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Original Article

Excess mortality and disease burden due to conflict in Gaza: focus on the 0-14 age group

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ABSTRACT

Background. The ongoing conflict in Gaza continues to take an unbearable toll, with particularly severe impacts on children. Measuring the burden of conflict-related disease in Gaza in terms of disability-adjusted life years (DALYs) is important in terms of showing this effect. The aim of this study was to calculate the conflict-related DALY in Gaza among children aged 0-14 years, following the October 7 events and compare these values with global and expected values.

Methods. We estimated the age and gender distribution of individuals killed or injured in Gaza, and calculated the DALYs, including Years of Life Lost (YLL) and Years Lived with Disability (YLD), attributable to the conflict. These estimates were then compared to the Institute for Health Metrics and Evaluation data for Palestine and global averages. The study also evaluated the DALY/YLD ratio and excess mortality rate.

Results. The DALY per 100,000 population was 160,745.01 (156,986.01-164,503.99) for males, 175,784.51 (170,812.52-180,756.50) for females, and 168,111.39 (164,009.17-172,213.62) overall. The daily DALY burden experienced by Gaza due to conflict indicates an increase of 181.05% compared to Palestinian estimates. The increase was calculated as 115.39% for YLL and 4,268.25% for YLD. Compared to global data for conflict and terrorism, the increases in daily DALY, YLL, and YLD values in Gaza were 1,918.08%, 1,316.32%, and 8,537.50%, respectively. The data calculated in our study indicate that the daily DALY/YLD ratio for the 0-14 age group in Gaza was 333.21 with a p-score of 6,952.0%.

Conclusion. To reduce the devastating effects of violence, such as conflict and terrorism, on children's health, more effective measures should be taken at the international level and preventive strategies should be developed.

Key words: conflict, disability adjusted life years (DALY), excess mortality, Gaza, 0-14 years.

Wars represent some of the most devastating and consequential events in human history, with their adverse effects extending far beyond immediate casualties in conflict zones.[1] The indirect effects of war, including the destruction of infrastructure, the disruption of healthcare services, the loss of economic resources, and forced displacement, have a significant impact on social structures. This leads to long-term losses in both the short and long term.[2] Additionally, wars promote the transmission of diseases and increase the prevalence of existing health issues.[3] The data published by the International Institute for Strategic Studies (IISS) indicates that the number and length of armed conflicts have increased over the 21st century.[4] Factors, such as political infighting, ethnic and religious animosity, economic disparities, and external assistance, have led to the increased intensity of conflicts, particularly in the Middle East, Africa, and Asia.

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The first recent instances of ongoing disputes were in Ukraine. The ongoing conflict in Ukraine has had a significant negative impact on the population of Ukraine. The healthcare system has been particularly affected. Recent estimates indicate that approximately 6.5 million people have been forced to move worldwide, and numerous healthcare facilities have been targeted.[5,6] The recent instance of this is the Palestinian-Israeli conflict. The Gaza Strip has historically faced severe humanitarian crises due to ongoing conflicts and political instability, however, the events following October 7, 2023, have led to a situation that is one of the most severe humanitarian crises in history, specifically affecting civilians, including children and women.

The events in Gaza have led to problems with healthcare services, infrastructure destruction, financial loss, and have directly affected healthcare. The suspension of healthcare services in Gaza allows diseases to spread and makes it difficult to treat chronic conditions.[7] Trouble with housing, constant travel, overcrowded conditions, and lack of access to fresh water have had a significant impact on the disease burden in Gaza during the ongoing conflict. The definitions of Disability-Adjusted Life Years (DALY), Years of Life Lost (YLL), and Years Lived with Disability (YLD) illustrate the complexity of estimating the public health burden associated with inadequate health services and conflict settings. In the context of the Gaza conflicts, indirect deaths have led to a substantial increase in YLL.[8] Particularly high rates of mortality among civilians contribute to increased YLLs.[2,9] Adversities in accessing healthcare services during disputes, tardy responses to emergency situations, and inability to address chronic diseases all contribute to increased fatalities.[7] Additionally, the long-term effects of bombings and armed conflict are increasing YLD.[10] These factors negatively affect the effective operation of health infrastructure and services, posing a significant threat to public health.

The aim of this study was to calculate the conflict-related DALY, YLL, and YLD in Gaza among children aged 0-14 years following the October 7 events and compare these values with global and expected values.

Materials and Methods

This descriptive study was conducted on the data of Palestinian citizens who were killed or injured due to the ongoing Gaza-Israel war between October 2023 and June 2024. According to the Ministry of Health in Gaza, at least 42,652 Palestinians were killed and 103,053 injured in Gaza between October 7, 2023 and the afternoon of October 7, 2024.[11]

DALYs were calculated as the sum of YLL due to premature mortality and YLD. YLLs were estimated by multiplying the number of deaths by the standard life expectancy at the age of death, based on Global Burden of Disease (GBD) reference life tables. YLDs were calculated by multiplying the number of incident cases by the average duration of the condition and a disability weight reflecting the severity of the health outcome. These metrics were applied to age- and sex-specific data to reflect the burden within the affected population. We calculated the DALY, YLL and YLD of the conflict in the Gaza. The 2023 projection of the United Nations Fund for Population Activities (UNFPA) for the Gaza population was used to calculate the rate per 100,000 population.[12] The DALY was calculated by adding YLLs and YLDs. One DALY equals one lost year of healthy life. YLLs were estimated and determined from age and gender stratified mortality rates (YLL=N*L, where N is the number of deaths per year and L is the life expectancy at age of death in years).[13] For the analysis of the number of deaths (predicted deaths: N) by age in this study, we used a list published by the Palestinian Ministry of Health, covering the period between October 7 and October 26, 2023 at 15:00, which, according to the source, included only people who were brought to health facilities and morgues.[14-16] In this list, the distribution of 6,747 people

with known ages in the 0-14 years range was obtained. Of the deceased individuals on the list, 2,258 (33.4%) were aged 0-14 years. Once this data was obtained, the estimated number of deaths and injuries by gender of individuals aged 0-14 years was estimated according to the number of deaths and injuries published by the Palestinian authorities on July 17, 2024.[11] Life Expectancy at Birth (L) in Palestine was based on data published by the Palestinian Bureau of Statistics for the year 2023 (male: 73.30, female: 75.5).[17] YLDs (YLD=I×DW×L) were calculated by multiplying the number of cases resulting from conflict and terrorism by the disability weight assigned to this health outcome. In the formula, I represents the number of new cases resulting from the conflict and terrorism during the study period, while DW denotes the disability weight reflecting the severity of the health outcome on a scale from 0 (perfect health) to 1 (equivalent to death).The estimation of the number of cases (I) was based on the age distribution in the above list and the number of injured as announced by the Palestinian authorities on October 7, 2024.[11] The DW value (0.273) was calculated by averaging the minimum and maximum values of the disability weights due to mass shooting as specified in Daniel G. Arce's study.[18] In the YLL formula, L refers to the standard life expectancy at the age of death (i.e., the number of years a person would have lived had they not died prematurely). In contrast, in the YLD formula, L represents the average duration of disability (i.e., the time period an individual lives with a health condition or injury before recovery or death). Although the same symbol is used, its interpretation differs in each context.

The Institute for Health Metrics and Evaluation (IHME), which conducts GBD studies, categorises diseases into three broad groups according to their main causes. The third category of causes includes injury-related health problems, which are subdivided into transport injuries, unintentional injuries, self-harm and interpersonal violence. Conflict and terrorism are included as a subgroup within the subcategory of self-harm and interpersonal violence. We compared YLL, YLD and DALYs by cause (conflict and terrorism- all causes) and over time.[19,20] In presenting past and estimated data, we used the GBD interactive data visualization tools (GBD Foresight Visualization and GBD Results). The data were evaluated daily and Absolute Change Relative Change was calculated. The following formulas were used in the analysis: Absolute Change = Value at Time 2 − Value at Time 1, Relative Change (%) = (Value at Time 2 − Value at Time 1) / Value at Time 1 × 100, Rate per 100,000 population = (Number of cases / Total population) × 100,000.

When converting to daily data, DALY, YLD and YLL variables calculated for Gaza were divided by 365 days (October 7, 2023 to October 7, 2024). In addition, the global and Palestinian 2023 estimate data were divided into 365 days. For the estimation of DALY, YLL, and YLD, 95% confidence intervals (CIs) were calculated using standard statistical approaches to uncertainty quantification, grounded in the propagation of error framework. Specifically, the standard error of the aggregate burden estimates was computed based on the empirical variance of the underlying input parameters (e.g., number of deaths, incidence of injuries, and disability weights). Assuming approximate normality of the sampling distribution, two-sided 95% confidence intervals were constructed using the Student's *t*-distribution. This approach is consistent with conventional methods employed in global burden of disease analyses and facilitates the quantification of uncertainty arising from data variability.[21]

The study also calculated the excess mortality rate. This rate refers to the extent to which all-cause mortality during a crisis exceeds the expected baseline under normal conditions. Excess mortality [P-score = (Reported deaths-Projected deaths) /Projected deaths×100] was measured as the percentage difference between the reported and estimated number of deaths.[22]

The study was conducted in accordance with the ethical standards of the Helsinki Declaration. Ethical approval and informed consent were not required for this study as it was based on secondary analysis of publicly available, aggregated data that did not contain any personal identifiers. Nevertheless, we acknowledge the ethical responsibility involved in reporting conflict-related mortality data with sensitivity and accuracy, recognizing the profound human impact behind these figures.

Results

According to the UNFPA 2023 projection, the total population in the 0-14 age group is 898,707, 458,531 males and 440,176 females. According to this analysis, 14,246 (1.58%) children in the 0-14 age group are predicted to have been killed. The distribution of YLL, YLD and DALY by gender in the 0-14 age group in Gaza is shown in Table I. While YLL, YLD, and DALY values are relatively lower for male children, these values are higher for female children.

For the year 2023, the expected DALY per 100,000 population was calculated as 87.41 (29.45-154.05) globally, while for Palestine it was 922.66 (24.77-6,240.73). In the same year, the expected YLL per 100,000 population was found to be 80.04 (23.39-145.97) globally, and 908.31 (9.67-6,226.94) in Palestine. Additionally, for 2023, the expected YLD per 100,000 population was determined to be 7.37 (3.35-21.07) globally, while in Palestine it was 14.34 (8.75-22.36). Table II provides the estimated values for daily DALY, YLL, and YLD due to conflict, as well as all causes, for the age group 0-14 years globally and in Palestine. These values show a significant increase when compared to the estimates for Palestine and the global estimates. The daily DALY burden experienced in Gaza due to conflict indicates an increase of 181.05% compared to Palestinian estimates. The increase was calculated as 115.39% for YLL and 4268.25% for YLD. Compared to global data for conflict and terrorism the increases in daily DALY, YLL, and YLD values in Gaza are 1,918.08%, 1,316.32%, and 8,537.50%, respectively. Additionally, when assessed across all causes, daily values

Table I. Distribution of YLL, YLD, and DALY by gender in children aged 0–14 years in Gaza.

Gaza, 0-14 years	Male (95% CI)	Female (95% CI)	Total (95% CI)
Population[1]	458,531.00	440,176.00	898,707.00
Total YLLs	466,633.81 (455,721.67–477,545.93)	484,037.28 (470,346.49–497,728.07)	950,671.09 (927,488.18–973,853.96)
Years of life lost (YLLs) (per 100,000 population)	101,770.01 (99,390.14–104,149.88)	109,961.24 (106,851.03–113,071.45)	105,782.09 (103,202.51–108,361.67)
Total YLDs	270,410.98 (264,087.49–276,734.49)	289,746.79 (281,551.43–297,942.17)	560,157.77 (546,473.51–573,842.01)
Years lived with disability (YLDs) (per 100,000 population)	58,975.00 (57,595.88–60,354.12)	65,823.27 (63,961.49–67,685.05)	62,329.30 (60,806.64–63,851.96)
Total DALY	737,044.79 (719,809.14–754,280.42)	773,784.07 (751,897.91–795,670.23)	1,510.828,86 (1,473,961.88–1,547,695.86)
DALY (per 100,000 population)	160,745.01 (156,986.01–164,503.99)	175,784.51 (170,812.52–180,756.50)	168,111.39 (164,009.17–172,213.62)

DALY: disability-adjusted life years, YLD: years lived with disability, YLL: years of life lost.

Table II. Distribution of Daily DALY, YLL, YLD values and changes due to conflict in Gaza with Palestine and Global 2023 estimate data on conflict and all causes for 0-14 years group.

	DALY (95% CI)	YLL (95% CI)	YLD (95% CI)
2023 Estimate Palestine (Conflict and terrorism, 0-14 years, per 100 000 population, per day)	2.53 (0.07–17.10)	2.49 (0.03–17.06)	0.04 (0.02–0.06)
2023 Estimate Global (Conflict and terrorism, 0-14 years, per 100 000 population, per day)	0.24 (0.08–0.42)	0.22 (0.06–0.40)	0.02 (0.01–0.06)
2023 Estimate Palestine (All causes, 0-14 years, per 100 000 population, per day)	33.24 (26.42–47.87)	22.81 (17.08–37.57)	10.47 (7.61–14.18)
2023 Estimate Global (All causes, 0-14 years, per 100 000 population, per day)	74.78 (65.79–86.33)	62.50 (53.87–72.91)	12.37 (8.98–16.46)
Gaza (0-14 years, per 100 000 population, per day)	460.58 (449.34–471.82)	289.81 (282.75–296.88)	170.77 (166.59–174.94)
Absolute change; Relative change[1]	458.05; 181.05	287.32; 115.39	170.73; 4.268.25
Absolute change; Relative change[2]	460.34; 1.918.08	289.59; 1.316.32	170.75; 8.537.50
Absolute change; Relative change[3]	427.34; 12.85	267.00; 11.71	160.30; 15.31
Absolute change; Relative change[4]	385.80; 5.16	227.31; 3.64	158.40; 12.81

[1]Comparison between 2023 Estimate Palestine (Conflict and terrorism) and Gaza
[2]Comparison between 2023 Estimate Global (Conflict and terrorism) and Gaza
[3]Comparison between 2023 Estimate Palestine (All causes) and Gaza
[4]Comparison n between 2023 Estimate Global (All causes) and Gaza.
DALY: disability-adjusted life years, YLD: years lived with disability, YLL: years of life lost.

of DALY, YLL, and YLD in Gaza were found to be higher than those in the broader Palestinian population, with increases of 12.85%, 11.71%, and 15.31%, respectively. Compared to global data for all causes, the increases in daily DALY, YLL, and YLD values in Gaza were 5.16%, 3.64%, and 12.81%, respectively (Fig. 1). These losses represent an additional burden of 0.28% to the globally expected total DALY (Global: 544,679,488.54; Gaza: 1,510,828.86), 0.21% to YLLs (Global: 455,247,949.56; Gaza: 950,671.09), and 0.62% to YLDs (Global: 90,096,459.72; Gaza: 560,157.77). When evaluating the losses due to conflict, the losses experienced by the 0-14 age group account for an additional burden of 86.63% of the globally expected DALY (Global: 1,743,877.45; Gaza: 1,510,828.86), 59,53% of YLLs (Global: 1,596,805.74; Gaza: 950,671.09), and 380.87% of YLDs (Global: 147,071.72; Gaza: 560,157.77).

Upon evaluation of the daily DALY/YLD ratio, it is anticipated that the expected DALY/YLD ratio due to conflict and terrorism for children aged 0-14 years in Palestine will be 1.58, while the global average for this age group is estimated to be 8.33. When all causes are considered, the estimated rate for children aged 0-14 years in Palestine was 31.50, while the global average is 16.54. The data calculated in our study indicate that the daily DALY/YLD ratio for this age group in Gaza is 333.21, which is above both the

Palestinian and global average. Although the expected values for Palestine are high compared to the global data, the disability experienced due to the war is found to be higher than the expected value for Palestine.

For 2023, the total number of projected deaths for the 0-14 age group in Palestine due to conflict and terrorism is 199.91[20] while the total predicted deaths amount to 14,246, resulting in an overall p-score of 6,952.0% (Table III).

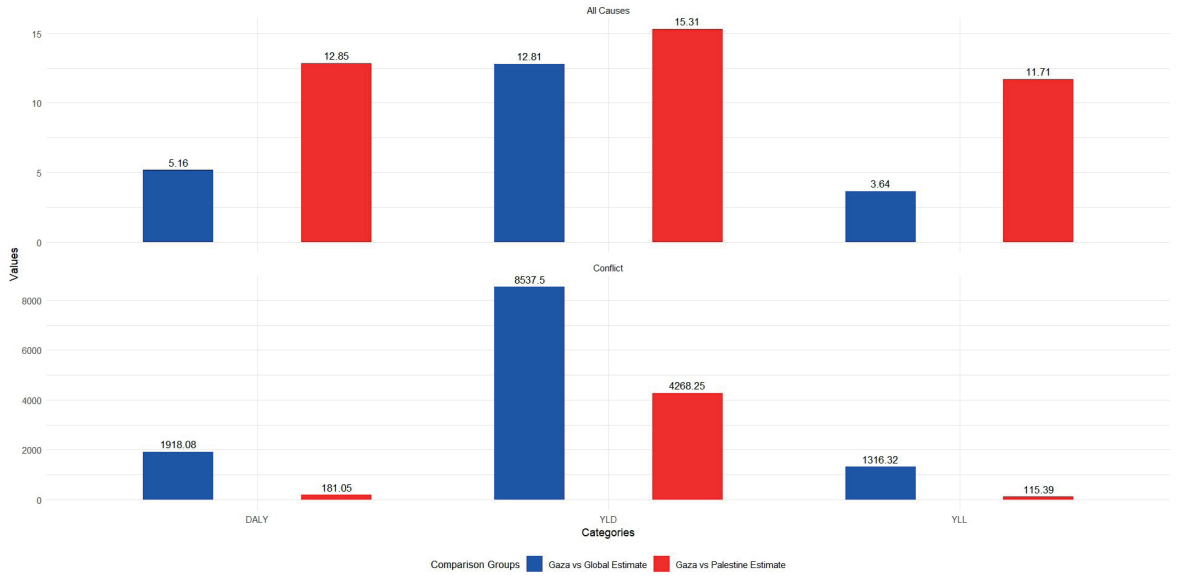

Fig. 1. Relative change in DALY, YLL, and YLD in Gaza (Oct 2023–Oct 2024), compared to 2023 estimates for Palestine and global data across conflict and terrorism and all causes.
DALY: disability-adjusted life years, YLD: years lived with disability, YLL: years of life lost.

Table III. Excess mortality in Gaza.

Years Group	Projected deaths[1]	Predicted deaths (N)	Excess mortality p-score[2]
0	13	970	7,361.5
1	14	999	7,035.7
2	16	1,075	6,618.8
3	15	1,007	6,613.3
4	16	1,162	7,162.5
5	15	1,041	6,840.0
6	12	939	7,725.0
7	12	928	7,633.3
8	12	850	6,983.3
9	11	821	7,363.6
10	15	1,072	7,046.7
11	13	937	7,107.7
12	13	886	6,715.4
13	14	842	5,914.3
14	11	716	6,409.1
Total	200	14,246	6,952.0

[1]2023 Projected Palestine death 0-14 years because of conflict and terrorism
[2]P-score (a measure of excess mortality)= (Predicted deaths- Projected deaths)/ Projected deaths×100

Among the individual age groups, the highest p-score is observed in age group 6, with a p-score of 7,725.0%. Other age groups also show considerable excess mortality, with p-scores ranging from 5,914.3% to 7,725.0%.

Discussion

This study highlights how children aged 0-14 years in the Gaza Strip have been affected in terms of the burden of disease following the attacks. The findings demonstrate that state violence substantially contributes to the loss of DALYs. The war imposed an additional burden of one in a million on the globally expected DALYs in the 0-14 age group. In addition, while the daily DALYs lost due to war are approximately five times the expected rate at the global level, it is approximately thirteen times the expected value for Palestine. The values for YLL and YLD calculated by considering all causes were found to be eleven and fifteen times higher than the expected values for Palestine, compared to four and twelve times, respectively, at the global level. A notable increase was observed in the rates when the conflict data analysis was examined.

On the other hand, the results of this study reveal a significant excess of predicted deaths due to conflict in the 0-14 age group in Palestine compared to reported deaths (p score: 6,952.0%). These excess mortality rates point to the need to reassess and improve health and humanitarian policies. One year after the beginning of the Israeli-Gaza war, the health system is severely strained. Numerous mass casualty incidents have led to a critical shortage of hospital beds, with many hospitals out of service. Both the inadequate functioning of hospitals and the inadequate provision of primary health care in the region are causing life crises secondary to the destruction caused by the war.[23] International humanitarian law, which should guarantee the rights of civilians and medical personnel during armed conflicts, has been repeatedly violated.[24] These high excess death rates may be due to deliberate targeting of civilians.[25]

According to figures provided by international organizations, approximately 1 million cases of acute respiratory infections, over 500,000 cases of acute watery diarrhea and over 100,000 cases of acute jaundice syndrome have been reported. Furthermore, supply problems in the provision of medical supplies, medicines, imaging and laboratory services are putting the lives of the critically ill and wounded at risk.[26] Adding to the risk, the lack of access to clean water for both drinking and use continues to pose major health risks. The effects of these problems are exacerbated by poor living conditions and overcrowding in Gaza, making it difficult for health care providers to respond effectively. Repeated displacement, insecurity and access restrictions lead to malnutrition among children and women in need of nutrition services. In screening surveys, 6.82% of children were reported to be diagnosed with malnutrition.[27] In addition, repeated displacement makes it difficult to monitor and track these cases. It has been reported that even under the most optimistic ceasefire conditions, the number of excess deaths will continue to be significant due to the time required to improve water, sanitation and shelter conditions, reduce malnutrition and restore health services.[9]

In our study, the frequency of years lived with disability was found to be very high when compared to both conflict-induced and all causes. Furthermore, the daily DALY/YLD ratio in Gaza was above both the Palestinian and global averages. The high DALY and YLD rates in this study reflect the severe and long-lasting impact of the conflict on the health of children in Gaza. A YLD rate of over 300 per 100,000 indicates not only high levels of disability, but also long-term pressure on an already fragile health system. This war has led to the formation of a generation that will continue their lives with disability, especially in the 0-14 age group. Beyond numerical estimates, these indicators underscore the importance of sustained healthcare access, rehabilitation services and long-term support for affected children. Addressing these broader implications

is essential for a proper understanding of the public health burden of war. In addition to physical trauma, psychological trauma is another important reason that will increase this burden. It reveals how important rehabilitation is in the post-war health system. This situation draws attention to the potential burden that health problems arising from post-war disability may create on the health system.

The findings of this study demonstrate that the impact of conflict on children is far-reaching and significant. A study on the health burden and attributable economic damage of conflict and terrorism in the region indicates that from 1990 to 2019, death rates among children under five increased by 337%, and among those aged 5-14 by 35.7% due to conflict. This increase has been compounded by a number of additional factors, including a lack of adequate food and clean water, failures in healthcare services, and the collapse of health facilities, which have resulted in an additional burden on surviving children.[28] While this study provides a direct measurement of the disease burden attributable to conflict, it is important to note that the indirect health consequences are likely to be even greater. In addition to mortality and injury, indirect effects such as psychological trauma, disruption in chronic disease management, and reduced access to essential health services contribute significantly to the overall public health burden. These consequences, though not quantified in the present analysis, are expected to intensify as the conflict persists and should be considered critical components of the long-term health impact, particularly among vulnerable groups such as children and individuals with pre-existing conditions.

This study has several limitations. The first one is that we were not able to make predictions for the age distribution due to the lack of accurate reporting of mortality data. The data cover only a 19-day window (October 7–26, 2023) and reflect cases reported through the Palestinian Ministry of Health from hospitals and morgues. While this source remains the primary provider of health data in the region, the ongoing conflict poses major obstacles to data completeness and accuracy, including restricted access, disruptions in reporting, and potential underreporting or duplication. To estimate the annual burden, we applied a cautious extrapolation approach based on patterns from previous conflicts and available surveillance data. Although necessary given the urgency and lack of longer-term data, this introduces uncertainty. Variability in conflict dynamics and health service accessibility likely influence the reliability of these projections, which is why confidence intervals were included to reflect potential margins of error. This analysis focuses solely on the burden related to conflict and terrorism, excluding other health issues such as non-communicable diseases that may be indirectly affected by the war.

Despite these constraints, the findings provide an important early assessment of the conflict's health impact and underscore the need for robust data infrastructure and international health monitoring in crisis settings. Second, only the conflict and terrorism cause was calculated. The impact of death and injury from other causes (e.g., non-communicable diseases and chronic diseases) on the burden of disease is not included in the calculation.

Despite these limitations, this analysis provides valuable insights into the immediate impact of the conflict. More effective measures should be taken at national and international levels to reduce the devastating effects of violence, such as conflict and terrorism, on children's health, and the ongoing war in Gaza should end as soon as possible.

Ethical approval

The study was conducted in accordance with the ethical standards of the Helsinki Declaration. Ethical approval and informed consent were not required for this study as it was based on secondary analysis of publicly available, aggregated data that did not contain any personal identifiers.

Author contribution

The author confirm contribution to the paper as follows: Study conception and design: MEG; data collection: MEG; analysis and interpretation of results: MEG; draft manuscript preparation: MEG. The author reviewed the results and approved the final version of the manuscript.

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Conflict of interest

The authors declare that there is no conflict of interest.

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