmine, bomb, and knife violence was more commonly an indication for intervention among men ($P < .0001$). Notably, women more commonly underwent interventions for iatrogenic causes, including traditional and clandestine medical practices ($P < .0001$).

On univariate analysis, interventions were performed less commonly on women in countries with low HDI scores ($P < .0001$), in the Eastern Mediterranean WHO region ($P < .0001$), in countries with lower female literacy ($P < .0001$), and where the predominant religion was Islam ($P < .0001$). There was an inverse relationship between the percentage of a country's GDP spent on health care and the frequency of interventions performed on women ($P < .0001$).

Variables incorporated into the multilevel mixed-effects logistic regression model after attaining $P < .1$ on univariate analysis included HDI score, percent of GDP spent on health care, female literacy rate, predominant religion, age group, ASA score, degree of intervention urgency, indication for intervention, and intervention type. After multivariate analysis, patient-level variables associated with decreased interventions performed on women included ASA score ($P = .003$), degree of urgency ($P = .02$), and mechanism ($P < .0001$). Predominant religion ($P = .006$) was associated with decreased numbers of interventions in women at the country level. Odds ratios (OR) for variables included in the final model are seen in Table III.

DISCUSSION

During armed conflict, women undergo fewer operative interventions than men. Armed conflict frequently disrupts societal structures including health care systems. The most profound deficits are found in nations with pre-existing health system deficiencies. A health care void develops, such that both persons injured in conflicts and those with nonconflict related medical conditions, are unable to receive medical care. After multivariate analysis accounting for country- and project-level clustering, ASA score, degree of urgency, mechanism, and predominant religion were factors found to be significantly associated with sex disparity.

While much media attention is directed at the impact of armed conflict on civilian populations, and growing literature exists on military casualty care, little published data to quantitatively describe vulnerable groups, such as women, exists.[16,17] Yet, the need is immense; Zha et al[7] published a global

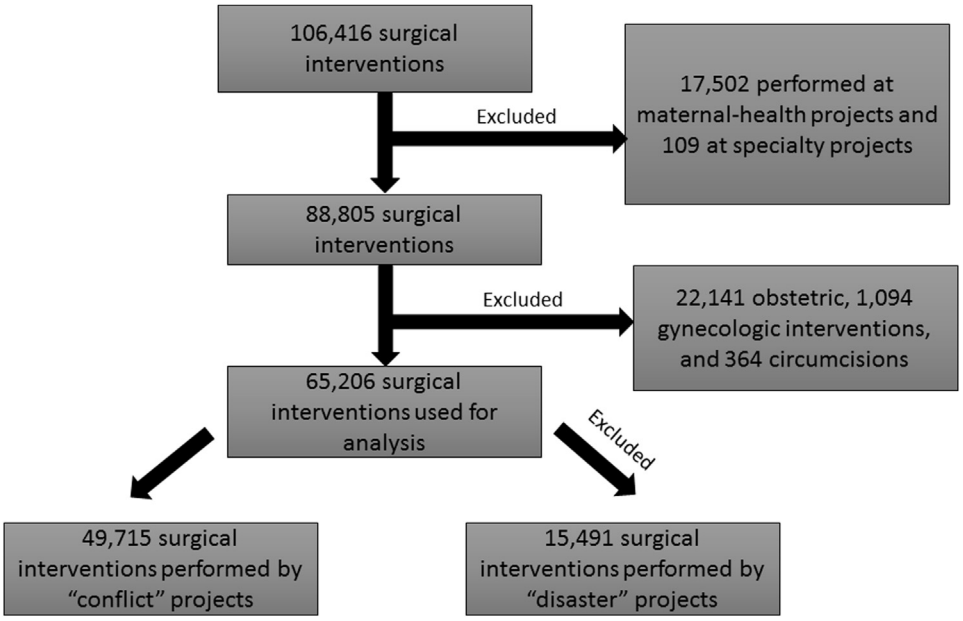

Fig 1. Flow diagram describing how exclusion criteria were applied to the study population.

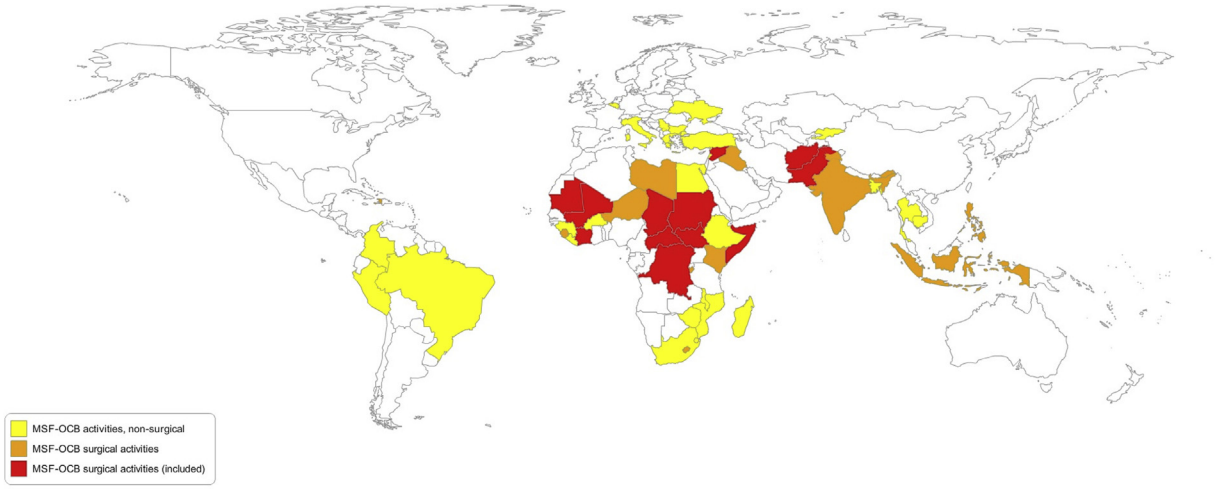

Fig 2. Médecins Sans Frontières Operation Center Brussels missions worldwide, 2008–2014. Countries marked *yellow* are MSF-OCB nonsurgical missions. Countries marked *orange* are MSF-OCB nonconflict surgical missions. Countries marked *red* are MSF-OCB conflict missions. (Color version of this figure is available online.)

estimation of the operative needs of forcibly displaced populations and concluded that nearly 3 million interventions are needed annually. To address this deficit, we evaluated a large humanitarian group's surgical care database specifically asking if, and why, women may be less likely to receive operative care.

Across the spectrum of indications for operation, and among operative interventions, interventions were more commonly performed for men than women after controlling for trauma burden. The key question then is whether sex inequities exist because of epidemiology of the conditions treated, or for other yet unidentified causes. The increased frequency of operative interventions performed in men in conflict zones, particularly among victims of trauma either intentional or unintentional, inherently makes sense.[4] Historically, men are more likely to be combatants, although civilian victims of trauma may not be.[4] Even among

Table I. Country demographic variables for all countries included in analysis—Médecins Sans Frontières Operation Center Brussels, 2008–2014

Country (number of missions)	*Total population male:female ratio (2016 est)*	*Human development index group (2010)*	*WHO GBD region*	*Health expenditure quartile (% GDP)**	*Female literacy rate ≥ 50% (% females literate)*	*Religion*
Afghanistan (3)	1.03	Low	EM	Highest (9)	No (24)	Muslim 99.7% (Sunni 84.7%–89.7%, Shia 10%–15%), other 0.3%
Central African Republic (5)	0.98	Low	A	Lowest (4)	No (24)	Christian 50%, Indigenous beliefs 35%, Muslim 15%
Chad (2)	0.93	Low	A	Lowest (4)	No (32)	Muslim 53.1%, Catholic 20.1%, Protestant 14.2%, animist 7.3%, other 0.5%, unknown 1.7%, atheist 3.1%
Cote D'Ivoire (2)	1.02	Low	A	High (7)	No (33)	Muslim 40.2%, Catholic 19.4%, Evangelical 19.3%, Methodist 2.5%, other Christian 4.5%, animist or no religion 12.8%, other religion/unspecified 1.4%
Democratic Republic of Congo (5)	1.00	Low	A	Low (6)	Yes (50)	Roman Catholic 50%, Protestant 20%, Kimbanguist 10%, Muslim 10%, other (includes syncretic sects and indigenous beliefs) 10%
Mali (1)	0.95	Low	A	Low (6)	No (29)	Muslim 94.8%, Christian 2.4%, Animist 2%, none 0.5%, unspecified 0.3%
Mauritania (1)	0.93	Low	A	Low (6)	No (42)	Muslim 100%
Pakistan (2)	1.06	Medium	EM	Lowest (3)	No (46)	Muslim 96.4% (Sunni 85%–90%, Shia 10%–15%), other (includes Christian and Hindu) 3.6%
Sudan (1)	1.02	Low	EM	High (7)	Yes (69)	Sunni Muslim, small Christian minority
Somalia (1)	1.01	N/A	EM	N/A	N/A	Sunni Muslim
South Sudan (3)	N/A	Low†	EM	Lowest (3)	No (16)	Christian, Animist
Syria (1)	1.01	Medium	EM	Lowest (3)	Yes (81)	Muslim 87%, Christian 10%, Druze 3%, Jewish (few)

*2012 CIA factbook (https://www.cia.gov/library/publications/resources/the-world-factbook/index.html).
†Based on HDI 2010 (http://hdr.undp.org/sites/default/files/reports/270/hdr_2010_en_complete_reprint.pdf).
A, Africa; *EM*, Eastern Mediterranean; *GBD*, global burden of disease; *GDP*, gross domestic product; *N/A*, not available.

nonconflict-related trauma, such as vehicular-related injuries, there is a strong male preponderance worldwide.[18] In our analysis, there was a significantly greater frequency of men undergoing interventions for trauma, which was expected.

Reasons for the observed discrepancy in our study between operative care for men and women for nontrauma-related pathology is less clear, particularly with such a wide range of pathology. These nontrauma-related pathologies should be less dependent upon the conflict burden and, therefore, more likely to reflect true sex biases. For example, in nonconflict zones, the frequency of appendectomy is only slightly biased toward men in both high-income and low- and middle-income countries alike.[19,20] Small bowel obstruction secondary to adhesive disease is less sex neutral. In high-income countries, women are more frequently represented.[21] The opposite is true in low- and middle-income countries outside of conflict.[22,23]

Unfortunately, in the MSF-OCB data set, the degree of granularity to assess for specific pathologies was not available. Both appendicitis and small bowel obstruction are coded under visceral gut interventions. It is less certain if observed biases toward more interventions in men was due to greater pre-existing burden in the population,

Table II. Frequency of interventions performed among men and women by country-level and patient-level variables—Médecins Sans Frontières Operation Center Brussels, 2008–2014

Variables	*Men (%)*	*Women (%)*	P *value (univariate analysis)*	P *value (multivariate analysis)*
Country-level variables				
Country (number of missions)				
Afghanistan (3)	14,443 (81)	3,468 (19)	<.0001	N/A
Central African Republic (5)	1,826 (59)	1,255 (41)		
Chad (2)	645 (69)	295 (31)		
Cote D'Ivoire (2)	1,138 (75)	385 (25)		
Democratic Republic of Congo (5)	8,857 (61)	5,774 (39)		
Mali (1)	20 (61)	13 (39)		
Mauritania (1)	160 (70)	70 (30)		
Pakistan (2)	4,235 (64)	2,420 (36)		
Sudan (1)	91 (67)	45 (33)		
Somalia (1)	923 (71)	376 (29)		
South Sudan (3)	1,663 (60)	1,094 (40)		
Syria (1)	435 (84)	84 (16)		
Human Development Index Group				
Medium	4,670 (65)	2,504 (35)	<.0001	.9
Low	28,843 (70)	12,399 (30)		
WHO Region (number of missions)				
Eastern Mediterranean (12)	21,790 (74)	7,487 (26)	<.0001	.8
African (16)	12,646 (62)	7,792 (38)		
Percent of GDP spent on health care (quartile)				
1%–24%	14,443 (81)	3,468 (19)	<.0001	.9
25%–49%	1,229 (74)	430 (26)		
50%–74%	9,037 (61)	5,857 (39)		
75%–100%	8,804 (63)	5,148 (37)		
Female literacy rate ≥ 50%				
Yes	9,383 (61)	5,903 (39)	<.0001	.5
No	25,053 (73)	9,376 (27)		
Dominant religion (number of missions)				
Islam (15)	22,090 (76)	7,156 (24)	<.0001	.006
Christianity (13)	12,346 (60)	8,123 (40)		
Patient-level variables				
Age				
1–14 y	10,037 (29)	5,010 (33)	<.0001	<.0001
15–24 y	7,482 (22)	2,856 (19)		
25–54 y	12,989 (38)	5,972 (39)		
55–64 y	2,073 (6)	861 (6)		
≥ 65 y	1,855 (5)	580 (4)		
ASA score				
I	23,403 (69)	10,291 (68)	<.0001	<.0001
II	8,503 (25)	3,855 (26)		
III	1,682 (5)	789 (5)		
IV	362 (1)	106 (1)		
V	41 (0)	8 (0)		
Degree of urgency				
Urgent	10,999 (32)	4,371 (29)	<.0001	.022
Delayed	16,675 (48)	7,290 (48)		
Elective	6,762 (20)	3,618 (24)		
Mechanism				
Violent trauma	7,845 (84)	1,459 (16)	<.0001	<.001
Assault: an intentional physical attack upon another	112 (1)	58 (4)		
Bombs: explosions Including shells, bombs, grenades	1,220 (16)	235 (16)		

(*continued*)

Table II. (*continued*)

Variables	*Men (%)*	*Women (%)*	P *value (univariate analysis)*	P *value (multivariate analysis)*
Gunshot: includes gunshots caused in a non-war context	5,228 (67)	907 (62)		
Knives: caused by knife, machete, etc.	868 (11)	174 (12)		
Mine injury	289 (4)	44 (3)		
Rape	11 (0)	10 (1)		
Torture	117 (1)	31 (2)		
Nonviolent trauma	12,599 (73)	4,765 (27)		
Burns	2,419 (19)	2,102 (44)		
Others: foreign objects, natural catastrophes, hurricanes, earthquakes, spontaneous and stress fractures, work and domestic accidents, sport and game injuries, etc.	4,825 (38)	1,560 (33)		
Driver or passenger of a motorized vehicle, pedestrians or cyclists	5,355 (43)	1,103 (23)		
Nontrauma pathology	13,992 (61)	9,055 (39)		
Hemorrhage: internal or external bleeding not due to trauma	41 (0)	24 (0)		
Abscess: caused by infection, inflammation, suppuration, cysts, abscesses	4,929 (35)	4,342 (48)		
Tropical: typhoid fever, Echinococcus cyst, Schistosomiasis, Guinea worm, Ulcus Buruli, etc	161 (1)	114 (1)		
Vascular: ischemia, gangrene, thrombosis of vascular origin, vasculopathies (diabetes)	277 (2)	147 (2)		
Benign: tumors of benign cause, includes cysts	327 (2)	687 (8)		
Malignant: tumors of malignant cause	73 (1)	96 (1)		
Unknown: tumors of unknown cause	135 (1)	220 (2)		
Congenital: imperforation ani, cleft palate, congenital hernia, etc	137 (1)	48 (1)		
Iatrogenic: includes traditional and clandestine medicine	46 (0)	56 (1)		
Other causes: including obstruction (not due to tumor), bladder and kidney stones, hernia, unknown diagnosis, etc.	7,866 (56)	3,321 (37)		
Type of intervention				
Minor	8,543 (63)	4,936 (37)	<.0001	<.001
Simple wound treatment (suturing, cleaning, dressing)	5,701 (67)	3,301 (67)		
Insertion and removal of drain, puncture or drainage of cavity, chest drains, laparo- and pericardiocentesis. Dressings under sedation (except burn), etc.	2,842 (33)	1,635 (33)		
Wound	10,254 (72)	4,083 (28)		
Burns dressings	1,928 (19)	1,720 (42)		
Extensive debridement, including fasciotomy, delayed closure, removal of sequesters, amputation of digits or toes, etc.	7,521 (73)	2,019 (49)		
Graft of skin or muscle	521 (5)	181 (4)		
Foreign body removal	284 (3)	163 (4)		
Visceral	9,772 (67)	4,789 (33)		
Hernia, hydrocele, hemorrhoids. Includes all interventions on external genitals and anus, except circumcision (MS)	5,491 (56)	1,614 (34)		
Exploratory laparotomy, if no other operative actions performed (open, look and close). Includes second look laparotomy with lavage	1,107 (11)	808 (17)		

(*continued*)

Table II. (*continued*)

Variables	Men (%)	Women (%)	P value (univariate analysis)	P value (multivariate analysis)
Solid viscous: resection or repair. Spleen, liver, kidney (eg, splenectomy, liver repair, nephrectomy, etc)	247 (3)	123 (3)		
Gut: resection or repair. Intestine, stomach (perforation), colon, etc. Includes stoma and restoration of integrity or continuity, volvulus, appendectomy, etc.	2,404 (25)	1,503 (31)		
Other general/visceral operation. Removal of tumors, mammectomy, thyroidectomy, etc. Excludes minor operation and pelvic tumor (GH).	523 (5)	741 (15)		
Orthopedic	5,192 (81)	1,227 (19)		
Reduction of fractures and dislocation	2,192 (42)	542 (44)		
Reduction with placement of external fixator	819 (16)	152 (12)		
Osteosynthesis or internal fixation	830 (16)	154 (12)		
Osteosynthesis removal	328 (6)	52 (4)		
Bone graft	26 (1)	5 (0)		
Curettage for osteomyelitis	154 (3)	71 (6)		
Orthopedic joint operation	21 (0)	3 (0)		
Orthopedic nerve operation	18 (0)	2 (0)		
Amputation of a limb. Excludes amputation of fingers or toes	516 (10)	165 (13)		
Other orthopedic operation. Corrective procedures, etc.	288 (6)	81 (7)		
Specialized	675 (74)	243 (26)		
Urology: small pelvis. Prostatectomy, bladder stones. Excludes intervention on external genitals and kidney	273 (40)	41 (17)		
Neurosurgery. Implies open of cranial vault, excludes scalp injuries	54 (8)	10 (4)		
Vascular operation: suturing, patching or anastomosis of major vessel	82 (12)	5 (2)		
Plastic and reconstructive, relief of contractures, etc.	49 (7)	19 (8)		
Thoracotomy. Implies opening of thoracic cavity, excludes chest drain.	52 (8)	9 (4)		
Ear-nose-throat. Includes tracheotomy. Excludes thyroidectomy	42 (6)	13 (5)		
Ophthalmology	81 (12)	117 (48)		
Maxillofacial	10 (1)	15 (6)		
Other forms of specialized operation	32 (5)	14 (6)		
Outcome				
Death	85 (74)	30 (26)	.32	Not included

some socioeconomic or cultural preponderance, or true bias in treating men rather than women. Yet, this trend has been observed in other surgery-specific studies. In 2016, the GlobalSurg Collaborative published a worldwide point-in-time assessment of surgical utilization. High HDI countries accounted for the majority of hospitals but had a much lower burden of trauma when compared to low HDI countries.[24]

Despite trauma burden differences, the percentage of female patients was significantly different among all strata of HDI countries: 51.6%—high, 44.6%—middle, and 38.7%—low.[24] It seems unlikely that men would be more likely to experience such a disparate set of conditions solely upon pathologic tendencies of disease in various locations. Similarly suggestive of underlying bias, even after controlling for mission- and country-level variation in trauma burden, women underwent procedures coded as urgent less frequently than men. It is unclear if this is due to health care seeking patterns, health care provider coding bias, a true reflection

Table III. Results of multilevel mixed-effects regression model—Médecins Sans Frontières Operation Center Brussels, 2008–2014

	Regression coeffecient (standard error)	*Odds ratio point estimate (standard error)*	P *value*
Predominant religion	0.511 (0.186)	1.668 (0.310)	.006
ASA score	0.062 (0.017)	1.064 (0.018)	<.001
Degree of urgency	0.036 (0.016)	1.036 (0.016)	.022
Mechanism	0.019 (0.002)	1.019 (0.002)	<.001
Age group	−0.006 (<0.001)	0.994 (<0.001)	<.001
Operative procedure	−0.010 (0.002)	0.989 (0.002)	<.001

of disease burden, or a combination of these factors.

Sex disparities in health care are well described in low- and middle-income countries among other medical conditions and often do not correlate with pathologic disease burden.[25] Finally, the observed sex disparity in our data set is likely an underestimate, as a statistically greater percentage of female patients required secondary intervention, which increased the observed frequency of interventions on women.

To further explore causes of the operative sex disparity, we assessed country-level factors. Predominant religion was associated with an increased sex disparity. Men were 1.7 times more likely to have an operative intervention in a predominantly Muslim country. Some authors have suggested that more patriarchal societies where socioeconomic sex discrepancies are more commonplace result in a greater degree of health care disparity.[25,26] Some religious practices, which may manifest as requirements that women be accompanied by men outside of the home or only receive care from female health care providers, may be enhanced due to insecurity associated with armed conflict and result in greater barriers to operative care.[27,28]

Women were more likely to require operative care for iatrogenic injury, defined as injury accrued as a result of traditional or clandestine medicine. It is possible that either due to lack of access to care (either real or perceived), cultural stigma, or existing cultural norms, women are more likely to seek health care from traditional healers rather than modern health care facilities, or are more likely to suffer untoward consequences of these traditional practices.[29] Such barriers to operative care have been shown to affect women more than their male counterparts in nonconflict settings.[25,30] These barriers may be exacerbated in conflict zones. As our study excluded gynecologic or obstetric procedures, the female preponderance among patients requiring operative procedures for clandestine or traditional practices is likely an underestimate.

There are several limitations to this study. Obtaining population denominators, specifically a sex distribution, in a conflict population is challenging. There are rarely adequate population surveys in conflict regions to which the population presenting for operative care can be compared.[4] It is possible that the strong predominance of men receiving operative care is as much a reflection of the population as it is a marker of underlying social, cultural, economic, or education biases, which decrease the numbers of women receiving operative care.

Limiting our data analysis to MSF facilities does not capture women who may present for care elsewhere. However, MSF projects are established in areas devoid of other existing medical capacity, so we anticipated that selection bias would be minimal. Obstetric and gynecologic interventions were excluded. It is possible that women are more likely to receive medical care at maternity or obstetric specific facilities if available, rather than general or trauma hospitals. However, for conditions such as trauma or acute general surgery emergencies, this selection bias will have limited effect given the urgency in diagnosis and treatment of these disorders.

In this analysis, only MSF-OCB facilities in Africa and the Middle East were assessed, which introduces selection bias among the sampled population. It is possible that trends seen in our study might not represent conflict in other regions. Finally, religious majority is an imperfect proxy to use in evaluating any populations' religious beliefs. There is often wide variability in how individuals practice religions, and this becomes magnified at the population level.

Despite the limitations described above, among persons receiving operative care at the MSF-OCB missions, there remains a disparity between the number of men and women receiving operative care. While it is tempting to simply ascribe blame

to the most predictive variable, this would be an ineffective and errant tactic. Instead, targeted public health action must be encouraged and implemented. Womens' groups, local leaders, both religious and political, and local health care providers, including traditional healers, should be educated regarding operative disease and the importance of prompt and effective treatment.

Humanitarian aid organizations can encourage and empower survivors to teach their families and peers about operative conditions and facilitate presentation to health facilities. If possible, humanitarian aid organizations should ensure that female health providers are available to provide health care if this is the only culturally acceptable option. Finally, larger-scale epidemiologic burden of operative disease studies are urgently needed among refugee and conflict populations to fully define the scale of the operative challenge facing some of the world's most fragile populations.

In conclusion, conflict, either formal wars between nation states, among defined factions at the country level, or among groups of people in smaller communities, is common. This is the first study to describe the disparity between the frequency of men and women receiving operative care among persons seeking care for operative interventions in conflict zones. While disparity may be expected among combatants in conflict zones, it would not be expected among persons seeking operative care for pathology not related to trauma. Yet for most interventions, men were represented with much greater frequency than women. Predominant religion was the greatest predictor of increased disparity between sexes, irrespective of the number of patients presenting as a result of traumatic injury.

Populations in conflict zones are already at risk of health disparity based on the availability of health care resources. Women may be at higher risk of not having access to care or seeking care. It is critical to understand what factors may underlie this disparity to ensure equitable and appropriate care for all patients in an already tragic situation.

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