Ongoing conflicts in the Eastern Mediterranean Region (EMR): health burden and attributable economic damage estimate

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Abstract

**Background:** Due to the ongoing conflicts in the Eastern Mediterranean Region (EMR), countries in the region have confronted a severe health crisis in recent years. This study was conducted to describe the direct health burden of conflicts in the region and quantify the fraction of economic damage attributed to the health impact of conflict.

**Methods:** We used Disability Adjusted Life Years (DALYs) from the Global Burden of Disease attributed to conflict and considered the value of a life-year as at least one Gross Domestic Product (GDP) per capita purchasing power parity (PPP) to indirectly estimate the economic burden.

**Results:** From 1990 to 2017, out of the 22 countries in the EMR, Afghanistan, Iraq, Kuwait, Lebanon, Palestine, Libya, Somalia, Sudan, Syria, and Yemen suffered the most from conflict and terrorism. Conflict accounted for 64%, 50%, and 35% of all causes of DALYs in Libya and Syria, and Palestine, in 2011, 2016, and 2008, respectively. In 2017, Iraq, Libya, and Afghanistan had the most significant health-related economic burden of conflict per capita, more than 100 current international dollars. Iraq was affected by a loss of about 80% of its health expenditure due to conflict and terrorism, an estimated total of 23 billion current international dollars.

**Conclusions:** Our study reflects the significance of the health burden due to conflict in the EMR and its subsequent economic consequences. Stability and peace is among the most influential determinants of health and economic development in the region.

**Background**

Conflict and terrorism have been recognized as one of the leading causes of fatal discontinuity, acknowledged as unexpected mortality spikes in a given location-year (1). From 2007 to 2017, conflict-related mortality has increased by 118% (88-148), globally, compared to only 2% (0.5-4) of increase in all injury-related deaths and 9% (8-10) of all-cause mortality (1). Comprising the fastest-growing injury-related mortality cause, this category of interpersonal violence substantially centers in the Eastern Mediterranean Region (EMR) (2). Nevertheless, despite the serious threat of conflict and terrorism to public health in the EMR, there is no adequate attention to their growing burden in policy debates and even public health research.

Among the 22 countries of the EMR, Afghanistan, Iraq, Libya, Palestine, Somalia, Syria, and Yemen have confronted with the most consequential conflicts in recent years (3). Accordingly, the majority of conflict and terrorism occur in the countries that hold limited amounts of public health resources to tackle the consequences of the unrest, as the affected countries are of low- or middle-income (4). In order to more efficiently allocate the limited health resources in these areas, public health issues should be prioritized based on their health and economic burden.
The economic burden of conflict is a multidimensional issue that can hardly be assessed in all its complexity; this economic burden consists of different components, including the direct costs concerning the management of injuries and other provoked health issues, such as outbreaks of communicable diseases (5), as well as a wide range of costs which are not related to health.

There has been a concept in health economics, recognized as the value of a life year, by adopting the Gross Domestic Product (GDP) per capita as a scale based on the earnings of economic activity within a country (6). Thereby, the fraction of conflict-related economic loss attributable to the impact of war on population health could be estimated. A quite similar methodology has been adopted by the World Health Organization (WHO) to quantify the non-health GDP loss for each condition of disease (7).

The purpose of this study is to provide an overview of the direct health burden of conflict and terrorism in the war-torn EMR countries, from 1990 to 2017, by investigating the changes in consequent Disability Adjusted Life Years (DALYs) and their distribution by age and gender. Moreover, a model has been proposed to estimate the fraction of the economic damage of conflict, attributable to its public health burden, in the EMR countries.

**Methods**

*The GBD study 2017:*

We used the GBD study 2017, on conflict and terrorism-related burden in the EMR countries, explored the changes throughout 1990-2017 in the countries with the highest burden. The Institutes of Health Metrics and Evaluation (IHME) categorizes the diseases based on the International Classification of Diseases (ICD), in three major groups based on their primary causes, as the third category of causes, injury-related health issues are then subcategorized, and the conflict and terrorism are recognized as a type of interpersonal violence and self-harm in the hierarchy. This group includes U00-U03, Y36-Y38.9 and Y89.1 codes of the ICD-10 (8). Based on the WHO's categorization of global regions, the EMR consists of 22 countries; Afghanistan, Bahrain, Djibouti, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Occupied Palestinian Territory, Oman, Pakistan, Qatar, Saudi Arabia, Somalia, Sudan, Syria, Tunisia, United Arab Emirates, and Yemen. We considered DALYs as our primary assessment metric, taking both the premature mortality and morbidity into account. Age and gender distributions of conflict burden were assessed. Mortality rates have also been used for specific age-groups. The GBD methodology comprises different approaches which are explained in detail elsewhere and are out of the scope of this paper.

*The estimation of economic costs:*

We used World Bank Group data 2017 to obtain each EMR country's GDP per capita, based on constant international currency in 2017, and the Current Health Expenditure (CHE), in the current international currency (constant amounts were not available), based on Purchasing Power Parity (PPP). The CHE is the total government’s expenditure on health, mainly reported as a percentage of GDP. The 2017’s GDP per
capita for Syria and Somalia and Yemen, and the CHE for Libya, Palestine, Somalia, Syria, and Yemen were missing, therefore the associated calculations could not be completed for these countries.

In 2001, the WHO's Commission of Macroeconomics and Health (CMH) estimated the value of a life year as about three times GDP per capita (6). The value per life-year is considered one to three times GDP per capita in different health economics texts (9). Conservatively, we assumed the value of a life year lost due to premature mortality and/or disability, combined into the measure of DALYs, as one GDP per capita and proposed a method to calculate the magnitude of public health consequences due to conflict and terrorism.

Given that the DALYs rates are measured per 100,000 of population, the burden of conflict and war, in this case, on each person's life, equals the division of conflict-related DALYs per 100,000. Accordingly, the indirect economic burden due to the conflict-related loss of healthy life years on each person equals the product of GDP multiplication with per head conflict-related DALYs.

Health-attributable Economic Burden (HEB) of conflict:

Conflict's HEB per capita \[\text{Conflict and terrorism DALYs (rate) 100,000}] \times \frac{\text{GDP per capita}}{100,000}\]

Moreover, the conflict-related monetary loss proportional to capital expenditure on health could be assessed by dividing the product of the above multiplication per CHE per capita. Conflict's HEB proportional to CHE \[\text{HEB per capita CHE per capita ppp}\]

After all, the total economic loss of conflict, attributable to its public health burden, is the conflict and terrorism DALYs on the level of the whole country (number) multiplied with the country's GDP per capita. Conflict's HEB in a country \[\text{Conflict and terrorism DALYs (number)]} \times \frac{\text{GDP per capita}}{100,000}\]

WHO used a comparable method to estimate each disease condition's indirect costs, which were not related to health, entitled productivity loss. The authors used non-health GDP, which excludes total health expenditure from total GDP to describe value costs unrelated to direct health spending (7).

**Results**

**Burden of disease of conflict and terrorism in the EMR:**

Figure 1, obtained from the IHME, describes the rate of conflict related DALYs and the changes over the time period of 27 years, in the EMR and the whole world.

Based on the results of the GBD study 2017, figure 2, conflict and terrorism ranked as the 7th cause of DALYs in the EMR in 2017, with an increase of 144% from the 28th cause in 1990, so that in 2017, it led to 1,147 (1,017-1,333) DALYs per 100,000 individuals in the region.
Since 1990, out of the 22 countries of the EMR, ten countries, including Afghanistan, Iraq, Lebanon, Libya, Somalia, Sudan, Syria, Yemen, Palestine, and Kuwait have confronted the most serious armed conflicts based on the cumulative annual DALYs rates. Figure 3. Represents the countries with a burden of higher than 6,000 DALYs per 100,000 and Figure 4. Represents the countries with a burden less.

The consequences ensuing these conflicts in their most intense period, in each of these countries were as follows (in alphabetical order):

Conflict and terrorism have been bold causes of the burden of diseases in Afghanistan throughout the whole time period of this study, with the highest burden of 6,759 (5,622-8,703) DALYs per 100,000, 13% (11-17%), in 2016. Iraq faced the most challenging time of its ongoing conflicts in 2007, as it resulted in the 23% (20-26%) of the country's DALYs, 8,758 (7,512-10,234) per 100,000 in this year. Kuwait experienced a significant burden of conflict in 1991 with DALYs of 6,345 (5,741-7,018), 27% (24-30%), however after this period this country has been one of the most stable countries in the region. Lebanon had the largest burden of its conflict in 2006 with DALYs rate of 1,729 (1,298- 1,298), comprising 6% (4-8) of the country's total DALYs. Conflict and terrorism caused 64% (51-81) of DALYs, 5,945 (5,237-6,769) per 100,000 in Libya in 2011. Somalia faced the most challenging time of its conflict in 1991 with DALYs rate of 8,083 (7,212-9,542), 7% (6-8) and although tensions appeared to recede, the crisis has risen as it resulted in 1,812 (1,608-2,130) DALYs in 100,000, 3% (2-3) in 2017. In Sudan, Conflict and Terrorism led to 3,004 (2,787-3,246) DALYs in 100,000, 5% (4-6) in 2004. Syria has been involved in armed conflict since 2011 and confronted the most intense period of unrest in 2016, as the conflict and terrorism accounted for 50% (45-55%) of DALYs, with the rate of 23,744 (21,572-26,313) per 100,000. Palestine witnessed the worst time of unrest in 2008, through which conflict caused 11,856 (10,674-13,248) DALYs per 100,000, 35% (31-38%). The most recent conflict in the region has started in Yemen, and the situation was getting more fierce until the end of this study's time period, as the conflict resulted in 3,872 (3,507-4,311) DALYs per 100,000, 10% (8-12), in 2017.

Conflict-related under-five mortality rates in the EMR has increased by 263 % (181-366%) from 1990 to 2017. The condition has been worse in the age groups of 5-14, as conflict and terrorism have been the first causes of mortality in these children of both sexes in 2017, with an increase of 349% (251-476%) since 1990, it also accounts for the second cause of death in 15-49 year-olds in 2017.

Gender distribution of mortality rates due to war was notably diverse in the 15-49-year-old; the majority of deaths occurred among males with a rate of 28 (23-34), compared to females 7 (6-9) per 100,000, in 2017, figure 5. The male-to-female ratio of DALY rates were 2.02 and 3.28, for all-ages and 15-49-year-old individuals, respectively.

Economic burden:

Table 1. provides the estimates of conflict costs in the EMR countries, in 2017. Based on our proposed model, the extent of economic loss per capita was huge in Iraq, Libya, and Afghanistan in 2017, respectively. Iraq and Afghanistan lost the most significant share of resources proportionate to their
health expenditures in 2017. The most substantial economic loss attributable to the health burden of conflict on population was recorded in Iraq, equal to 80% as country’s health expenditure with the total impact of 23 billion current international dollars in 2017. Due to the lack of data on GDP per capita and/or health expenditure of certain countries, some calculations could not be performed. Table 2. Presents the burden of conflict in the war-torn EMR countries in their most brutal time since 1990 to 2017. Table 1. The health burden and economic costs due to direct health burden of conflict and terrorism in the EMR countries affected the most, in 2017.
| Country     | Conflict related DALYs rate | Conflict related DALYs number (000) | GDP per capita PPP | CHE per capita PPP | Economic burden of conflict HEB PC PPP | CHE ratio | HEB in country PPP (000) |
|-------------|----------------------------|------------------------------------|-------------------|-------------------|---------------------------------------|-----------|--------------------------|
| Afghanistan | 4,912.64                   | 1,764.3                            | 2,058             | 228               | 101.10                               | 0.44      | 3,630,931                |
| Bahrain     | 60.64                      | 0.8                                | 47,710            | 2,263.04          | 28.93                                | 0.01      | 41,182                   |
| Djibouti    | 35.44                      | 0.4                                | 4,885             | 134.43            | 1.73                                 | 0.01      | 1,978                    |
| Egypt       | 90.04                      | 86.3                               | 11,014            | 661.44            | 9.91                                 | 0.01      | 951,067                  |
| Iran        | 94.62                      | 78.2                               | 14,536            | 1,758.99          | 13.75                                | 0.00      | 1,137,564                |
| Iraq        | 5,307.62                   | 2,151.2                            | 10,972            | 722.66            | 582.35                               | 0.80      | 23,603,619               |
| Jordan      | 11.00                      | 1.1                                | 10,010            | 749.82            | 1.10                                 | 0.00      | 11,764                   |
| Kuwait      | 53.53                      | 2.2                                | 50,855            | 3,760.22          | 27.22                                | 0.00      | 112,152                  |
| Lebanon     | 534.25                     | 27.1                               | 16,005            | 1,081.28          | 85.50                                | 0.07      | 434,502                  |
| Libya       | 1,016.65                   | 67.4                               | 13,238            | NA**              | 134.58                               | NA        | 892,317                  |
| Morocco     | 10.08                      | 3.5                                | 7,314             | 439.6             | 0.73                                 | 0.00      | 26,167                   |
| Oman        | 0.00                       | 0.00                               | 29,082            | 1,651.55          | 0.00                                 | 0.00      | 9                        |
| Pakistan    | 61.76                      | 132.6                              | 4,571             | 152.13            | 2.82                                 | 0.01      | 606,469                  |
| Country                  | DALYs    | CHE PC  | GDP    | HEB PC  | CHE per capita  |
|-------------------------|----------|---------|--------|---------|-----------------|
| Palestine territories   | 997.55   | 47.8    | 6,402  | NA      | 63.86           |
| Qatar                   | 0.59     | 0.01    | 91,739 | 3,391.37| 0.54            |
| Saudi Arabia            | 2.67     | 0.9     | 47,309 | 3,760.28| 1.26            |
| Somalia                 | 1,812.16 | 343.4   | NA     | NA      | NA              |
| Sudan                   | 211.74   | 83.2    | 4,880.3| 297.86  | 10.33           |
| Syria                   | 14,681.85| 2,111.3 | NA     | NA      | NA              |
| Tunisia                 | 7.93     | 0.9     | 10,605 | 874.34  | 0.84            |
| United Arab Emirates    | 2.81     | 0.2     | 67,184 | 3,031.25| 1.89            |
| Yemen                   | 3,872.38 | 1,169.7 | NA     | NA      | NA              |

- **Note:** All information included in this table belong to 2017, except for CHE per capita, 2016
- DALYs: disability adjusted life years, GDP: Gross Domestic Product, CHE: Current Health Expenditure, HEB PC: Health-attributable Economic Burden (of conflict) per capita
- **NA; not assessed.**

Table 2. The health burden and economic costs of conflict and terrorism in the EMR countries involved in war, at their most brutal period during 1990-2017.
| Country/year       | Conflict related | GDP per capita | CHE per capita | Economic burden of conflict |
|--------------------|------------------|----------------|----------------|-----------------------------|
|                    | DALYs rate       | DALYs number (000) | PPPNEW         | HEB PC PPP | CHE ratio | HEB in country PPP(000) |
| Afghanistan        | 6,759.51         | 2,346.5         | 2,057          | 208.63       | 139.04    | 0.66                | 4,826,796 |
| (2016)             |                  |                 |                |              |           |                    |          |
| Iraq               | 8,758.62         | 2,727.5         | 8,113          | 344.75       | 710.58    | 2.06                | 22,128,579 |
| (2007)             |                  |                 |                |              |           |                    |          |
| Kuwait             | 6,345.97         | 109.6           | NA             | NA           | NA        | NA                  | NA        |
| (1991)             |                  |                 |                |              |           |                    |          |
| Lebanon            | 1,729.54         | 68.6            | 14,299         | 838.10       | 247.30    | 0.29                | 981,391   |
| (2006)             |                  |                 |                |              |           |                    |          |
| Libya              | 5,945.21         | 368.3           | 8,480          | 619.05       | 504.15    | 0.81                | 3,123,237 |
| (2011)             |                  |                 |                |              |           |                    |          |
| Palestine territories | 11,856.29       | 468.4           | 4,965          | NA**         | 588.66    | NA                  | 2,326,011 |
| (2008)             |                  |                 |                |              |           |                    |          |
| Somalia            | 8,082.96         | 584.3           | NA             | NA           | NA        | NA                  | NA        |
| (1991)             |                  |                 |                |              |           |                    |          |
| Sudan              | 3,004.19         | 884.5           | 2,588          | 127.39       | 77.74     | 0.61                | 2,289,160 |
| (2004)             |                  |                 |                |              |           |                    |          |
| Syria              | 23,744.74        | 3,479.3         | NA             | NA           | NA        | NA                  | NA        |
| (2016)             |                  |                 |                |              |           |                    |          |
| Yemen              | 3,872.38         | 1,169.7         | NA             | NA           | NA        | NA                  | NA        |
| (2017)             |                  |                 |                |              |           |                    |          |

- DALYs: disability adjusted life years, GDP: Gross Domestic Product, CHE: Current Health Expenditure, HEB PC: Health-attributable Economic Burden (of conflict) per capita
- **NA**: not assessed

**Discussion**
The Global Burden of Disease (GBD) study 2017 presents comprehensive data regarding the disease burden of 359 causes worldwide (10). The present study aimed at investigating the direct health burden of conflict and terrorism, the C.3.3 code of IHME hierarchy of causes, and its consequent economic loss in the EMR countries from 1990 to 2017. Based on the results of this study, between 1990 and 2017, the conflict-related DALYs decreased globally by 10%, compared to a huge increase of 143% in the EMR countries.

The impact of war is more devastating on children. In accordance with the GBD study 2017, the escalating trend of violence in the region resulted in an increase of 263% in the under-five mortality rates. This substantial increase just represents the direct effect of war on the mortality of this vulnerable age-group, several other factors such as lack of enough food and clean water supply, the failure of health services in nation-wide immunization coverage, and the collapse of healthcare facilities to manage the pregnancy-related medical emergencies in affected areas, impose extra mortality to under-five children population (11, 12). The war tragedy follows the same pattern in the 5-14 and 15-49-year-old individuals, accounting for the first and second cause of mortality in these age groups, respectively. Besides the direct war casualties, the child-soldier phenomenon needs to be addressed, as, in some of the war-torn countries in the region, including Iraq, Palestine, Sudan, and Somalia, children are coerced to get actively involved in the war (12). Based on the GBD study 2017, we observed that in the age group of 15-49, men are more affected by the consequences of armed conflicts, which is in agreement with the previous studies, indicating that the young men comprise the majority of combat casualties (2).

Based on the World Bank Data 2017, among the EMR countries, Afghanistan got the least GDP per capita and the highest GDP per capita belonged to Qatar, the United Arab Emirates, Kuwait, and Saudi Arabia. Saudi Arabia, Kuwait, Qatar, and United Arab Emirates also comprised the countries with the highest outlay on health, respectively.

According to the results of our suggested model, the most significant monetary damages of war in 2017 were in Iraq and Afghanistan, which are the countries in the region with the least outlay on health. Hence, disparities in the EMR countries in terms of economic and public health developments, considering GDP per capita and CHE per capita as indicators, are, in part attributable to the burden of conflict and terrorism. It is worth mentioning that the countries which are vastly affected by war fail to achieve the economic growth as expected, and as a result, the GDP per capita, as a value metric of economic activity in a given country, would decline (13), whereas the conflict-related DALYs would inevitably rise. Consequently, this study’s suggested method doesn’t provide a cross-national comparison of the impact of war on country’s economy but an estimation of conflict-related health consequences on each country’s economy alone.

As claimed by previous studies, underdevelopment and economic dilemmas are not only the consequence of conflict but also the source of it (14, 15). There might be an argument, for instance, that the continued conflicts for more than 40 years in Afghanistan have ended up with an under-developed economy (4).
In this study as well, according to the GBD study 2017 and World Bank data, the economically underdeveloped EMR countries were shown to be more amenable to be involved in a war. This is while Qatar and the United Arab Emirates, as the wealthiest countries of the region, have been less directly involved in armed conflict. However, both of them were among the Saudi Arabia allies during the war with Yemen for a short period. Nonetheless, Lebanon's economic growth based on its GDP, despite the ongoing conflicts since 1975 is exceptionally remarkable (4). This issue provokes speculations on so many other elements that influence the economy.

This is also to no surprise that the countries might succeed in achieving economic development and market stability after the tension resolution (13). As demonstrated, Kuwait, one of the three wealthiest countries in the region in 2017, endured a huge burden of war in 1991 with the attributable DALYs rate of 6,345 (5,741-7,018) per 100,000.

Violent conflicts put financial pressure not merely on the countries involved in the war, but also on the neighborhood counterparts. This is, in part, due to the massive displacement of the population; for instance, the refugee crisis following the Syrian civil war in 2011 put an extraordinary strain on Lebanon's economy (4). Hence, the political instabilities and civil unrest in the region slow the pace of economic development and hinder the expected reconstruction of health infrastructures in the whole EMR. As stated by Gates et al., armed conflicts cease some of the Millennium Development Goals (MDGs) being achieved both in the countries in war and globally, and this detrimental effect is more dramatic in some aspects; including life expectancy, GDP per capita, infant mortality and access to water and they further emphasize that the consequences of conflict in a region might be even more prominent in the whole world than the affected area (13).

Today, having the Sustainable Developmental Goals (SDGs) to achieve in 2030 ahead, we need a change. Universal health coverage as one of the SDGs (the SDG3) is among the WHO’s top priorities, and efforts need to be given to cease the war cycle, as a threat to public health and economy and a major source of inequity in the EMR.

As claimed by Murray et al., registration systems in countries affected by violent political conflicts wouldn't succeed in collecting the information (16). As the main limitation of this study, we encountered the same challenge as we lacked data on financial indicators of certain countries in the region, which were enormously affected by war. Syria for instance, which held the highest burden of war and terrorism in 2017, lacked the data concerning country’s GDP per capita since 2012.

Finally, it should be borne in mind that the model proposed in this study neither includes the indirect health burden of the conflict, nor calculates the whole financial burden of war in a country, rather provides a reasonable estimate of the economic burden of conflict, attributable to its impact on population health. In other words, our suggested model calculates conflict-related economic damage due to the loss of GDP share of each person as the human resources, who could have been economically active and benefit the country’s economy in the absence of war.
Conclusion

Based on our report, conflict and terrorism is a major public health issue in the EMR with huge economic impacts. It is one of the most important determinants of under-development among the countries of the region. According to what we observed in this study, countries involved in conflict mainly hold a limited amount of resources and can spend less on health, and this may be speculated that conflict and terrorism contribute to health inequities in the EMR. Without any further action to cease the instabilities, the expected universal health coverage would not be achieved in the region.

List Of Abbreviations

- EMR: Eastern Mediterranean Region
- GDP: Gross Domestic Product
- WHO: World Health Organization
- DALYs: Disability Adjusted Life Years
- IHME: Health Metrics and Evaluation
- ICD: International Classification of Diseases
- CHE: Current Health Expenditure
- PPP: Purchasing Power Parity
- HEB: Health-attributable Economic Burden
- GBD: Global Burden of Disease
- MDGs: Millennium Development Goals
- SDGs: Sustainable Developmental Goals

Declarations

- Ethics approval and consent to participate: not applicable
- Consent for publication: not applicable
- Availability of data and materials: The datasets used and analyzed during the current study are available in the “IHME, GBD” and “World Bank Data” websites, http://ghdx.healthdata.org/gbd-results-tool, https://data.worldbank.org/indicator
- Competing interests: The authors declare that they have no competing interests
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- Authors' contributions: RM provided the conception and proposed the design of the work, SHS contributed to data acquisition and interpretation, and drafted the manuscript, MM substantively revised the draft.
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**Figures**

**Figure 1**

The time trend of conflict and terrorism DALYs in the EMR and the world, 1990-2017.
Figure 2

The arrow diagram of the most common causes of DALYs in the EMR, 1990-2017.
Figure 3

The burden of conflict and terrorism of the most severely affected countries in the Eastern Mediterranean Region (EMR), with a burden higher than 6000 DALYs per 100,000, 1990-2017.
Figure 4

The burden of conflict and terrorism of the most severely affected countries in the Eastern Mediterranean Region (EMR), with a burden less than 6000 DALYs per 100,000, 1990-2017.
Figure 5

Gender distribution of conflict related DALYs in the 15-49 age group, EMR, 2017.