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Libyan armed conflict 2011: Mortality, injury and population displacement



Le conflit armé Libyen de 2011: Mortalité, blessures et déplacements de population

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Background: Armed conflicts can negatively affect health services and cause injuries and death. The recent Arab uprising has been associated with considerable damage to infrastructure and loss of human lives. The aim of this study was to determine mortality, injuries and population displacement that occurred during the recent Libyan armed conflict.

Methods: A systematic cross-sectional field survey and non-structured search was carried out over fourteen provinces in six Libyan regions, representing the primary sites of the armed conflict between February 2011 and February 2012. Thirty-five percent of the total area of Libya and 62.4% of the Libyan population were involved in the study. The mortality and injury rates were determined and the number of displaced people was calculated during the conflict period.

Results: A total of 21,490 (0.5%) persons were killed, 19,700 (0.47%) injured and 435,000 (10.33%) displaced. The overall mortality rate was found to be 5.1 per 1000 per year (95% CI 4.1–7.4) and injury rate was found to be 4.7 per 1000 per year (95% CI 3.9–7.2) but varied by both region and time, reaching peak rates by July–August 2011.

Conclusion: The Libyan armed conflict resulted in great human loss and social damage mirrored by high rates of mortality, injury and human displacement. Such parameters peaked as the conflict escalated and differed according to the Libyan regions and provinces involved. National and international efforts should be combined to overcome the consequences of these conflicts.

Présentation: Les conflits armés peuvent affecter négativement la santé et provoquer des blessures et des décès. Le récent soulèvement arabe a été associé à des dommages considérables aux infrastructures et à la perte de vies humaines. L'objectif de cette étude était de déterminer le taux de mortalité, de blessures et les déplacements de population pendant le récent conflit armé en Libye.

Méthodes: Une étude de terrain transversale et systématique et une recherche non structurée ont été réalisées afin de couvrir six régions libyennes incluant 14 provinces, qui étaient les principaux théâtres du conflit armé entre février 2011 et février 2012. Cette étude concernait trente-cinq pour cent de la surface totale de la Libye et 62,4 % de la population libyenne. Les taux de mortalité et de blessures et le nombre de personnes déplacées ont été calculés sur la période du conflit.

Résultats: Au total, 21,490 (0,5 %) personnes ont été tuées, 19,700 (0,47 %) personnes ont été blessées et 435,000 (10,33 %) personnes ont été déplacées. Le taux de mortalité global a été estimé à 5,1 pour 1 000 par an (IC de 95 % ; 4,1 – 7,4) et le taux de blessures global a été estimé à 4,7 pour 1 000 par an (IC de 95 % ; 3,9 – 7,2); ces taux variaient d'une région à l'autre. Ils ont varié périodiquement au cours du conflit et ont atteint un sommet en juillet-août 2011, la situation s'étant aggravée pour connaître ensuite un retour au calme vers la fin du conflit.

Conclusion: Le conflit armé libyen a été associé à des pertes humaines considérables ainsi qu'à des dommages sur le plan social, que reflètent les forts taux de mortalité, de blessures et les importants déplacements humains. Ces paramètres ont atteint un sommet quand la situation s'est aggravée, et ont varié selon les régions et provinces libyennes concernées. Il convient de combiner efforts nationaux et internationaux afin de surmonter les conséquences des conflits de ce type.

African relevance

- The study highlights the mortality, injury and population displacement as a result of the armed conflict in Libya.

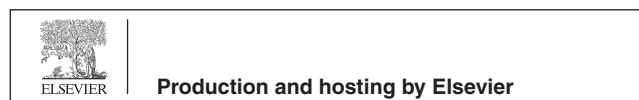
- The rates of such war complications varied extensively from one region to another in Libya and during the conflict period.

Introduction

Armed conflict in any country results in devastating and long-lasting consequences. Low to middle income countries tend to be both more susceptible to armed conflict as well as the least equipped to deal with post-conflict devastation including death; disability and injury; destruction of property; disruption

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of economic activities and the diversion of resources from health care.^{1,2} The direct and immediate casualties of war represent the tip of the iceberg compared to their long-term consequences, which are often poorly documented and inadequately reported.³⁻⁷ In recent years there have been uprisings in several Arab states, including Tunisia, Egypt, Yemen, Libya and Syria. In Tunisia, Egypt and Yemen these took the form of mainly civil protests and clashes between civilians and police forces, though in Libya and Syria it escalated into armed combat.^{8,9}

Libya is a North African country with a surface area of 1,775,500 km², making it the second largest on the continent. According to the World Bank, its population is 6,154,623 and the gross national income per capita of its oil-based economy in 2009 was US\$12,930 (<http://data.worldbank.org/country/libya>).^{10,11} Consequently, it boasts the highest literacy rate and educational enrolment in North Africa and Arab countries.^{12,13} In February 2011, after more than four decades under the rule of Colonel Gaddafi and in the wake of the uprisings in adjacent Tunisia and Egypt, Libya experienced a major armed uprising.¹⁴ International intervention in the form of NATO airpower enabled the fighting groups to topple the Libyan socialist regime. Moreover, the war and its repercussions resulted in internal and external population displacement, on top of great human and economic cost.¹⁵⁻¹⁷ There are no reliable data on the numbers involved and the objectives of this study were to estimate the number of deaths and injuries in the different regions of Libya and to examine population displacement in the Libyan community.

Methods

This epidemiological community-based study was guided by previously published studies and guidelines.^{15,18,19} The recruitment and data collection were conducted in the 14 provinces of the six regions affected by the conflict. The regions included in the study were: Eastward Coastal Region (ECR), Middle Coastal Region (MCR), Westward Coastal Region (WCR), West Mountain Region (WMR), Middle Mountain Region (MMR), and Southward Sahara Region (SSR). The geographical location, provinces and total population of each region is illustrated in Table 1. The study covered an area of 621,425 km² with approximately 4,211,700 inhabitants. Regions that were not directly involved in the fighting were not included in the study.

Face to face interviews were carried out with at least one member of each affected family listed in the registry of the Ministry of Housing and Planning. The interviews were carried out by medical doctors and trained social workers under the supervision of a senior clinical epidemiologist. The data were used to confirm the information regarding the affected people within the families, for whom documentation was otherwise missing. Written informed consent was obtained from all the participants before the interview. Data on changes and consequences in each region as a result of fighting were collected as well, including information on direct damages, demographic changes and human suffering.

The questionnaire used to collect demographic and epidemiologic data was anonymous, and sought information on all adult citizens killed, injured or displaced between February 2011 and February 2012. The data were obtained

Table 1 Distribution of deaths, injury and human displacement among the regions involved in the Libya conflict, 2011.

Region	Population		Deaths		Injured		Displaced	
	n	% total deaths	n	% total injured	n	% total displaced		
Eastward Coast Region [ECR]	886,800	2.6	2300	7800	70,000	78.9	16.1	
Middle Coast Region [MCR]	715,200	17.5	12,500	4900	184,000	257.3	42.3	
Westward Coast Region [WCR]	1,709,400	1.8	3100	1900	29,500	17.3	6.8	
West Mountain Region [WMR]	418,200	1.8	775	1600	49,000	117.2	11.3	
Middle Mountain Region [MMR]	350,100	7.1	2500	2800	98,000	279.9	22.5	
Southward Sahara Region [SSR]	132,000	2.6	334	700	4500	3.8	1.0	
Total	4,211,700	5.1	21,490 (0.5%)	19,701 (0.47%)	435,000 (10.33%)	8.3	100	

via official request to access the civil registers at each regional office of the Ministry of Housing and Planning. The local authority in each region also completed a questionnaire asking for detailed information about those who were killed, injured, or displaced. Official government reports and reports of the Libyan Red Crescent were consulted, and accounts were obtained from eyewitnesses and combatants.

The data were extracted from the most recent and detailed data archives available. To improve the accuracy of the survey, the final data were discussed with and approved by the local social district leaders, revolutionary commanders and government officials who supported and agreed to assist with the study.

Data entry and descriptive statistics were calculated using Microsoft Excel and SPSS version 12.0. Mortality, injury and displacement rates were calculated on the bases of med-intervals population and regression models.²⁰ within a one year period from February 17, 2011 until the country declared that fighting had officially ended in 2012.²¹ Mortality, injury and displacement rates were calculated per 1000 per year. The attributable variation rates were consistent among the regions studied over the one year period and an additional sensitivity analysis assessed the differences in mortality, injury and displacement across the study regions.²²

The study was approved by the Ethics Board of the Faculty of Medicine, Tripoli, which acknowledged the study and credited the final approval from the Libyan National Ethics Committee – A approval No. LY2011/986/WCS. The study was conducted in accordance with the Helsinki Declaration.²³ All participants signed an informed consent form witnessed by the local health officer and no minors were involved.

Results

The surveillance study was conducted between February 2011 and February 2012. The data were collected from the six regions considered to be the battlefield. Table 1 shows the distribution of affected Libyan citizens over the studied regions during the armed conflict.

A total of 21,490 (0.5%) persons were killed; 19,700 (0.47%) injured; and 435,000 (10.33%) displaced. The national mortality rate was calculated at 5.1 per 1000 per year (95% CI 4.1–7.4) but this varied significantly by region. The highest were Middle Coastal Region [MCR] with 17.5 per 1000, and Middle Mountain Region [MMR] with 7.1 per 1000, followed by Eastward Coastal Region [ECR] and Southward Sahara Region [SSR] at 2.6 per 1000. The lowest reported mortality

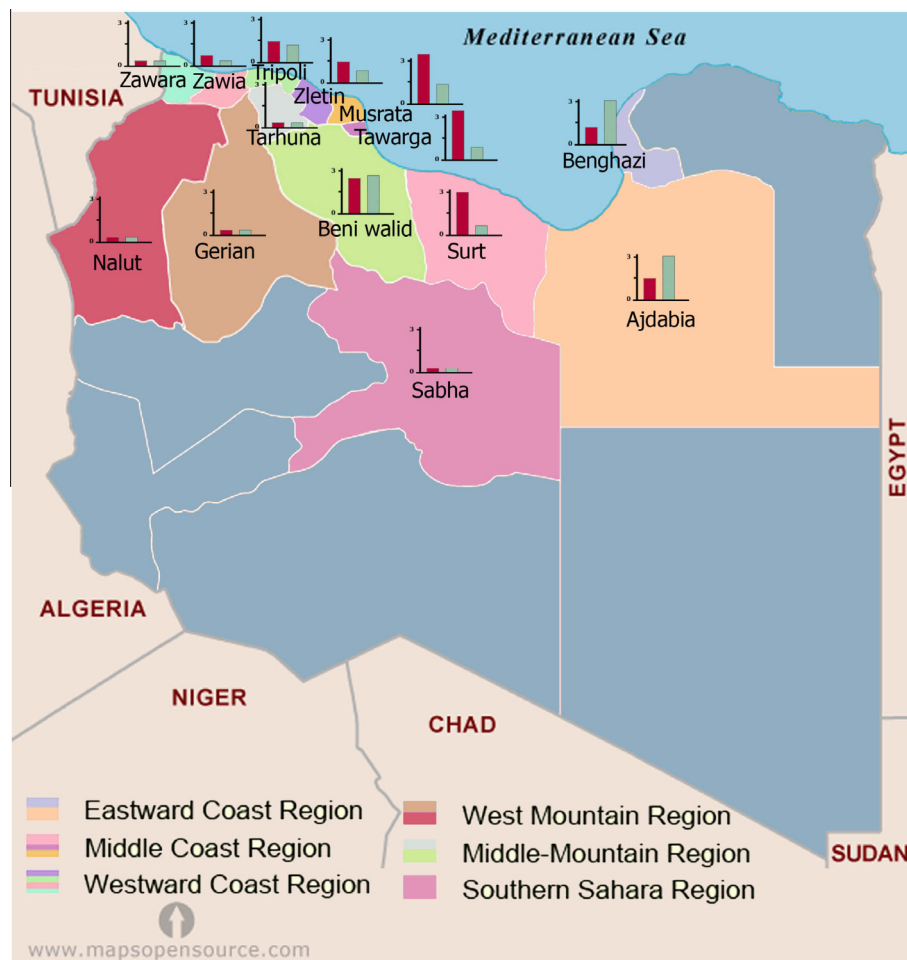


Figure 1 Map of Libya showing the mortality and injury ($\times 1000$ persons) per year. The scale represents both killed (red) and injured (blue) for each province. Libya 2011. (Source: www.mapsopensource.com).

rates were Westward Coastal Region [WCR] and West Mountain Region [WMR] at 1.8 per 1000. The average injury rate among the studied population was 4.7 per 1000 per year (95% CI 3.9–7.2). The two most affected regions were ECR (8.8 per 1000) and MMR (8.0 per 1000), followed by MCR (6.9 per 1000 and SSR (5.3 per 1000), and the lowest were in WMR and WCR (3.8 and 1.1 per 1000, respectively). The average population displacement was 8.3 per 1000 per year (95% CI 7.8–9.2), and the greatest regional displacement rates were in MMR and MCR as 279.9 and 257.3 per 1000, respectively, followed by WMR (117.2 per 1000) and ECR (78.9 per 1000). The lowest displacement rates were found in WCR (17.3 per 1000) and SSR (3.8 per 1000).

The mortality and injury rates among the different provinces involved in the Libyan armed conflict are shown in Fig. 1. The rates varied significantly between the provinces within each region. The highest mortality rates were reported in Musrata (4662, 2.2%), Surt (4325, 2.0%) and Tawarga (3531, 1.6%) within the MCR followed by Beni-Walied (1780, 0.8%) in MMR. Injury rates were highest in Benghazi (4320, 2.3%) and Ajdabia (3480, 1.8%) in ECR followed by Beni-Walied (2107, 1.1%) in MMR. The mortality and injury rates were similar in Tripoli, Zletan, Zawia and Zawara in WCR and lowest in Sabha in SSR, Gerian and Nalut in WMR as well as Tarhuna in MMR.

The variations of mortality, injury and displacement rates among Libyans during the conflict period are shown in Fig. 2. Of the 21,490 persons killed during the study period, only 2675 (13.11%) were killed in the first four months (February–May 2011). The number increased steadily from June through September 2011 until peaking in August at 5127 (25.13%), then decreasing once more to 3152 (15.45%) by February 2012. The injury rates showed similar trends over the study period. Of 19,700 injured 3920 (19.90%) were reported in the first four Months followed by 12,319 (62.53%) from June to September and 3461 (17.57%) from October to February 2012.

Human displacement followed a different trend over the study period. It reached 148,200 (34.07%) in the first four months, with a notable spike in February as the uprising started, then increased to 171,349 (39.39%) between June and September. The highest monthly total was reported in

August (51,317, 11.80%). An additional 115,451 (26.54%) persons were displaced between October 2011 and February 2012.

The mortality, injury and displacement rates by gender are shown in Fig. 3. 87.90% (male:female = 7.3:1.0) of the 17,932 casualties were male. The injury ratio for male to female was 9.1:1.0, with a total of 17,743 (90.1%) injuries reported in males. Again different trends are apparent among the displaced people. Of the total displaced people, 297,050 (68.29%) were female and 137,950 (31.71%) were male, giving a male-to-female ratio of 1:2.3.

Fig. 4 shows the mortality, injury and population displacement by age. Deaths and injury by age group followed the expected J-shaped demographic curve where most deaths and injury were in the middle-age groups. Men of age 15–59 years were most susceptible to death or injury, and the majority of displaced people were either < 15 or > 59 years of age.

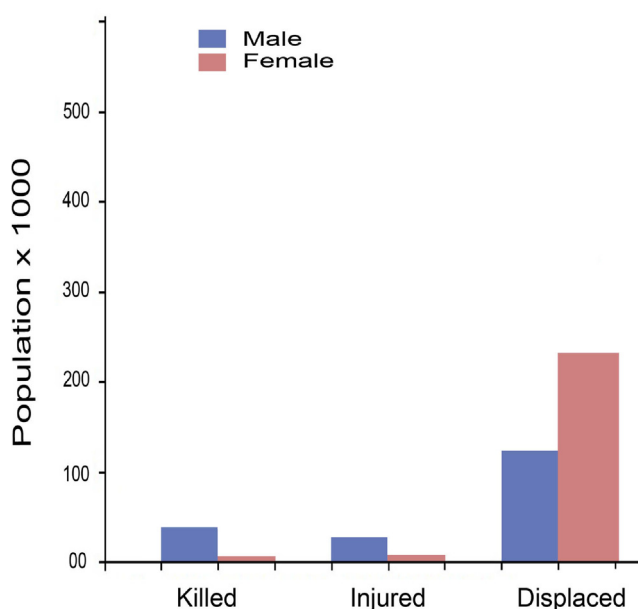


Figure 3 Gender of deaths, injured and displaced persons during the Libyan armed conflict 2011.

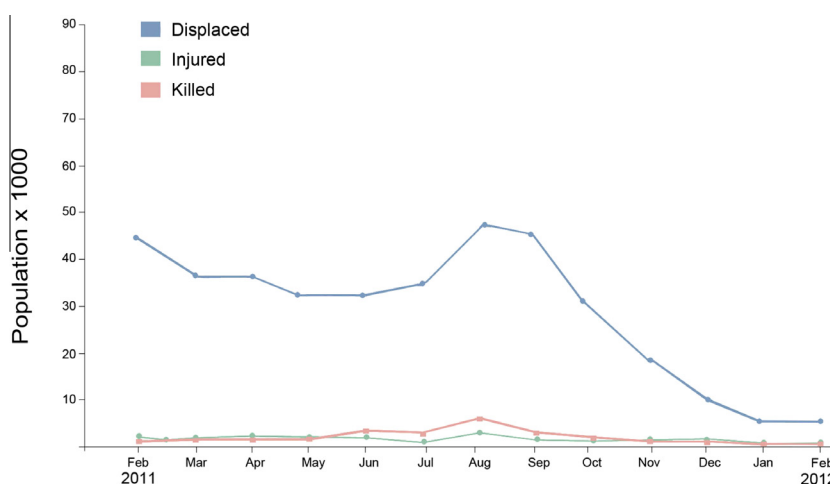


Figure 2 Number of deaths, injured and IDPs during the Libyan conflict over one year period (February 2011–February 2012).

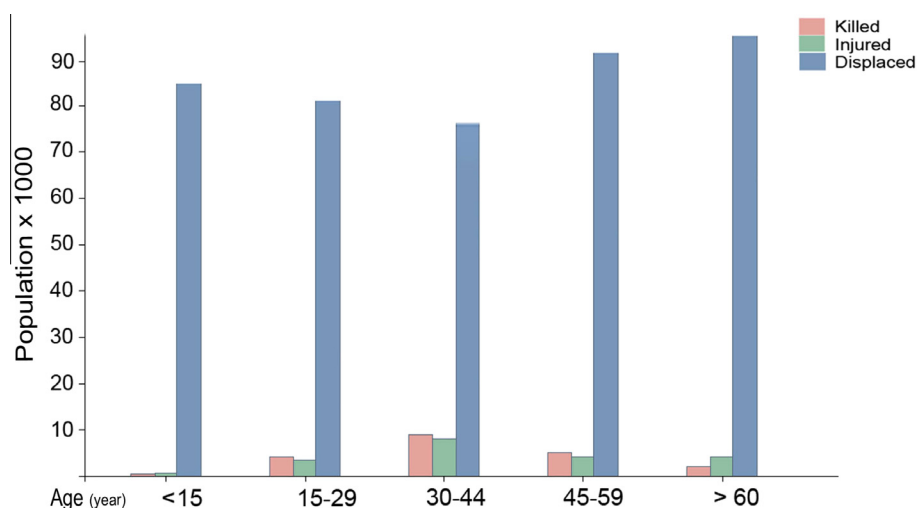


Figure 4 Age breakdown for deaths, injured and IDPs since the start of conflict. Libya 2011.

Discussion

Armed conflicts are major causes of death, injury and ill health in affected communities.^{24,25} The data presented here highlight the effects of the Libyan armed uprising on Libyan society and assessed the deaths, injuries and displacement of people during the Libyan armed conflict. The survey covers half of the Libyan population across 35% of the surface area of the country. The data were collected from the 14 provinces in six regions making up the battlefield area. It extended from Benghazi in the east, where the conflict started, to Zawara in the west and from the Central mountain areas of Sabha in the south to the Mediterranean coast in the North. Our main findings show high rates of mortality and injury proportional to internal displacement of people. This indicates that Libya is experiencing a major humanitarian crisis that will be reflected on Libyan society for a long time.

Our study showed that during the Libyan conflict, the overall mortality rate was 5.1 per 1000 population. This varied from one region to another, the highest was reported in MCR and the lowest was in both WCR & WMR. Different studies have shown that mortality rates often vary substantially from one conflict to another and among regions of the same country. They have reached as high as 20–35 deaths per 1000 daily in African conflicts such as those in Sudan and Rwanda,^{26,27} and ranged from 8.1 to 15.2 in Cambodia and Thailand.²⁸ In Iraq where the war mortality rates are well studied the average deaths per day ranged from 48 to 759 while the specific mortality rates attributable to war deaths ranged from 0.64 to 18.25 per 1000 per year.^{29,30} Our results are similar to those reported in Iraq despite the difficulty in differentiating between military and civilian casualties, though the data derived from the field suggest that most deaths were from army combatants.

Injuries resulting from armed conflict tend to have even worse consequences than mortality due to their long-lasting effects. Our analysis shows that injuries among Libyans varied over the period of the conflict and by geographic locale with an average injury rate of 4.7 per 1000. The highest was in ECR (8.8 per 1000) and MMR followed by MCR and SSR, and notably less across other regions. Such results are similar to

those reported in Kosovo (5.2 per 1000) and less than the 9.8 per 1000 rate reported in Iraqi conflicts.^{31,32} War-related trauma is more likely to be a major cause of death among injured individuals, a phenomenon that increases with age.³³ A recent study analysing presentation of surgical wounds during the Libyan conflict showed that the main causes of injury were gunshot, shrapnel and blast. Such wounds are often exacerbated by infection with *Acinetobacter* and other highly resistant bacteria that are difficult to eradicate.^{15,34}

Armed conflicts and population displacement are complicated by the fact that neither are monolithic phenomena.³⁵ Indeed, one of the measures of the severity of a conflict, in addition to casualties and duration, is the extent to which people have been displaced from their communities.³⁶ Libya has previously been considered the largest recipient of migrant persons in the region, but the recent revolt has resulted in considerable population displacement within the country itself. An estimated 2.3 million people fled Libya to Tunisia, Egypt, Algeria, Italy and Malta over the course of the study period.³⁷ An additional 422,000 (approximately 6.5%) Libyans have been internally displaced, particularly in MCR and MMR, where certain provinces witnessed up to total displacement.

The displacement followed a rising trend in early February 2011. As the conflict escalated, massive displacement occurred in Ajdabia during April 2011 and in Surt, Tawarga and Bani-walied from September–November 2011. Residents of certain cities, such as Tawarga, were not allowed to come back and became internal refugees. Similar considerable population displacement has been reported in neighbouring Sub-Saharan African countries.³⁸ Such crises are expected to increase poverty, at least short-term. Most of the displaced citizens lost their jobs and income, and had to leave behind their assets and savings. The collection of information on mortality of these internally displaced people is less complete in our study as access to these communities was often difficult. However, studies carried out on select displaced communities in Iraq, Somalia and Southern Sudan indicate that the occurrence of microbial diseases and malnutrition was endemic, attributable to the typically inadequate water supply and food delivery logistics.³⁹

The death toll was not uniformly distributed throughout the country; it was higher in Jedabia, Sert, Musrat, Zleitan and Beni-Walied than in the West coast, Sebha, and Western Mountain areas. The death rate reached 5.1 deaths per 1000 population in our study. This is similar to reports from the Democratic Republic of Congo where the mortality rates varied from 1.9 to 18.1 deaths per 1000 depending on the region studied.^{40,41}

Mortality and injury rates varied from one month to another according to the intensity of fighting. The lowest mortality was reported in February 2011 as the conflict started, and then it increased with escalation of the conflict and the start of NATO bombardment in March 2011.^{42,43} The largest increase in mortality was reported at the peak of the conflict in July–August 2011, when it was five times the base time rate. The highest injury rate was recorded early – in February and March 2011 – and then it paralleled the mortality rate throughout the rest of the conflict. The highest rates of injury were reported in Ajdabia and Zleitan, while the lowest were in Gerian and the rest of Western Mountain, followed by Zawara and Zawia provinces. Such increases in mortality rates have been reported in other war related conflicts, varying from 4 to 15.2× in Sudan and Kosovo to more than 30× in Rwanda.^{44,45}

The exact counts of Libyan deaths and injuries may exceed those reported here, as these data were mainly gathered via a passive surveillance study. Such data are rarely complete even under peaceful circumstances, and are more susceptible to error during armed conflicts due to limited access and intentional cover up of deaths.^{46,47} Different studies have shown that death and disease burden have been underestimated by factors of two or more using facility based surveillance methods. Therefore, population-based studies should be carried out to evaluate the exact death counts among Libyans. Nevertheless, such surveillance studies have been shown to be important in monitoring death trends during periods of conflict.^{48,49}

The estimates of mortality, injury and displacement during the Libyan conflict represent a humanitarian emergency by international standards. The assessment of the burden of new armed conflicts on public health has been hampered by the lack of common investigation methods.⁵⁰ In this study we present the data relating to the mortality, injury and internal people displacement among the Libyan population affected by the armed conflict regardless of whether they actively participated in the war or not. In a similar cross-sectional study carried out by Burnham et al., it is estimated that in the 40 months post-invasion of Iraq, there were over 654,965 deaths, which corresponded to 2.5% of the population in the study area.²⁹ Although the mortality rate was higher in Iraq, the Libyan situation mimics the Iraqi conflict in terms of death-clustering and age distribution of persons killed, injured or displaced.

This study describes the magnitude of the damage to Libyan society during and after the conflict period. Despite the caveats regarding the accuracy of our epidemiological assessment, measured mortality and morbidity are both high, portending significant long-term consequences. Efforts should be combined for urgent intervention and long-term planning to address these consequences and to improve existing conditions for Libyan citizens. The considerable economic resources of

the country, if properly allocated, can be used to achieve these goals.

A variety of limitations to this study are worth emphasizing for data interpretation. Firstly, there are uncertainties about the Libyan pre-conflict baseline data. Secondly, the data could mirror the personal opinion of the respondents regarding the conflict, which could result in exaggeration or underestimation. Finally, distinguishing criminal murders from deaths in armed conflict was not possible. However, the study still provides information that should be useful in combining efforts to establish justice and restore peace within the Libyan community. National and international efforts should be utilized to protect the population from the continuing consequences of the conflict.

Conflict of interest

The authors declare no conflict of interest.

Dissemination of results

Results from this research study were shared with staff members at regional hospital emergency centre through an informal presentation. The results were also published in the hospital's newsletter.

Author contributions

M.D. conceived and designed the study. M.D., A.A. and A.D. participated in the conduct of the study, and reviewed the manuscript. All authors approved the final manuscript.

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