Crisis in Gaza:

Scenario-based Health Impact Projections

Report One:

7 February to 6 August 2024

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This publication is partly based on third party-generated data herein analysed and interpreted, and it is not intended to question or challenge such data.

Any geographical entities or references to armed conflict events are only for the purpose of the analysis / report, and do not imply acknowledgement or endorsement of facts relating to these geographical entities or events.

Feedback and further information:

All reports, data and analysis code produced as part of this project are available at https://github.com/Gaza-projections

We have a developed a Frequently Asked Questions (FAQ) as well as detailed estimations method are also available at www.gaza-projections.org.

Please direct any questions to info@gaza-projections.org.

Table of contents

List of acronyms

Age (yo, mo)	Year and months old
CDR	Crude Death Rate
CFR	Case-Fatality Ratio
CL	Confidence Limits
COPD	Chronic Obstructive Pulmonary Disease
DM1	Diabetes Mellitus type 1
DM2	Diabetes Mellitus type 2
GAM	Global Acute Malnutrition
HIPs	Health Impact Projections
LiST	Lives Saved Tool
MMR	Maternal Mortality Ratio
MNH	Maternal And Neonatal Health
MoH	Ministry of Health
NCD	Non-Communicable Diseases
NICU	Neonatal Intensive Care Units
NMR	Neonatal Mortality Ratio
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
oPt	occupied Palestinian territories
SAM	Severe Acute Malnutrition
SBR	Stillbirth Rate
SEE	Structured Expert Elicitation
UNICEF	United Nations Children's Fund
UNFPA	United Nations Population Fund
UNRWA	United Nations Relief and Works Agency for Palestine Refugees in the Near East
WHO	World Health Organization

Executive Summary

Overall

The ongoing Israel-Gaza war has heavily affected civilians in both the Gaza Strip and Israel. Residents of Gaza are now mostly displaced from their homes and living in overcrowded conditions with insufficient access to water, sanitation and food, and health services have been considerably disrupted. So, to inform humanitarian and other decision-makers working on the Gaza crisis, the London School of Hygiene and Tropical Medicine and the Johns Hopkins Center for Humanitarian Health at Johns Hopkins University have initiated a project to estimate the potential public health impact of the crisis under different future trajectories of its evolution. The first set of projections covers a six-month period from 7 February to 6 August 2024. The projections will be periodically updated until May 2024. The projections are not predictions of what will happen in Gaza but provide a range of projections of what could happen under three distinct scenarios: 1) an immediate permanent ceasefire; 2) status quo (a continuation of conditions experienced from October 2023 till mid-January); and 3) a further escalation of the conflict.

The projections are based on a range of publicly available data from the current and past Gaza crises, data from similar crises, and peer-reviewed published research into excess death estimates and take into account the limitations and biases of different data sources. Where data is limited or unavailable, the projections draw on consultations with experts. These projections are designed to help humanitarian organisations, governments, and other actors plan their response to the crisis and take sound, evidence-based decisions. Ultimately, the hope is that they will make some contribution to saving lives.

Over the next six months we project that, in the absence of epidemics, 6,550 excess deaths would occur under the ceasefire scenario, climbing to 58,260 under the status quo scenario and 74,290 under the escalation scenario. Over the same period and with the occurrence of epidemics, our projections rise to 11,580, 66,720, and 85,750, respectively. All projections feature 95% uncertainty intervals as shown in the Summary Table below.

Under the ceasefire scenario, the projections suggest that infectious diseases would be the main cause of excess deaths, with 1,520 total infectious disease excess deaths without epidemics and 6,550 including epidemics. Traumatic injuries followed by infectious diseases would be the main causes of excess deaths in both the status quo (53,450 traumatic injuries; 2,120 total infectious disease excess deaths without epidemics and 10,590 including epidemics) and escalation scenarios (68,650 traumatic injuries; 2,720 total infectious disease excess deaths without epidemics and 14,180 including epidemics).

Our projections indicate that even in the best-case ceasefire scenario, thousands of excess deaths would continue to occur, mainly due to the time it would take to improve water, sanitation and shelter conditions, reduce malnutrition, and restore functioning healthcare services in Gaza. While the total number of estimated excess deaths from maternal and neonatal causes are relatively small (100-330 excess deaths), every loss of a mother has severe consequences for family health and wellbeing. Non-communicable diseases (NCDs) were the primary cause of death in Gaza in 2022, and the conflict has aggravated these conditions (1,680-2,680 excess deaths) via heavily disrupted specialised health services and impeded access to treatment and medications.

Summary Table. Projected numbers of excess, crisis-attributable deaths by cause, period and scenario. Values are the mean estimate and the 95% uncertainty interval.

Cause	Months 1 to 3 (7 Feb to 6 May 2024)			Months 4 to 6 (7 May to 6 Aug 2024)			Total projection period (7 Feb to 6 Aug 2024)		
	ceasefire	status quo	escalation	ceasefire	status quo	escalation	ceasefire	status quo	escalation
Traumatic injuries	**2,030** (1,820 to 2,270)	**26,740** (23,060 to 30,930)	**34,300** (30,000 to 39,390)	**1,220** (1,080 to 1,380)	**26,710** (23,030 to 30,900)	**34,260** (29,950 to 39,340)	**3,250** (2,900 to 3,640)	**53,450** (46,090 to 61,830)	**68,560** (59,950 to 78,730)
Infectious diseases - *endemic*	**1,030** (-50 to 3,870)	**1,430** (-20 to 5,140)	**1,750** (0 to 6,420)	**490** (-20 to 1,880)	**690** (-10 to 2,380)	**980** (10 to 3,550)	**1,520** (-70 to 5,750)	**2,120** (-30 to 7,520)	**2,720** (10 to 9,970)
Infectious diseases - *epidemic*	**1,520** (0 to 16,610)	**2,410** (0 to 30,540)	**3,400** (0 to 52,230)	**3,500** (0 to 52,020)	**6,050** (0 to 89,820)	**8,060** (0 to 114,800)	**5,030** (0 to 68,630)	**8,470** (0 to 120,350)	**11,460** (0 to 167,030)
Maternal and neonatal health	**50** (40 to 100)	**100** (80 to 210)	**160** (130 to 330)	**50** (40 to 100)	**100** (80 to 210)	**160** (130 to 330)	**100** (80 to 200)	**210** (170 to 420)	**330** (260 to 670)
Non-communicable diseases	**910** (720 to 1,160)	**1,260** (1,010 to 1,550)	**1,370** (1,090 to 1,670)	**770** (580 to 1,000)	**1,220** (970 to 1,510)	**1,310** (1,040 to 1,620)	**1,680** (1,300 to 2,160)	**2,480** (1,980 to 3,060)	**2,680** (2,130 to 3,290)
Total excluding epidemics	**4,030** (2,530 to 7,390)	**29,530** (24,130 to 37,840)	**37,580** (31,220 to 47,820)	**2,520** (1,670 to 4,350)	**28,730** (24,080 to 34,990)	**36,700** (31,140 to 44,840)	**6,550** (4,200 to 11,740)	**58,260** (48,210 to 72,830)	**74,290** (62,350 to 92,650)
Total including epidemics	**5,550** (2,530 to 24,000)	**31,940** (24,130 to 68,370)	**40,980** (31,220 to 100,040)	**6,020** (1,670 to 56,370)	**34,780** (24,080 to 124,810)	**44,770** (31,140 to 159,640)	**11,580** (4,200 to 80,370)	**66,720** (48,210 to 193,180)	**85,750** (62,350 to 259,680)

By cause of mortality

Excess deaths due to traumatic injuries include persons who died immediately due to their injury and those who died later due to wounds or other complications. These estimates include civilians and combatants. A ceasefire scenario is projected to avert most trauma-related deaths, but even in this scenario, residual traumatic deaths (3,250) would persist due to long-term mortality and unexploded ordnance. By contrast, excess deaths due to trauma are extremely high and predominate under the status quo (53,450) and escalation (68,560) scenarios. Examination of the age and sex distribution of traumatic injury deaths reveals that risk of injury death affects all ages and genders, with the majority occurring among segments of the population that are demographically unlikely to be combatants. The distribution of ages (e.g. children 0-15 years comprise 34% of deaths) and sex (57% male and 43% female) due to deaths by traumatic injuries amongst the Gaza population reflects the intensity and widespread nature of bombardment. Political and security agreements are imperative to ensure the security of healthcare facilities and workers, along with sufficient supply, quality, and access to lifesaving medications. Adherence to international humanitarian law, deconfliction agreements so that all hospitals can become secure and operational, combined with safe passage corridors for civilians to access and leave hospitals are needed. Longer-term care of individuals with severe and debilitating injuries will be lifelong and require frequent health care including wound care, rehabilitation, prostheses, mental health services and more.

The ongoing war in Gaza has precipitated a nutritional emergency for children. Before the current conflict, the global acute malnutrition (GAM) and severe acute malnutrition (SAM) prevalences were low amongst children 6-59 months (3.2% and 0.4%, respectively). As of 7 Feb 2024, we project they had already risen significantly (14.1% and 2.8%, respectively), albeit with likely geographical variations. GAM and SAM may slightly decrease during the ceasefire scenario (12.4% and 2.7% at 6 months, respectively). However, both measures increase to alarming rates in the status quo and escalation scenarios, although with wide uncertainty levels. Additionally, the conflict's disruption of breastfeeding due to stress and privacy violations exacerbates neonatal and infant health risks.

Excess deaths from infectious diseases under all scenarios are a particular concern. The breakdown of water and sanitation measures combined with overcrowding in inadequate shelters and insufficient food intake causing acute malnutrition combines into a projected high risk of excess deaths from a variety of infectious diseases. Endemic diseases, particularly COVID-19, influenza and pneumococcal disease, are projected to be the leading causes of infectious disease deaths, similar to the pre-war period. Overall, we project between 1,520 and 2,720 excess deaths due to common endemic infections depending on the scenario, though with wide uncertainty intervals. If epidemics also occur, those that are projected to cause the most excess deaths are cholera (3,595-8,971), polio (both wild-type and vaccine-derived; 1,1145-2,444), measles (260-793), and meningococcal meningitis (24-143); however, the estimates bear high levels of uncertainty inherent in projecting epidemics.

Projections for the six-month period suggest troubling increases in the relative risk of maternal, neonatal, and stillbirth deaths across all conflict scenarios compared to the pre-war period. These are linked to deterioration with respect to water, sanitation, and food security, and most importantly, to disrupted access to childbirth, antenatal, and postnatal services, and compromised quality of care. Under the ceasefire scenario we project that numbers and rates will increase slightly, while under the escalation scenario we project a regression to mortality numbers and rates not seen for nearly a quarter of a century, eroding at least two decades of health progress. If deaths from traumatic injury among pregnant and postpartum women and neonates are included in the projections, there is a substantial increase in deaths.

NCDs were the primary cause of death in Gaza in 2022, and the conflict has aggravated these conditions via a badly damaged and partially functioning healthcare system, and impeded access to treatment and medications. The current model projected excess mortality for cancer (lung, colorectal, and breast), acute strokes (ischemic and haemorrhagic), myocardial infarctions, diabetes mellitus type 1 (DM1) patients, and cases of chronic kidney disease requiring haemodialysis. In total, we project 1,680 excess deaths in a ceasefire, 2,480 excess deaths in the status quo, and 2,680 excess deaths in the escalation scenarios. Across the three scenarios, most deaths are projected to occur among individuals aged $\geq$50 years old (91%, 88% and 86% in the ceasefire, status quo and escalation scenarios, respectively). The model, focusing only on a subset of NCDs and neglecting the impact of the crisis on disease progression, likely underrepresents the actual mortality from NCDs. Future instances of these projections may feature additional NCDs and, critically, project mental health impacts.

Introduction

Context

Since 7 October 2023, large-scale military operations in the Gaza Strip, including aerial bombing and ground offensives, have resulted in an escalating public health crisis. As of 15 February 2024, the war had resulted in the deaths of over 28,000 people in Gaza and 68,000 injured [1]; approximately 75% of the 2.2 million population were displaced, and most resided in overcrowded shelters with limited access to water, sanitation and food. Health services were severely disrupted, with hospitals closed, damaged or overwhelmed by the large trauma injury caseload [1]. In Israel, the war had resulted in the deaths of over 1,200 people and 5,400 injured, while 124 hostages still remained in Gaza [1].

Scope of this project

This scenario-based health impact projections (HIPs) project aims to equip decision-makers with comprehensive projections of expected mortality of Palestinians in the Gaza Strip. Death is the most downstream metric of physical health impacts, and the death rate, as a per-population measure, enables comparison of a given crisis with others in broad severity terms. Our estimation target is specifically 'excess' mortality, namely deaths that are attributable to the crisis itself, i.e. would not have occurred in a counterfactual scenario of no crisis.

The projections are broken down by sub-period, broad category of proximal causes of death (traumatic injuries, infections, maternal and neonatal deaths and stillbirths, and non-communicable diseases (NCDs), with malnutrition as an underlying cause) and age, and are designed to encompass three possible future scenarios (see Scenarios section on page 15), providing a multifaceted view of potential health outcomes in Gaza. Scenarios are specified deliberately to encompass a realistic range of alternative trajectories that the crisis may follow. As such, our estimates are *projections* of what may happen under these specific scenarios, rather than *predictions* of what will happen.

The project's first set of projections spans a *six-month period, from 7 February to 6 August 2024*. These initial findings are crucial in understanding the immediate health needs and threats faced by Palestinians. To ensure relevance and adaptability, the project plans to release updated projections until at least May 2024. This iterative approach allows for continuous refinement and responsiveness to the evolving situation on the ground, and increased availability of data. Furthermore, subsequent reports may delve into the mental health impacts of the crisis, acknowledging the often-overlooked psychological toll of conflict and displacement.

Methods

Overview of estimation methods

Our estimation framework is structured around *five cause-specific mortality 'modules'* (traumatic injuries, infectious diseases, maternal and neonatal deaths, and stillbirths, NCDs and malnutrition as an underlying cause), with a final layer of analysis to compute overall excess mortality. To our knowledge, no pre-existing set of methods for projecting excess mortality in crisis settings was available. Except for maternal and neonatal deaths and stillbirths (see below), we developed de novo probabilistic methods for each disease module. Methods and source data are described fully in a separate Methods technical document (see www.gaza-projections.org). All data and analysis code (in R, Python or Matlab) required to replicate the analyses are uploaded onto GitHub (https://github.com/Gaza-projections).

Briefly, we conducted an extensive search for data from the pre-war period in Gaza, as well as the war period 'to date' (defined as the period from 7 October 2023 until the date at which our projections start). We also sourced reports from similar past and ongoing crises and undertook structured expert elicitation to help quantify specific parameters used in the analysis. Methods implemented for each cause-specific module are summarised below.

We modelled the three scenarios based on varying levels of deterioration (*ceasefire, status quo, escalation*, described in the Scenarios section) for the five modules. As a last analysis step, we adjusted for competing risks of deaths due to different causes by working out, by age group, the probability of mortality due to at least one cause, and downscaled all results accordingly.

Traumatic injuries

We estimated traumatic injuries and traumatic deaths using multiple sources of data, including publicly available literature on the rate and types of injuries in comparable wars and traumatic injury and death data for the ongoing war. We projected the number of reported (i.e. detected and reported) deaths by considering the average traumatic injury level in the war period to date (status quo scenario between 15 October 2023–14 January 2024) or the month of highest intensity (escalation scenario). We used case-fatality ratios (CFRs) obtained through rapid literature review and interviews with a panel of emergency and surgical experts. These ratios were combined with data on the anatomical locations of injuries from Gaza residents medically evacuated to other countries. These combined data were used to break down the total number of reported deaths into those that immediately died and those who initially survived but subsequently died of their wounds. The latter represents preventable deaths if adequate trauma care were available.

Further, we estimated the proportion and number of unreported (e.g. those killed that may be under rubble and have not been reported) traumatic injury deaths by comparing the ratio of mortality among United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA) staff (for whom 100% detection was assumed) to that among the general population, including uncertainty ranges, to estimate a confidence interval. Lastly, for the ceasefire scenario, we modelled ongoing mortality due to traumatic injuries and estimated the number of deaths due to unexploded ordnance and munitions, based on observations during the 2014 war on Gaza.

Malnutrition

We firstly combined available data on trucks carrying food into Gaza with assumptions about existing stocks and agricultural output to estimate mean caloric intake over time, including the projection period. We then

used a previously published method to estimate adult weight loss based on intake estimates and pre-war data on adult anthropometry and food intake. We lastly applied modelled percent weight loss to pre-war anthropometric data from children aged six to 59 months to project prevalences of acute malnutrition. We also multiplied pre-war exclusive breastfeeding prevalence data by documented reductions in breastfeeding observed in crises from the region to project breastfeeding under the three scenarios.

Infectious diseases

For all infections included in Gaza's pre-war routine vaccination programme, we estimated baseline and projected susceptibility to infection and/or disease based on a dynamic model informed by vaccination coverage estimates, vaccine effectiveness values from the literature, and assumed pre-war natural exposure to infection.

For each of eleven epidemic-prone pathogens, we then simulated a large number of epidemics based on starting susceptibility, their probability of occurrence, transmissibility, and case-fatality under the different scenarios. Epidemic parameters were sourced from the literature, and structured expert elicitation (SEE) was used to quantify estimates of and uncertainty around epidemic probability, reproduction number, and CFR based on scenario values (below) including the prevalence of acute malnutrition.

Lastly, we divided endemic infectious deaths into eight diseases and, for each, projected mortality by multiplying pre-war levels by factors reflecting SEE-estimated increases in transmissibility and CFR. We also accounted for the seasonal pattern of some pathogens by distributing deaths over the year based on available data of their calendar month-specific occurrence.

Maternal and neonatal mortality and stillbirths

We applied the existing and widely-used Lives Saved Tool (LiST) [2–4]. This model's starting point is baseline levels of maternal and neonatal mortality and stillbirth rates and the respective cause-of-death structures. The model projects numbers of deaths expected to occur given changes in risk factors or in intervention coverage. It uses linear and fixed relationships between inputs and outputs. The relationship between an input (e.g. a change in intervention coverage) with one or more outputs is specified in terms of the efficacy of the intervention in reducing the probability of the outcome.

LiST models were built using a hierarchy of evidence on the effect of interventions on mortality. The ideal estimates of effect were taken from meta-analyses or systematic reviews of individually randomized placebo-controlled trials of the effect of interventions on cause-specific mortality. When such estimates were not available, estimates of efficacy were derived from natural experiments or expert elicitation (such as Delphi).

Maternal and neonatal deaths and stillbirths from traumatic injury were modelled separately (see above).

Non-communicable diseases

As for endemic infections, we took pre-war mortality due to specific NCDs as the model's starting input. We reviewed the literature, including pre-war NCD data from Gaza, to estimate survival since disease onset with and without appropriate treatment, which we fitted time-dependent survival functions to. Using a long burn-in period (since the year 2000), we modelled parallel cohorts of cases and their mortality as a function of time since disease onset. After varying treatment coverage based on values for the war period to date and assumed under each scenario, we computed resulting deaths, and compared these levels to deaths experienced by counterfactual cohorts exposed to pre-war treatment coverage – the difference being excess mortality. For

diabetes mellitus type 1 (DM1), we simplified this approach by modelling mortality among the pre-war prevalent pool of cases.

Scenarios considered in this report

General description

We present projections under three scenarios:

1. 'Ceasefire': A long-term or permanent cessation of military activity, with far increased humanitarian access and mobility;
2. 'Status quo': Continuation of conditions experienced in the war period to date (specifically, the period 15 October 2023 to 15 January 2024); and
3. 'Escalation': Further intensification of military operations and resulting risk factors.

Table 1 describes how the scenarios differ in terms of key characteristics.

Table 1: Description of the projection scenarios.

Characteristic	Scenario		
	ceasefire	status quo	escalation
Occurrence and duration of any pauses/ceasefires	A permanent ceasefire occurs but Gaza continues to be under blockade, with ongoing border restrictions on transit of people and goods.	Two or three 'humanitarian' pauses each of about 5-7 days during the six-month projection period.	None.
Intensity and typology of military activity	None.	Aerial bombing and ground offensive continues including in South Gaza. Gaza is under de facto military control during the humanitarian pauses.	Aerial bombardment and ground operations increase in intensity, shifting focus to the crowded areas in the South of Gaza while also resuming in the North.
Population displacement	The population starts to return home, but the majority remain in shelters due to destroyed dwellings.	Displacement persists as people continue to move south.	Continued large-scale displacement, now into more open areas as shelters are full.
Humanitarian space and operational adaptation	▪ There is a large influx of humanitarian assistance that increases over time as logistics improve. ▪ The international community supports an emergency response. ▪ Challenges persist, but adaptive humanitarian efforts address evolving needs. ▪ WASH conditions improve in shelters and open areas, and food provision increases.	▪ Moderate but limited increase in aid, and humanitarian action constrained by military restrictions. ▪ Water and fuel continue to be at insufficient levels. ▪ Some adaptation of humanitarian services in the South, e.g. by moving health services closer to internally displaced persons (IDPs).	▪ Insecurity for humanitarian and health workers worsens, resulting in fewer services and aid delivered in fewer locations. ▪ Water, food, and fuel available to the population remains very scarce.
Functionality and performance of health services	▪ Health services operate with improved and sufficient supplies, but specialised services remain inadequate due to loss of skilled health workers and equipment. ▪ Pathways of patient referral for treatment outside Gaza are gradually restored. ▪ Humanitarian actors adapt their operations by shifting activities closer to the population, and large vaccination campaigns occur.	▪ Functionality of health services remains at the current low levels, with limited supplies and quality of services remaining very constrained.	▪ More health facilities become partially or fully non-functional and many people are in areas where there were fewer health facilities to begin with. ▪ Most of the population has less access to care due to limited hospitals, clinics, and transportation to healthcare facilities.

For each scenario, we made specific assumptions about risk factors and health services relevant to the disease modules. Projections are based on the most recent and publicly available data, and adjustments to data sources will be made in forthcoming projections as data quality improves. These assumptions are listed in Table 2. Please see the Annex (

Detailed Scenarios) for further details.

Table 2. Assumptions about risk factors and health services, by scenario.

Parameter	Relevant for				Value by scenario			Notes
	Infections	MNH	NCDs	Injuries	ceasefire	status quo	escalation	
Epidemiological risk factors								
WASH								
Mean litres of water available per person per day (L/p/d)	X	X			20-40	6-10	3-6	8.8 L/p/d in shelters [5] against Sphere standard of survival 7.5 and minimum of 15 [6]. Access difficult and North has very poor access. No comprehensive water quality testing has been conducted, there are concerns over water quality in Gaza strip [7]. Recent reports, since scenarios were written, show access to potable drinking water is a concern, with estimates of 0-0.6 L/p/d in some shelters [8, 9].
Number of persons per toilet (p/toilet)	X	X			130-350	450-800	580-1000	486 people per toilet [10] while the standard during the first phases of a rapid-onset crisis is with a minimum ratio of 1 communal toilet per 50 people [6] Some toilets may not be functional. Reporting of open defecation [11].
Percentage of people with access to soap	X	X			50-70%	30-40%	10-30%	142,669 hygiene kits (including soap) have been distributed since October (~35% of target) [7]. No other standard indicators currently reported for handwashing with soap.
Nutrition								
Proportion of recommended daily intake met through food aid as compared to 2213 kcal/day	X	X	X	X	1.10-1.30	1.00-1.20	0.80-1.00	See nutrition methods technical document
Prevalence of moderate or severe acute malnutrition as per WHO definitions among children aged 6 to 59 months	X				8-10%	13-16%	20-45%	See nutrition methods technical document
Percentage of infants who are exclusively breastfed: aged below 1 month aged below 6 months	X	X			 30-40% 25-30%	 30-40% 25-30%	 20-25% 15-20%	See nutrition methods technical document
Shelter								
Percentage of people living in communal shelters or tented camps	X				50-60%	70-80%	90-95%	UNRWA schools and governmental shelters 1.9 million [12].
Size of communal shelters and tented camps	X				4500-5000 per shelter	7500-8000 per shelter	8500 - 10000 per shelter	
Percentage of people living in inadequately winterized/ heated shelters/houses	X				55-60%	90-95%	90-95%	
Health system disruptions								
Percentage of infants who received their third dose of routine vaccination	X				30%-60%	10-20%	5-10%	Based on access to hospitals/ PHC [13], supply and quality of services provided [14].
Percentage of the population with access to outpatient public curative health facilities that are functional (for antimicrobials or oral rehydration salts)	X	X			50-70%	20-40%	5-10%	

Parameter	Relevant for				Value by scenario			Notes
	Infections	MNH	NCDs	Injuries	ceasefire	status quo	escalation	
Percentage of the population with access to inpatient public departments that are functional and able to administer rehydration	X				20-70%	10-15%	5-10%	
Percentage of the population with access to inpatient public departments that are functional and able to administer antimicrobials	X		X		20-70%	10-15%	5-10%	
Percentage of the population with access to inpatient public departments that are functional and able to administer respiratory support including oxygen	X		X		20-70%	5-10%	1-5%	Based on access to hospitals [13], supply and quality of services provided. Very limited supply of oxygen [15].
Percentage of pregnant women who access antenatal care: 1+ visit 4+ visits		X			 50-70% 40-60%	 20-30% 15-25%	 10-20% 5-15%	Based on access to PHC [13], number of registered pregnant women in shelter, supply and quality of services provided [14].
Percentage of pregnant women with access to health facilities for childbirth		X			85-95%	75-85%	45-55%	Deliveries reported in shelter is minimal according to UNRWA staff/ Ministry of Health (MoH) reported pregnant women unable to access hospital for delivery [16]
Percentage of pregnant women with access to health facilities with skilled staff (for manual procedure) for childbirth		X			75-85%	45-55%	25-35%	These are linked to access to health facility for childbirth [13], and reduction in supply of services provided [14].
Percentage of pregnant women with access to health facilities with available commodities ($MgSO_4$, antibiotics, uterotonics) for childbirth		X			50-70%	15-25%	5-15%	
Percentage of the population with access to functional inpatient public departments that can administer emergency care for cardiovascular events			X		30-40%	5-10%	1-5%	
Percentage of patients with access to insulin			X		90-100%	70-80%	70-60%	Acute shortage of insulin [17].
Percentage of cancer patients able to access to treatment			X		20-50%	1-5%	1-5%	Treatment before the conflict was mainly outside Gaza [18], Cancer hospital is non-functional [19].
Percentage of patients able to access haemodialysis			X		50-60%	15-20%	5-10%	A total of 180 patients have access on 31 Jan 2024 based on MoH Emergency Report [16].

* For detailed MNH intervention change please check methods for specific percentages used.

Results

Summary projections

Table 3 presents projected numbers of excess, crisis-attributable deaths by cause, period, and scenario. Over the six months until early August, including epidemic infections, we estimate that with the ceasefire scenario there would be approximately 11,580 excess deaths, with the status quo scenario there would be approximately 66,720 excess deaths, and with the escalation scenario there would be approximately 85,750 excess deaths in total. When excluding epidemic infections, for which confidence intervals are very wide, we estimate 6,550, 58,260 and 74,290 excess deaths under the ceasefire, status quo and escalation scenarios, respectively. The largest numbers of projected excess deaths are due to traumatic injuries, followed by infectious diseases. These estimates include civilians and combatants. Additional details for each module are provided below, including details of specific causes of mortality.

Notable patterns are worth explaining. For some causes of death (injuries, maternal and neonatal deaths and stillbirths) mortality is nearly static across the two sub-periods, reflecting model limitations and/or our inability to confidently specify scenario assumptions more granularly than for the entire six-month period. An exception is injury-related deaths in the ceasefire scenario, for which we project a relatively larger number initially than later in the period, reflecting residual mortality due to prior wounds. For endemic infections, seasonality results in lower mortality during the summer months, while some lower uncertainty bounds are negative, meaning the model projects lower mortality than pre-war data, albeit at the extreme of the uncertainty distribution.

Table 3. Projected numbers of excess, crisis-attributable deaths by cause, period and scenario. Values are the mean estimate and the 95% uncertainty interval.

Cause	Months 1 to 3 (7 Feb to 6 May 2024)			Months 4 to 6 (7 May to 6 Aug 2024)			Total projection period (7 Feb to 6 Aug 2024)		
	ceasefire	status quo	escalation	ceasefire	status quo	escalation	ceasefire	status quo	escalation
Traumatic injuries	**2,030** (1,820 to 2,270)	**26,740** (23,060 to 30,930)	**34,300** (30,000 to 39,390)	**1,220** (1,080 to 1,380)	**26,710** (23,030 to 30,900)	**34,260** (29,950 to 39,340)	**3,250** (2,900 to 3,640)	**53,450** (46,090 to 61,830)	**68,560** (59,950 to 78,730)
Infectious diseases - *endemic*	**1,030** (-50 to 3,870)	**1,430** (-20 to 5,140)	**1,750** (0 to 6,420)	**490** (-20 to 1,880)	**690** (-10 to 2,380)	**980** (10 to 3,550)	**1,520** (-70 to 5,750)	**2,120** (-30 to 7,520)	**2,720** (10 to 9,970)
Infectious diseases - *epidemic*	**1,520** (0 to 16,610)	**2,410** (0 to 30,540)	**3,400** (0 to 52,230)	**3,500** (0 to 52,020)	**6,050** (0 to 89,820)	**8,060** (0 to 114,800)	**5,030** (0 to 68,630)	**8,470** (0 to 120,350)	**11,460** (0 to 167,030)
Maternal and neonatal health	**50** (40 to 100)	**100** (80 to 210)	**160** (130 to 330)	**50** (40 to 100)	**100** (80 to 210)	**160** (130 to 330)	**100** (80 to 200)	**210** (170 to 420)	**330** (260 to 670)
Non-communicable diseases	**910** (720 to 1,160)	**1,260** (1,010 to 1,550)	**1,370** (1,090 to 1,670)	**770** (580 to 1,000)	**1,220** (970 to 1,510)	**1,310** (1,040 to 1,620)	**1,680** (1,300 to 2,160)	**2,480** (1,980 to 3,060)	**2,680** (2,130 to 3,290)
Total excluding epidemics	**4,030** (2,530 to 7,390)	**29,530** (24,130 to 37,840)	**37,580** (31,220 to 47,820)	**2,520** (1,670 to 4,350)	**28,730** (24,080 to 34,990)	**36,700** (31,140 to 44,840)	**6,550** (4,200 to 11,740)	**58,260** (48,210 to 72,830)	**74,290** (62,350 to 92,650)
Total including epidemics	**5,550** (2,530 to 24,000)	**31,940** (24,130 to 68,370)	**40,980** (31,220 to 100,040)	**6,020** (1,670 to 56,370)	**34,780** (24,080 to 124,810)	**44,770** (31,140 to 159,640)	**11,580** (4,200 to 80,370)	**66,720** (48,210 to 193,180)	**85,750** (62,350 to 259,680)

Death rates

Figure 1A shows the projected death rate per 1000 person-years, by age group and scenario, compared to the baseline (2022). As shown, we project elevations in mortality across all ages, with the largest relative increases among children, and far higher excess risk in the escalation and status quo scenarios.

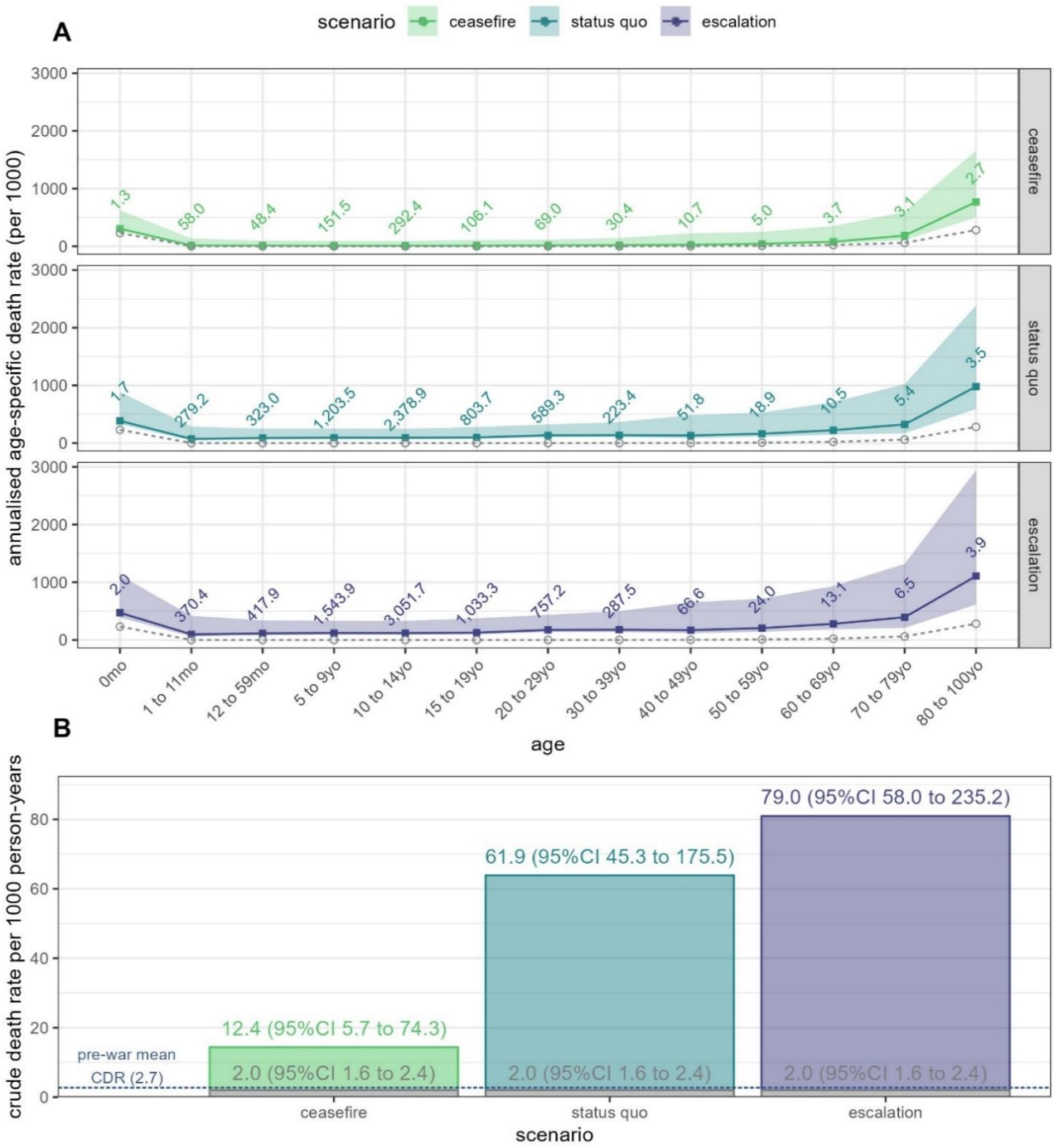

Figure 1. Panel A: Projected death rate per 1,000 person-years, by age group and scenario (coloured lines and shaded areas indicate means and 95th uncertainty intervals, respectively), compared to the baseline (2022; dotted grey line). Figures inside each graph indicate the relative mortality ratio in each age group. Panel B: Baseline (counterfactual) and projected crude death rate per 1000 person-years, by scenario, over the entire projection period. Text labels indicate means and 95% uncertainty intervals. The blue dotted line indicates the pre-war crude death rate (mean of 2016-2019 and 2022 MoH vital registration data).

Figure 1B shows the overall projected crude death rates (CDRs) per 1,000 person-years, i.e. among all age groups and for all causes of death. The corresponding CDRs expressed using the metric most familiar to humanitarian actors are 0.34 (95%CI 0.16 to 2.03), 1.70 (95%CI 1.24 to 4.81) and 2.16 (95%CI 1.59 to 6.44) deaths per 10,000 person-days under the ceasefire, status quo and escalation scenarios, respectively, against a counterfactual baseline of 0.05.

Notably, our projected counterfactual baseline of 2.0 is about 26% lower than the pre-war mean of 2.7, suggesting that we may have failed to account for about one-fourth of mortality under no-crisis conditions. Explanations for this under-estimate likely include the omission of high-burden diseases (e.g. DM2, some cardiovascular diseases, hypertensive disorders), rarer but numerous conditions (e.g. congenital disorders, cerebral palsy), accidental injuries, dementia and suicide. Furthermore, our projection period falls largely outside the winter months when mortality would be higher due to the seasonal peak of influenza and other airborne-droplet transmitted infections.

Age distribution of mortality

Figure 2 shows the projected age distribution of excess deaths under the three scenarios. We estimate that, under any scenario, a large proportion of mortality will occur among children (about 40% in the status quo and escalation scenarios each).

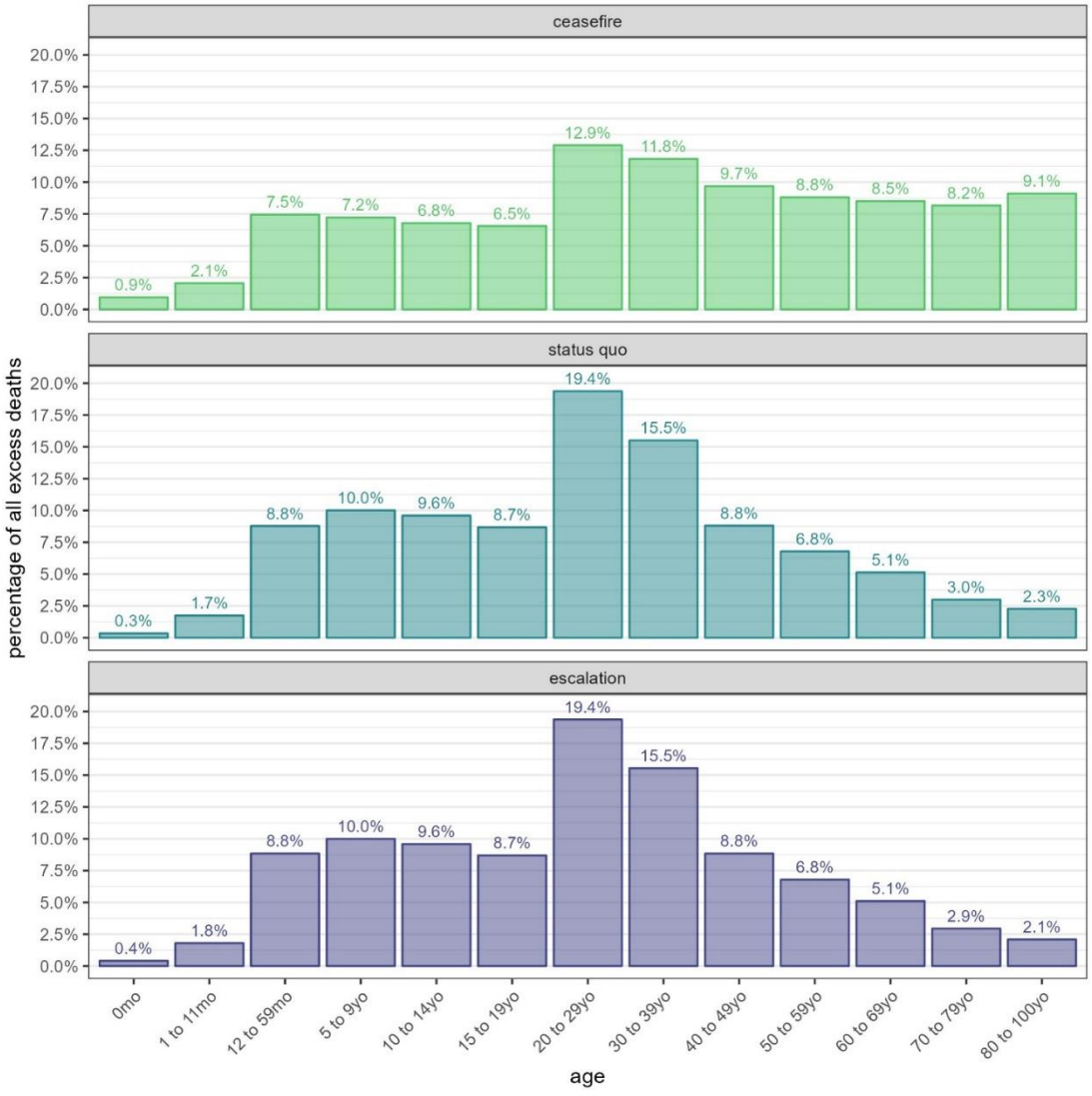

Figure 2. Age distribution of projected excess deaths over the entire projection period, by scenario.

Traumatic injuries

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A substantial number of traumatic injuries and deaths resulting from them (all included among excess mortality) is expected in the status quo and escalation scenarios, with 152,409 to 170,329 injuries expected, respectively, in the six-month projection period, compared to 451 injuries in the ceasefire scenario (Table 4).

Figure 4 summarises the breakdown of mortality due to traumatic injuries in each of the three scenarios. Traumatic injury deaths are significantly mitigated in the ceasefire scenario, but a total of 3,249 deaths are nonetheless expected to occur due to complications from wounds occurring in the previous period and unexploded ordnances and landmines. We project a total of 53,439 and 68,545 traumatic injury deaths in the status quo and escalation scenarios, respectively (Table 4), with a traumatic injury to death ratio of nearly 3:1, similar to that noted in past reviews of urban warfare [20]. In both scenarios, those who immediately die of their traumatic injury constitute most of the deaths, with between 31% (status quo scenario) and 40% (escalation scenario) dying at some point later, providing a scale for potentially avertable traumatic injury mortality if trauma surgery and allied services were optimally functional. We estimate that, out of all traumatic injuries, some 22-27% resulted in immediate death during the war period to date. Based on the estimated percentage of all traumatic injury deaths that have been reported by the MoH to date (see Methods Technical Document), we project that about 15% of all such deaths (8,134 in the status quo scenario, 10,335 in the escalation scenario) will go unreported.

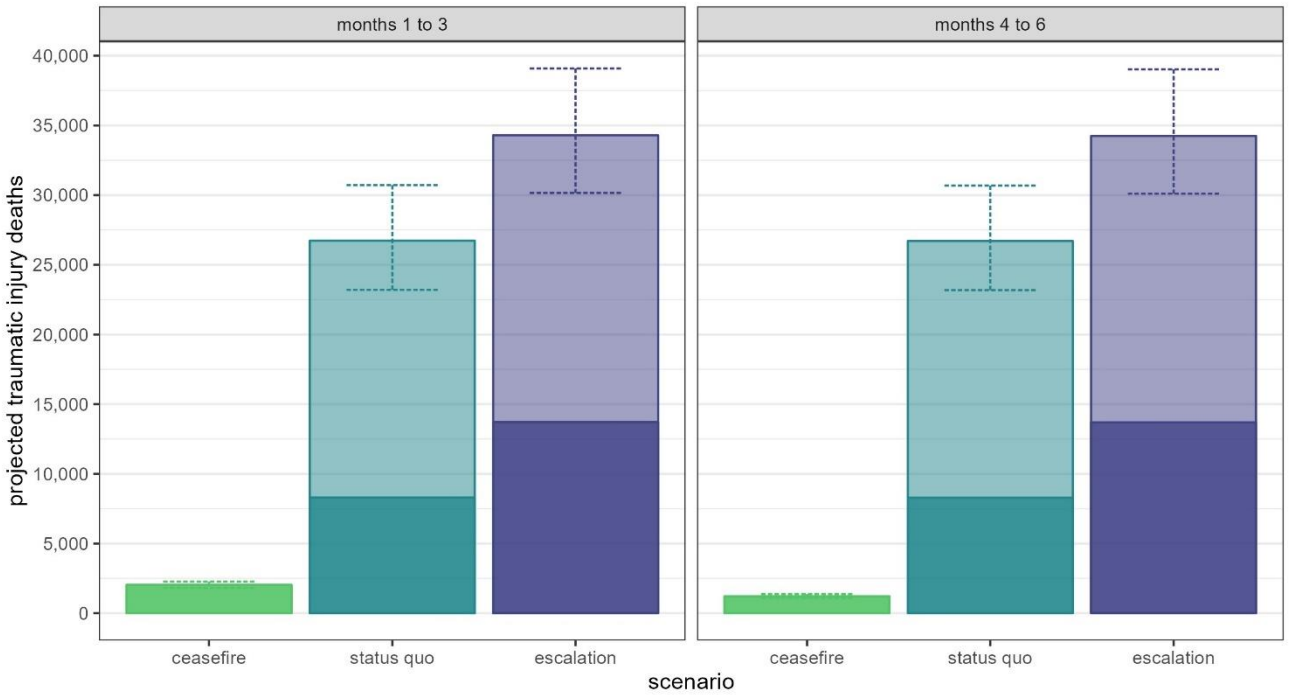

Figure 3. Projected numbers of traumatic injury deaths, by scenario. The error bars indicate 95% uncertainty intervals. The darker (lower) portion of each bar indicates deaths due to wounds among people who initially survived their injury. The lighter (upper) portion of the bars in the status quo and escalation scenarios indicate immediate deaths due to traumatic injury (nearly all deaths in the ceasefire scenario are due to wounds).

Table 4. Projected numbers of traumatic injuries and deaths by period, scenario and category of injury death.

Disease		Period	Scenario		
			ceasefire	status quo	escalation
Total traumatic injuries		months 1 to 3	225 (183 to 317)	76,205 (64,616 to 90,025)	85,165 (75,044 to 96,642)
		months 4 to 6	225 (183 to 317)	76,205 (64,616 to 90,025)	85,165 (75,044 to 96,642)
		total	**451 (366 to 634)**	**152,409 (129,231 to 180,051)**	**170,329 (150,087 to 193,283)**
Total traumatic injury deaths		months 1 to 3	2,032 (1,823 to 2,266)	26,733 (23,210 to 30,720)	34,296 (30,155 to 39,085)
		months 4 to 6	1,216 (1,078 to 1,376)	26,705 (23,185 to 30,689)	34,249 (30,112 to 39,031)
		total	**3,249 (2,901 to 3,642)**	**53,439 (46,395 to 61,408)**	**68,545 (60,267 to 78,117)**
	due to wounds†	months 1 to 3	2,020 (1,811 to 2,252)	8,305 (3,128 to 13,189)	13,716 (8,318 to 19,459)
		months 4 to 6	1,204 (1,066 to 1,364)	8,295 (3,122 to 13,176)	13,696 (8,306 to 19,431)
		total	3,223 (2,878 to 3,617)	16,599 (6,250 to 26,364)	27,413 (16,624 to 38,889)
	due to unexploded ordnance‡	months 1 to 3	52 (42 to 74)	subsumed within total injury death estimate	subsumed within total injury death estimate
		months 4 to 6	52 (42 to 74)		
		total	104 (85 to 147)		

† i.e. among people who initially survived their injury.

We relied on MoH lists of deceased persons to construct the projected age and sex distribution of injury deaths; as such, this feature of our projections has minimal variability across scenarios. **Error! Reference source not found.** overlays the age-sex distribution of injury deaths with that of the general population, showing that the risk of traumatic injury mortality is broadly similar across age and sex, with women, children and the elderly at very high risk. Overall, across the three scenarios, slightly more males are projected to die from traumatic injuries compared to females (57% and 43%, respectively). However, for the age groups 0-19 years and those older than 50 years of age, the percentage of males and females dying from injuries is less dissimilar. Children comprise a substantial proportion of traumatic injury deaths, with 34% of deaths occurring among those 0-15 years old, and 42% occurring among those ≤ 19 years. More detailed age-sex breakdowns are provided in the Annex.

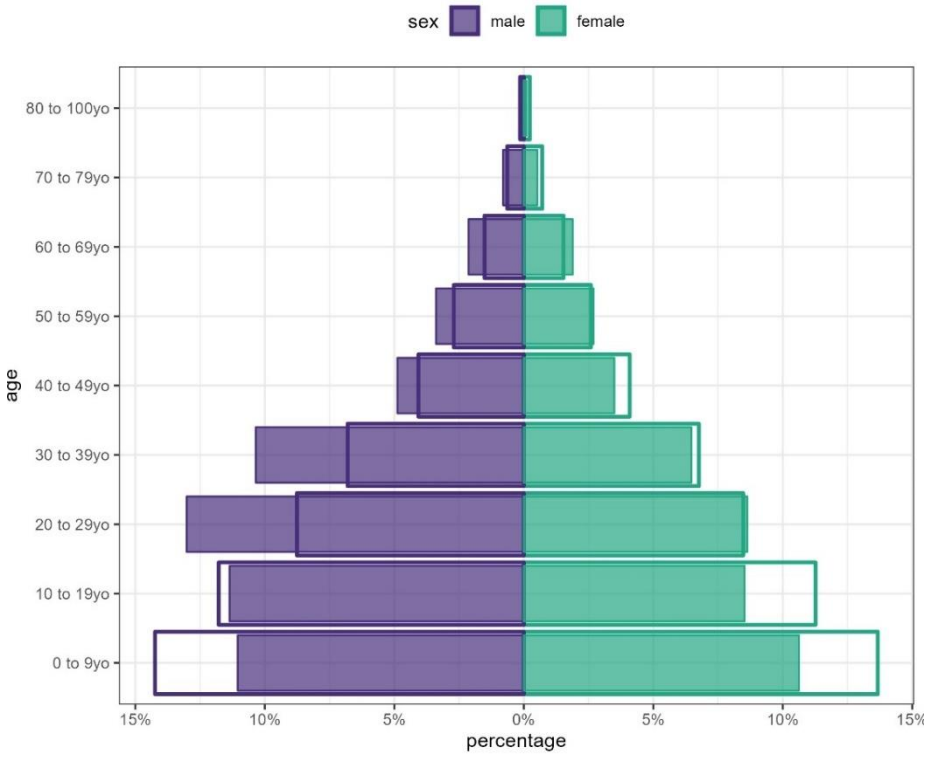

Figure 4. Comparison of the age-sex distribution of the general population (empty bars with thick borders) and projected traumatic injury deaths during the entire six-month period (filled bars). Only the 'status quo' scenario is shown.

Lastly, we projected traumatic deaths among pregnant and postpartum women (pregnancy-related deaths) and among neonates, as well as stillbirths due to injury-interrupted pregnancies; these results are described under the MNH module.

Malnutrition

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Caloric intake

Before the war, vulnerable households in Gaza relied heavily on humanitarian food aid, constituting 48% of their caloric intake [21]. From 7 October 2023 to date, approximately 5,300 food trucks reached Gaza compared to the 17,400-20,880 that would have entered during a comparable pre-war period [22, 23]. Concurrently, reported food insecurity rose to more than 90% by one estimate, with evidence of children and mothers limiting intake to two food groups daily [24], and at least a quarter of households potentially facing catastrophic conditions of starvation [22]. Our estimates of food quantities available in Gaza, corresponding caloric intake, and resulting weight loss among adults are shown in the Annex (Malnutrition).

Acute malnutrition

Figure 5 illustrates the projected shift in the prevalence of global and severe acute malnutrition (GAM, SAM) among children aged six to 59 months, the highest-risk group for the onset of, and complications due to acute malnutrition, under three caloric intake scenarios linked to ceasefire, status quo, and escalation. We estimate that, as of the start of the projection period (end of 'to date' period), GAM prevalence stood at about 14%. By comparison, a recent report by the Humanitarian Nutrition Cluster based on primary data (from children accessing health facilities) suggests a prevalence of GAM of 9.6% among internally displaced children with indication of levels reaching 16.2% in the North [25]. Our projections for the ceasefire scenario suggest that GAM prevalence could increase from 3% pre-conflict (based on growth monitoring data) to 13% by month two of the projection period, and stabilise at a similar level (12%) by month 5 (Figure 5). GAM prevalence could rise to 25% and 46% by month five under the status quo and escalation scenarios, respectively, while SAM prevalence could rise to 3%, 6% and 22% under the three respective scenarios. However, these estimates feature wide uncertainty intervals and a left-skewed distribution, with average projections perhaps best captured by the median values (see Annex: Malnutrition, Table S14).

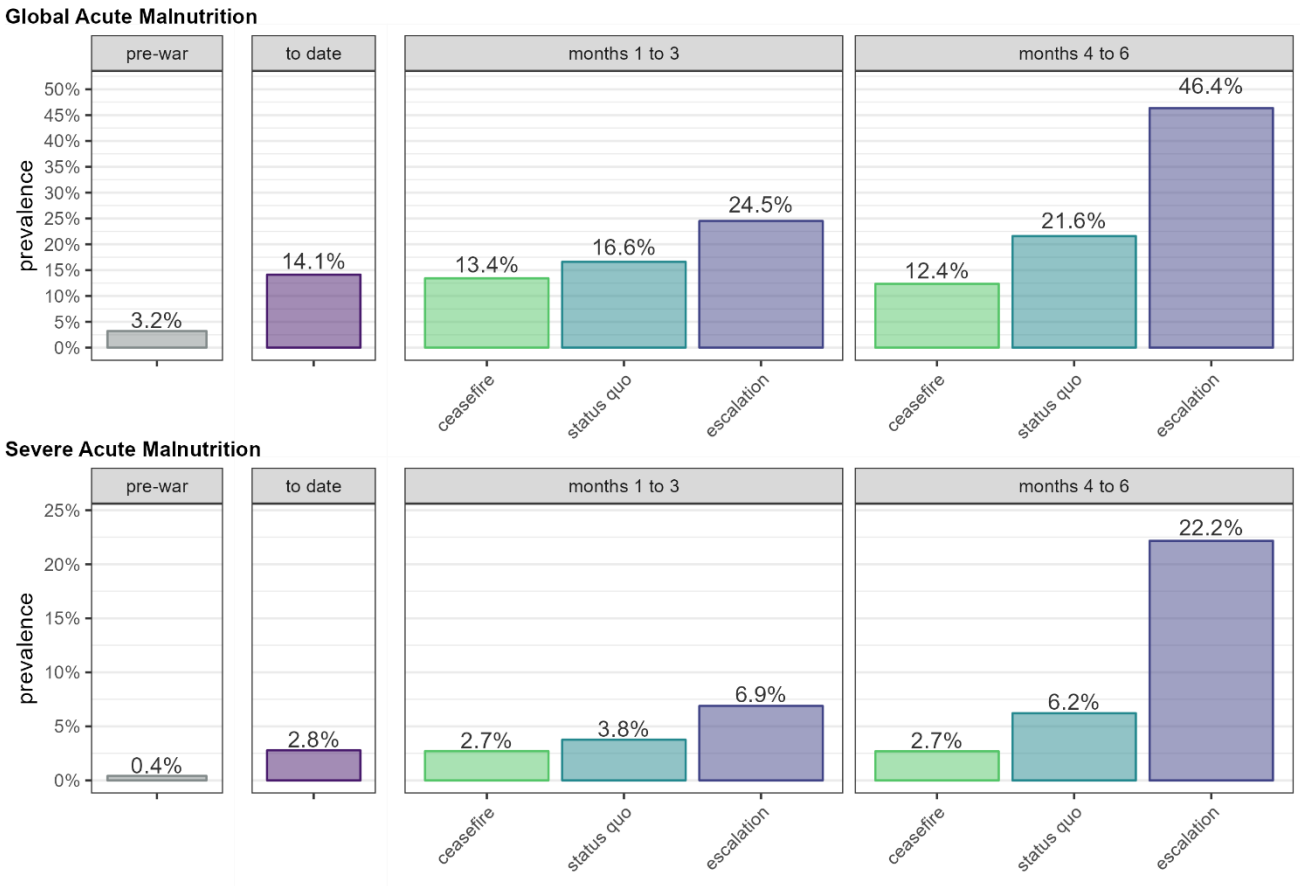

Figure 5. Projected change in the prevalence of global and severe acute malnutrition, by time-period and scenario. Prevalences refer to the mid-point of each period.

Several uncertainties affect our projections: there are limited data on the amount of food (in metric tons) and the caloric composition carried by each food truck. This affects the accuracy of our estimate of caloric availability. Additionally, there are uncertainties around delivery of aid to regions where access is restricted, as mentioned by UNRWA and other humanitarian actors [26], and on the extent to which relative weight loss among adults can be applied to children, among whom malnutrition is understood to be a multi-factorial outcome dependent on factors other than nutrient intake, such as inadequate WASH and high exposure to infections. The Methods Technical Document discusses these potential limitations.

Infant and young child feeding practices

Neonates also face deteriorating nutritional status if mothers are unable to breastfeed due to stress, poor mental health and/or inadequate breastfeeding privacy. Further, the high pre-war prevalence of formula use among Gazans (58% among under six-month-old infants) [27] raises concerns with regards to potential supply disruptions. Under poor WASH conditions, keeping formula water, teats, and bottles sterile is very challenging. These disruptions can result in increased incidence of diarrhoea and other infectious diseases, both of which further exacerbate malnutrition. Crises' impact on exclusive breastfeeding is evident from studies in the region (Methods Technical Document). We project that the prevalence of exclusive breastfeeding could average between 25% to 35% under the ceasefire scenario (lower than the pre-war baseline of 42% [27], reflecting ongoing disruptions including overcrowding and worsened mental health), falling to 20% to 30% under the status quo scenario and 5% to 15% under the escalation scenario. These disruptions have enduring consequences on infant and child health.

Infectious diseases

Section authors: Francesco Checchi, Gregory Barnsley, Zeina Jamaluddine, Hanan Abukmail, Fiona Majorin

Endemic diseases

Based on patterns in previous years and adjusting for the ongoing, added post-pandemic burden of COVID-19 (see Annex Infectious diseases), we project a counterfactual, no-crisis estimate of 191 (95%CI 156 to 237) deaths due to endemic diseases over the entire projection period. Against this baseline, Table 5 shows projected excess mortality, by endemic infectious disease, period, and scenario. Overall, we project between 1,522 and 2,721 excess deaths depending on the scenario, though with wide uncertainty intervals. Negative uncertainty intervals mean that, at the lowest extreme of uncertainty, mortality could be lower than in the absence of a crisis: however, these values are very improbable, and mainly reflect uncertainty propagated through our analysis (see Methods Technical Document).

COVID-19, influenza and pneumococcal disease are expected to be the leading causes of death, reflecting the pre-war observation of the vast majority of infectious disease deaths being attributable to pathogens transmitted mainly through the airborne-droplet route (Methods Technical Document). Note that for several diseases excess deaths are expected to be lower during months four to six of the projection, than during months one to three. This is because we accounted for seasonality in the analysis (months four to six fall within the summer months, when the lowest mortality due to airborne-droplet pathogens is expected).

Table 5. Projected excess deaths due to endemic infections, by disease, scenario and period.

Disease	Period	Scenario		
		ceasefire	status quo	escalation
bacterial gastroenteritis	months 1 to 3	20 (2 to 61)	33 (3 to 84)	36 (3 to 86)
	months 4 to 6	18 (2 to 59)	31 (3 to 81)	39 (3 to 92)
	total	38 (4 to 120)	64 (5 to 165)	75 (7 to 179)
COVID-19	months 1 to 3	405 (-24 to 1,531)	553 (-13 to 2,031)	680 (-5 to 2,549)
	months 4 to 6	177 (-10 to 688)	244 (-5 to 863)	349 (2 to 1,318)
	total	582 (-34 to 2,219)	797 (-17 to 2,894)	1,029 (-3 to 3,866)
haemophilus influenzae type b disease	months 1 to 3	0 (0 to 0)	0 (0 to 0)	0 (0 to 0)
	months 4 to 6	0 (0 to 0)	0 (0 to 0)	0 (0 to 0)
	total	0 (0 to 0)	0 (0 to 0)	0 (0 to 0)
influenza, para-influenza	months 1 to 3	236 (-14 to 891)	323 (-7 to 1,186)	398 (-3 to 1,491)
	months 4 to 6	17 (-1 to 65)	23 (0 to 82)	33 (0 to 125)
	total	252 (-15 to 956)	346 (-8 to 1,268)	431 (-3 to 1,616)
viral gastroenteritis (other than rotavirus)	months 1 to 3	20 (2 to 61)	33 (3 to 84)	36 (3 to 86)
	months 4 to 6	18 (2 to 59)	31 (3 to 81)	39 (3 to 92)
	total	38 (4 to 120)	64 (5 to 165)	75 (7 to 179)
pneumococcal disease	months 1 to 3	243 (-14 to 920)	333 (-8 to 1,222)	410 (-3 to 1,535)
	months 4 to 6	242 (-14 to 944)	335 (-6 to 1,186)	479 (2 to 1,812)
	total	486 (-28 to 1,864)	668 (-14 to 2,408)	889 (0 to 3,347)
rotavirus	months 1 to 3	10 (1 to 31)	16 (1 to 42)	18 (2 to 43)
	months 4 to 6	9 (1 to 29)	16 (1 to 41)	19 (2 to 46)
	total	19 (2 to 60)	32 (3 to 82)	37 (3 to 89)
RSV	months 1 to 3	99 (-6 to 373)	135 (-3 to 497)	167 (-1 to 625)
	months 4 to 6	9 (-1 to 34)	12 (0 to 43)	18 (0 to 66)
	total	107 (-6 to 407)	148 (-3 to 540)	185 (-1 to 692)
total	months 1 to 3	1,033 (-52 to 3,867)	1,426 (-24 to 5,145)	1,745 (-4 to 6,416)
	months 4 to 6	490 (-22 to 1,879)	693 (-5 to 2,377)	975 (13 to 3,551)
	total	**1,522 (-74 to 5,746)**	**2,118 (-29 to 7,522)**	**2,721 (9 to 9,967)**

Across the six-month projection period, in the ceasefire scenario, 913 (95%CI -50 to 3,474) excess endemic infectious disease deaths are projected to occur among persons aged ≥ 60 years old (60.0%), and 197 (95%CI -2 to 714) among children aged ≤ 59 months old (12.9%). The corresponding figures for the status quo and escalation scenarios are 1256 (95%CI -23 to 4520) and 1,627 (95%CI 0 to 6061) for persons aged ≥ 60 years old (59.3% and 59.8%), and 289 (95%CI 4 to 950) and 361 (95%CI 9 to 1203) among children aged ≤ 59 months old (13.6% and 13.3%). More detail is provided in Table S11.

Epidemic-prone diseases

Table 6 shows projected deaths due to different epidemic-prone pathogens under different scenario assumptions. Due to the absence of large-scale epidemics in Gaza over the decade prior to the war, we consider all such deaths to form part of the predicted excess mortality. Our projections suggest that cholera, measles, polio (both wild-type and vaccine-derived) and meningococcal meningitis pose the greatest mortality threat, with substantial mortality potentially occurring under the three scenarios, owing to ongoing disruptions including overcrowding, inadequate WASH, and an ongoing nutritional emergency. Measles is expected to cause moderate-size epidemics at most due to the very high vaccination coverage pre-war, which is projected to afford considerable (but falling) herd immunity protection (see Annex, Figure 12).

Under the ceasefire scenario, 571 (95%CI 0 to 6846) deaths due to epidemic disease, or 11.3%, are projected to occur among children aged below 59 months, while 1023 (95%CI 0 to 12,283) and 1451 (95%CI 0 to 16,187) are projected to occur in the status quo and escalation scenarios, respectively, yielding similar percentages (12.0%, 12.3%, respectively). A more complete age breakdown is provided in the Annex (Table S16).

Table 6. Projected mortality due to epidemic-prone infections, by disease, period and scenario. Values are the mean estimate and the 95% uncertainty interval.

Disease	Period	Scenario		
		ceasefire	status quo	escalation
bacterial dysentery (*S. dysenteriae* type 1)	months 1 to 3	0 (0 to 0)	0 (0 to 1)	0 (0 to 1)
	months 4 to 6	0 (0 to 3)	0 (0 to 5)	0 (0 to 6)
	total	0 (0 to 3)	0 (0 to 6)	0 (0 to 7)
cholera	months 1 to 3	1,177 (0 to 15,237)	1,878 (0 to 27,402)	2,546 (0 to 41,173)
	months 4 to 6	2,418 (0 to 35,313)	4,421 (0 to 64,269)	5,525 (0 to 78,488)
	total	3,595 (0 to 50,550)	6,299 (0 to 91,671)	8,071 (0 to 119,661)
diphtheria	months 1 to 3	0 (0 to 1)	0 (0 to 1)	0 (0 to 2)
	months 4 to 6	0 (0 to 2)	0 (0 to 4)	1 (0 to 9)
	total	0 (0 to 3)	0 (0 to 5)	1 (0 to 11)
hepatitis A	months 1 to 3	0 (0 to 0)	0 (0 to 0)	0 (0 to 0)
	months 4 to 6	0 (0 to 0)	0 (0 to 0)	0 (0 to 0)
	total	0 (0 to 0)	0 (0 to 0)	0 (0 to 0)
hepatitis E	months 1 to 3	0 (0 to 2)	0 (0 to 3)	0 (0 to 3)
	months 4 to 6	2 (0 to 25)	2 (0 to 35)	3 (0 to 45)
	total	2 (0 to 27)	2 (0 to 38)	3 (0 to 48)
measles	months 1 to 3	34 (0 to 114)	75 (0 to 553)	137 (0 to 2,075)
	months 4 to 6	226 (0 to 3,097)	379 (0 to 4,639)	656 (0 to 7,587)
	total	260 (0 to 3,211)	454 (0 to 5,192)	793 (0 to 9,662)
meningococcal meningitis	months 1 to 3	2 (0 to 8)	4 (0 to 12)	11 (0 to 40)
	months 4 to 6	22 (0 to 257)	44 (0 to 558)	132 (0 to 1,722)
	total	24 (0 to 265)	48 (0 to 570)	143 (0 to 1,762)

Disease	Period	Scenario		
		ceasefire	status quo	escalation
pertussis	months 1 to 3	0 (0 to 0)	0 (0 to 0)	0 (0 to 0)
	months 4 to 6	0 (0 to 0)	0 (0 to 0)	0 (0 to 1)
	total	0 (0 to 0)	0 (0 to 0)	0 (0 to 1)
polio - vaccine-derived	months 1 to 3	178 (0 to 998)	266 (0 to 1,897)	418 (0 to 6,367)
	months 4 to 6	461 (0 to 7,009)	668 (0 to 10,541)	976 (0 to 14,542)
	total	639 (0 to 8,007)	934 (0 to 12,438)	1,394 (0 to 20,909)
polio - wildtype	months 1 to 3	132 (0 to 115)	189 (0 to 617)	286 (0 to 2,458)
	months 4 to 6	374 (0 to 6,072)	535 (0 to 9,433)	764 (0 to 12,448)
	total	506 (0 to 6,187)	724 (0 to 10,050)	1,050 (0 to 14,906)
typhoid fever	months 1 to 3	0 (0 to 1)	0 (0 to 1)	0 (0 to 1)
	months 4 to 6	0 (0 to 3)	0 (0 to 4)	0 (0 to 5)
	total	0 (0 to 4)	0 (0 to 5)	0 (0 to 6)
total	months 1 to 3	1,523 (0 to 19,155)	2,412 (0 to 29,933)	3,399 (0 to 43,365)
	months 4 to 6	3,503 (0 to 39,586)	6,051 (0 to 70,390)	8,058 (0 to 85,552)
	total	5,026 (0 to 58,741)	8,463 (0 to 100,323)	11,457 (0 to 128,917)

Generally, our epidemic projections carry considerable uncertainty inherent in our modelling approach (see Methods Technical Document): the distributions of model run outputs are heavily skewed towards 0 deaths (the most common result given that $p_u < 0.50$ for all diseases) and feature a long tail. We therefore also present the probability of epidemics due to different pathogens, or all pathogens combined, reaching thresholds of 100, 1,000 or 10,000 deaths, over the projection period (Figure 6). Overall, we estimate that the probability of epidemics causing 1,000 or more deaths over the entire period rises from 23% to 27% and 34% under the ceasefire, status quo, and escalation scenarios, respectively.

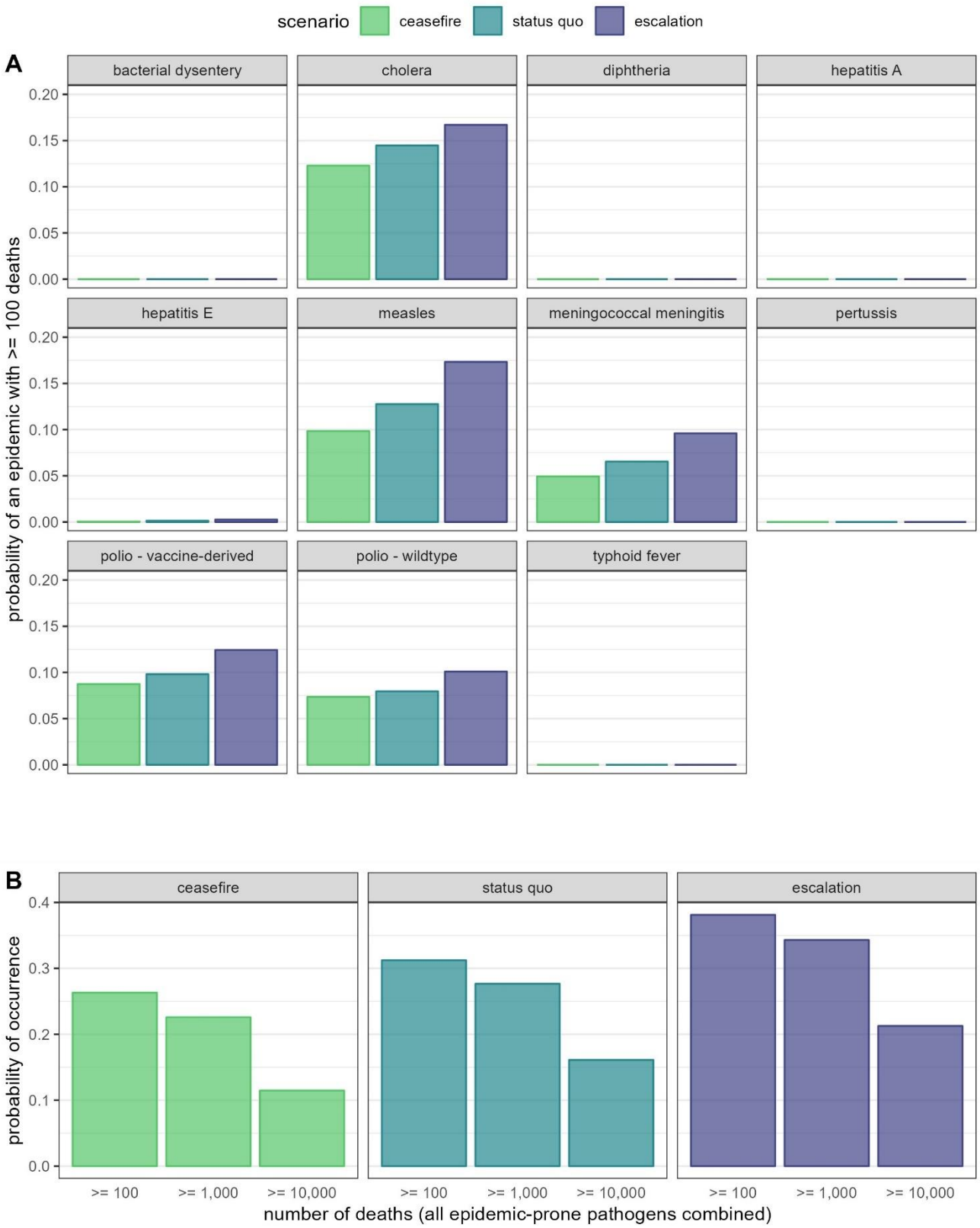

Figure 6. Panel A: Estimated probability of occurrence of an epidemic featuring ≥ 100 deaths, by disease and scenario, over the six-month projection period. Panel B: Estimated probability of exceeding specific death toll thresholds due to all epidemic-prone pathogens combined, by scenario, over the six-month projection period.

Maternal and neonatal health

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Figure 7 shows projected numbers of maternal, neonatal, and stillbirth deaths for each scenario (ceasefire, status quo and escalation) during the six-month projection period, divided into deaths that would have been expected under counterfactual pre-crisis conditions, and additional (excess) deaths due to decreases in intervention coverage and degradation of the environment and food security. This figure does not include deaths due to traumatic injury.

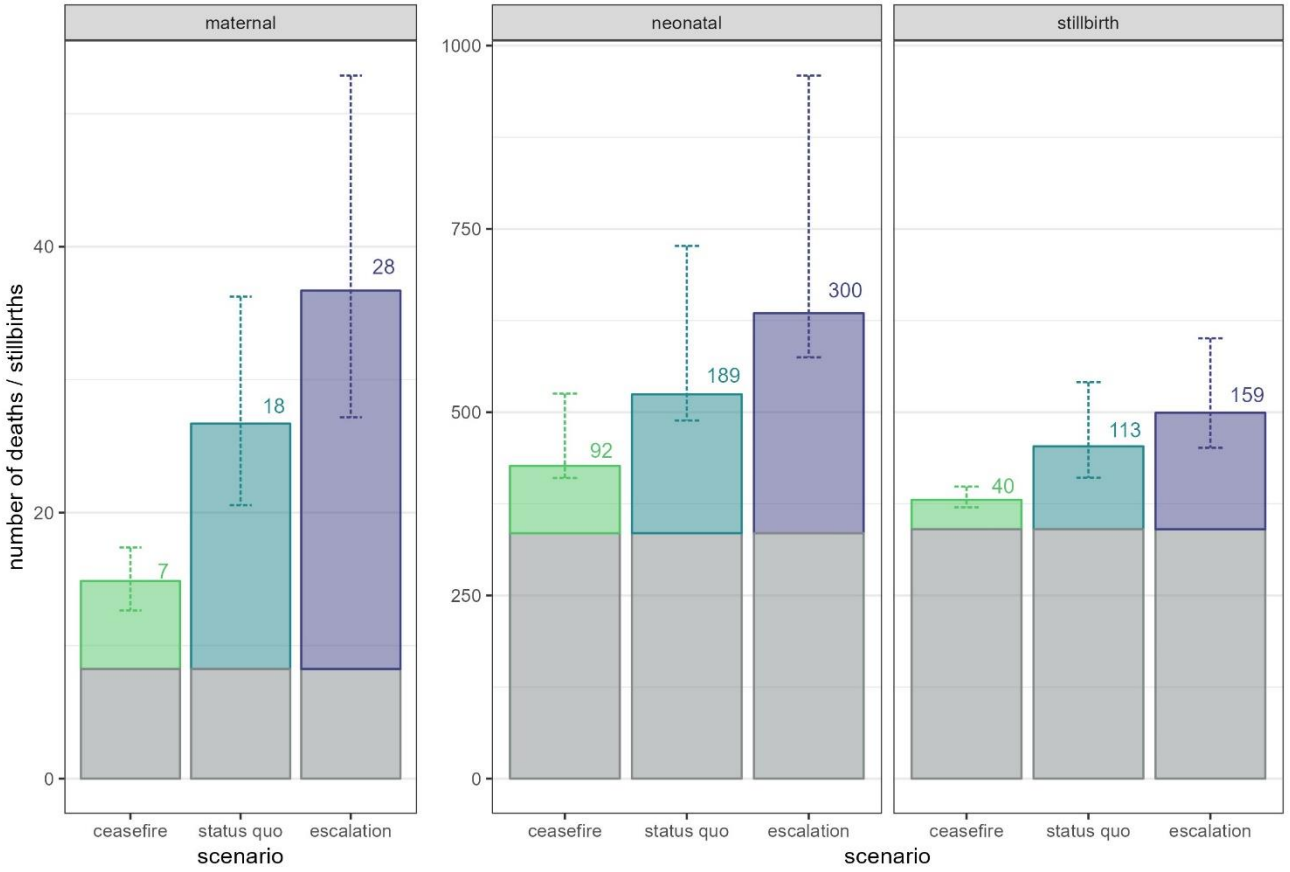

Figure 7: Projected counterfactual baseline (grey colour) and excess (scenario-specific colours) maternal, neonatal, and stillbirth deaths during the entire projection period, excluding traumatic injury deaths.

Pre-war levels of maternal and neonatal mortality in the occupied Palestinian territories (oPt) were relatively low, with an average maternal mortality ratio of 23 deaths per 100,000 live births during 2018-2022, excluding 2021 when the COVID-19 pandemic may have resulted in an abnormally high level [28] (Table 7). The neonatal mortality rate was 9.3 deaths per 1,000 live births, and the stillbirth rate (at 28+ weeks gestation) was 9.4 stillbirths per 1,000 births [29]. Had these rates continued, the corresponding numbers of deaths in six months, would have been eight maternal, 335 neonatal, and 340 stillbirths respectively.

Table 7 also shows historical values of these indicators below our projections, providing a benchmark of how far back in time one must go to find values comparable to those projected for each scenario. Similarly, Figure 8 shows cumulative numbers of deaths or stillbirths that would have occurred had pre-war trends been maintained, deaths that are estimated to have occurred during the war period to date, and projections under the three scenarios.

Table 7. Maternal mortality ratio (MMR), Pregnancy- related death ratio, neonatal mortality rate (NMR) and stillbirth rate (SBR): pre-war estimates and projections by scenario over the entire projection period, excluding and including traumatic injury deaths.

	Indicator	Pre-war oPt MMEIG & IGME [29, 30]	Scenario		
			ceasefire	status quo	escalation
Maternal	Total deaths excluding traumatic injuries	8 (6 to11)	15 (13 to 17)	27 (20 to 34)	37 (27 to 50)
	Total deaths including traumatic injuries		96 (85 to 107)	1,388 (1,209 to 1,588)	1,779 (1,565 to 2,029)
	Excess deaths excluding traumatic injuries		7 (4 to 9)	18 (12 to 28)	28 (19 to 45)
	Excess traumatic injuries deaths		81 (72 to 90)	1,361 (1,189 to 1,554)	1,742 (1,538 to 1,979)
	Excess deaths including traumatic injuries		88 (76 to 99)	1,379 (1,201 to 1,582)	1,770 (1,557 to 2,024)
	MMR per 100,000 live births	23 (16 to 30)	42 (36 to 47)	75 (56 to 94)	103 (75 to 139)
	MMR (reference year) [29, 30]		*43 (2010)*	*72 (2000)*	*96 (1995)*
	Pregnancy-related deaths per 100,000 live births ‡	NA	266 (236 to 297)	3,853 (3,356 to 4,408)	4,938 (4,344 to 5,632)
Neonatal	Total deaths excluding traumatic injuries	335 (237 to 473)	426 (384 to 754)	523 (474 to 957)	634 (563 to 1,174)
	Total deaths including traumatic injuries		431 (388 to 759)	536 (474 to 1,032)	655 (563 to 1,270)
	Excess deaths excluding traumatic injuries		92 (75 to 190)	189 (154 to 392)	300 (240 to 624)
	Excess traumatic injuries deaths		5 (4 to 5)	13 (0 to 75)	21 (0 to 96)
	Excess deaths including traumatic injuries		97 (79 to 195)	202 (154 to 467)	321 (240 to 720)
	NMR per 1,000 live births	9 (6 to 13)	12 (11 to 21)	15 (13 to 27)	18 (16 to 33)
	NMR per 1,000 live births including injuries	9 (6 to 13)	12 (11 to 21)	15 (13 to 29)	18 (16 to 35)
	NMR (reference year) [29, 30]		*11 (2015)*	*15 (2006)*	*18 (1998)*
Stillbirths†	Total stillbirths excluding traumatic injuries	340 (202 to 564)	380 (370 to 398)	453 (410 to 540)	499 (451 to 600)
	Total stillbirths including traumatic injuries		401 (389 to 422)	804 (716 to 940)	948 (847 to 1,110)
	Excess stillbirths excl. traumatic injuries		40 (30 to 58)	113 (70 to 200)	158 (111 to 260)
	Excess traumatic injuries deaths		21 (19 to 24)	351 (306 to 400)	449 (396 to 510)
	Excess stillbirths including traumatic injuries		61 (49 to 82)	464 (376 to 600)	607 (507 to 770)
	SBR per 1,000 births	9 (5 to 15)	10 (10 to 11)	13 (11 to 15)	14 (12 to 17)
	SBR per 1,000 births including injuries	9 (5 to 15)	11 (11 to 12)	22 (20 to 26)	26 (23 to 31)
	SBR (reference year) [29, 30]		*11 (2013)*	*Before 2000*	*Before 2000*
Total	Total maternal deaths, neonatal deaths and stillbirths excluding traumatic injuries	683 (445 to 1,048)	821 (767 to 1,169)	1003 (904 to 1,531)	1,170 (1,041 to 1,824)
	Total maternal deaths, neonatal deaths and stillbirths including traumatic injuries		928 (862 to 1,288)	2728 (2,399 to 3,560)	3,382 (2,975 to 4,409)
	Excess maternal deaths, neonatal deaths and stillbirths excluding traumatic injuries		139 (109 to 257)	320 (236 to 620)	486 (370 to 929)
	Excess Traumatic injuries deaths		15 (13 to 17)	27 (20 to 34)	37 (27 to 50)
	Excess maternal deaths, neonatal deaths and stillbirths including traumatic injuries		96 (85 to 107)	1,388 (1,209 to 1,588)	1,779 (1,565 to 2,029)

† defined as foetuses at ≥ 28 weeks of gestation. ‡ deaths from any cause among women who are pregnant or in the six weeks postpartum stage. MMEIG: UN Maternal Mortality Estimation Inter Agency Group. UN IGME: UN Inter-agency Group for Child Mortality Estimation.

With the severity of the scenarios (which have a rising gradient in decreasing health service contacts and quality, exclusive breastfeeding, quantity and quality of water and sanitation, and food security), the number of deaths increase. In the Annex (Maternal and neonatal health), we present the contribution to excess mortality of disruptions to different public health interventions. Each of these scenarios sets Gaza back in time. The escalation scenario would potentially undo over a quarter of a century of progress, setting back maternal mortality to levels last seen in 1995, neonatal mortality to levels last seen in 1998, and stillbirth mortality to well before 2000 (earlier estimates are not available).

While LiST-projected deaths exclude those due to traumatic injuries, including these within excess mortality is arguably appropriate, given that pregnancy-related and neonatal mortality are defined based on timing rather than cause. Furthermore, pregnancies interrupted by fatal or non-fatal injuries would increase stillbirth projections. If these are added, we would get a further 1,361 deaths of pregnant or postpartum women (which would add 351 stillbirths), and 13 neonatal deaths in the status quo scenario. In the escalation scenario, injuries would add 1,742, 449, and 21 deaths respectively. In the ceasefire scenario, very few of these deaths would occur (81, 21, and 5 respectively).

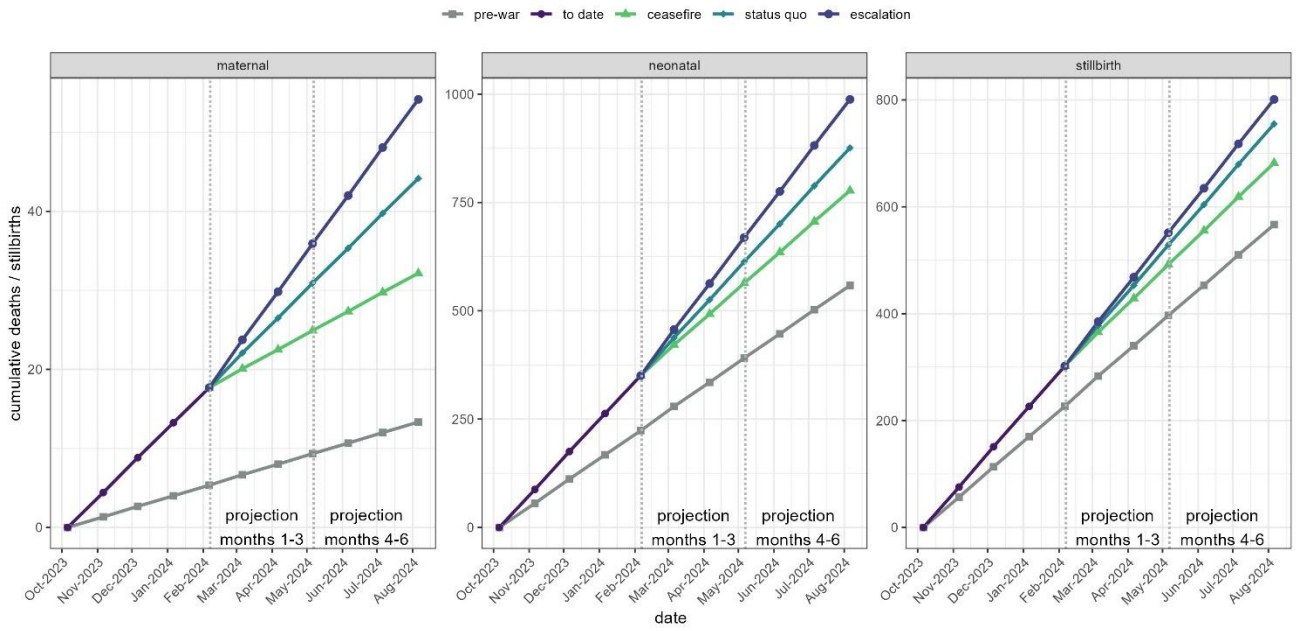

Figure 8. Cumulative maternal, newborn and stillbirth mortality (all excluding traumatic injury deaths) by period and scenario. The grey line shows the counterfactual trend based on pre-war mortality.

Maternal, neonatal and stillbirth findings in context

In the absence of medical care, pregnancy, childbirth and the postpartum period are risky time-periods for women and neonates. In high mortality contexts, about 1-1.5% of women and 4% of neonates die, and a further 4% of pregnancies end in stillbirth [31]. Women at high risk or with complicated pregnancies need intensive inter-professional medical care to avoid unnecessary morbidity and mortality. Even women at low risk can experience unanticipated complications such as post-partum haemorrhage or sepsis, which have high CFR if untreated. Obstetric haemorrhage places high demand for blood products, without which doctors may need to resort to hysterectomy (a life-changing procedure) to prevent death. Many women with earlier caesarean delivery will need a repeat caesarean-section or else risk stillbirth, ruptured uterus, or maternal death. In Gaza to date, there are reports of caesareans being conducted without anaesthesia [32].

Some neonates will need to be immediately resuscitated by skilled health professionals to survive, and hospital care is also critical for many who are born small and sick. Percentages of neonates needing neonatal intensive care units (NICU) will increase, as the risk of being born preterm or small-for-gestational age is known to increase in conflict. Most NICU equipment relies heavily on electricity, which is in short supply to date. Small and preterm babies are at higher risk of neonatal mortality. Neonatal mortality is also likely to increase if post-natal care and infant feeding deteriorate. Added to this, when we include deaths from traumatic injury, levels of mortality become very high, and some (e.g. pregnancy-related mortality) exceed the "natural maxima" seen even in the highest mortality contexts.

Non-communicable diseases

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In 2022, NCDs were the primary cause of death in the Gaza Strip according to the MoH. Continuous and timely management of NCDs is crucial for optimizing survival and outcomes among patients [33]. However, NCD management is a major challenge in emergency settings where the risk of acute NCD exacerbation increases and the capacity of the health system to effectively respond decreases [33].

The current model projected excess mortality for cancer (lung, colorectal, and breast), acute strokes (ischemic and haemorrhagic), myocardial infarctions, DM1 patients, and complications due to chronic kidney disease. In total, we projected 1,680 excess deaths in a ceasefire, 2,480 excess deaths in the status quo, and 2,676 excess deaths in an escalation. Table 8 shows the breakdown by category and scenario.

Table 8. Projected excess mortality due to non-communicable diseases, by category, and scenario in 6 months. Values are the mean estimate and the 95% uncertainty interval.

Disease	Period	Scenario		
		ceasefire	status quo	escalation
Ischaemic Heart Disease	months 1 to 3	776 (685 to 867)	992 (893 to 1,091)	1,044 (942 to 1,145)
	months 4 to 6	651 (569 to 739)	962 (863 to 1,062)	1,006 (902 to 1,111)
	total	1,427 (1,254 to 1,606)	1,954 (1,757 to 2,153)	2,050 (1,845 to 2,256)
Chronic kidney disease†	months 1 to 3	21 (5 to 38)	34 (16 to 57)	39 (20 to 63)
	months 4 to 6	15 (2 to 33)	32 (14 to 55)	38 (18 to 61)
	total	36 (7 to 70)	67 (29 to 112)	77 (37 to 124)
Diabetes mellitus type 1‡	months 1 to 3	18 (0 to 53)	97 (53 to 161)	141 (79 to 212)
	months 4 to 6	18 (0 to 51)	95 (48 to 153)	130 (76 to 198)
	total	36 (0 to 104)	191 (101 to 313)	271 (154 to 410)
Stroke (Haemorrhagic and Ischaemic)	months 1 to 3	70 (22 to 131)	92 (37 to 155)	99 (40 to 164)
	months 4 to 6	59 (12 to 117)	88 (33 to 153)	91 (37 to 162)
	total	129 (34 to 247)	180 (71 to 308)	191 (77 to 326)
Cancer (lung, colorectal, breast)	months 1 to 3	30 (6 to 71)	46 (12 to 88)	45 (12 to 90)
	months 4 to 6	23 (-4 to 57)	43 (8 to 86)	42 (7 to 84)
	total	53 (2 to 128)	89 (20 to 174)	87 (19 to 173)
total	months 1 to 3	915 (718 to 1,159)	1,261 (1,011 to 1,552)	1,368 (1,093 to 1,674)
	months 4 to 6	766 (579 to 996)	1,219 (966 to 1,509)	1,308 (1,039 to 1,616)
	total	**1,680 (1,297 to 2,155)**	**2,480 (1,977 to 3,061)**	**2,676 (2,132 to 3,290)**

† Includes only people in need of haemodialysis. ‡ Other than through cardiovascular disease events.

Figure 9 shows the projected numbers of deaths among patients with NCDs for each scenario over six months (7 February-6 August 2024), showing pre-conflict deaths, and additional deaths due to disruption of access, supply and quality of healthcare services. As mentioned above, ischaemic heart disease, DM1 and stroke are the most common causes, in that order.

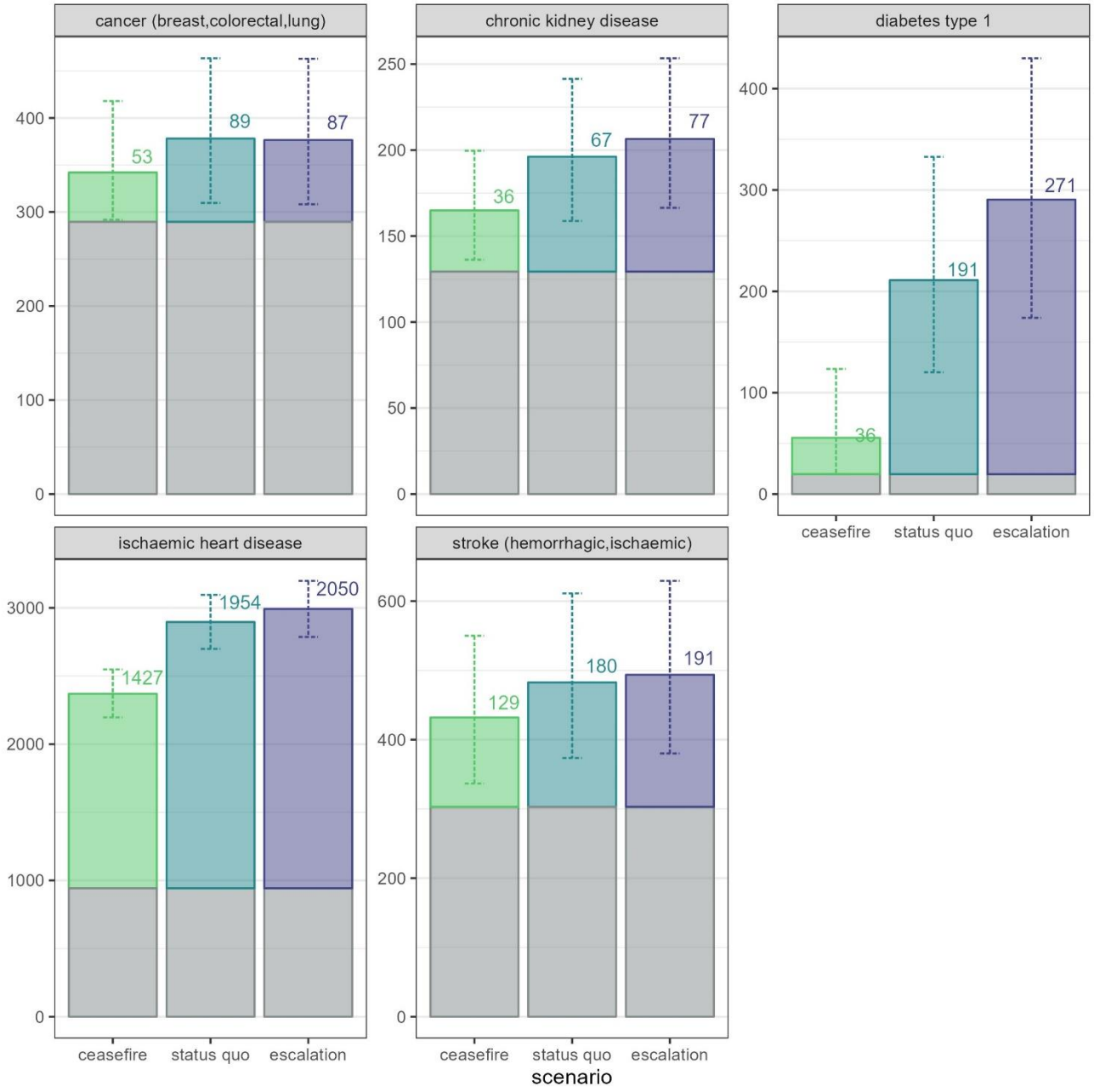

Figure 9. Projected number of deaths due to specific high-burden NCDs, by scenario, (in grey we have the pre-war mortality data expected for six months and the excess mortality marked in colour fill).

Across the three scenarios, most deaths are projected to occur among individuals aged ≥ 50 year old (91%, 88% and 86% in the ceasefire, status quo and escalation scenarios, respectively). Few deaths are expected to occur among those aged 20 to 49 years old, and almost a minimal number of deaths are projected for those 0 to 19 years old (Annex: Non-communicable diseases).

Mental health

Commentary: Hanan Abukmail

It is critical to underscore that mental health is inextricable from physical health problems [34]. The events that have taken place since 7 October 2023, in combination with pre-existing conditions in Gaza and previous episodes of localized conflict, can be assumed to have had a detrimental impact on the mental health of a large number of people in the region.

An important immediate concern is the safety and continued care of psychiatric patients, including those living in mental health facilities. Before the conflict, more than 485,000 people with diagnosed mental health disorders were experiencing a disruption in their treatment [35], in addition to at least 20,000 people in need of specialized mental health services and mental health drugs [36]. It can only be assumed that these numbers will continue to rise.

It has been reported that 17,000 to 18,000 children have lost one or both of their parents and have been and left to continue their lives without care and financial support, while over 450,000 children's family homes were damaged or destroyed [37]. UNICEF has described Gaza as currently being the most dangerous place to be a child [38] and the statistics support that assessment: four out of five children in the Gaza Strip live with depression, grief, and fear as a result of fifteen years of blockade and previous military attacks [39] and cases of post-traumatic stress, anxiety, and severe depression are on the rise [40].

It is known that intimate partner violence (IPV) increases in conflict settings [41] which is an area of concern given that pre-war levels of IPV in the Gaza Strip were already high. A household survey in 2018/9 showed 12-month prevalence estimates of psychological aggression (68.2%), physical assault (27.5%), economic and deprivation of resources (27.1%), and sexual coercion (11.3%) among currently or ever-married women [40]. During the 2021 conflict in the Gaza Strip, women and girls reported their concern for their safety and security in the shelters such as when they used the school's latrines, and when mothers slept next to their daughters since there was no privacy in the shelters they were staying in [42]. This is another area of serious concern to consider moving forward.

Discussion

Section authors: Paul Spiegel, Zeina Jamaluddine, Francesco Checchi

Key findings

This first set of projections of mortality in the Gaza Strip covers the period from 7 February to 6 August 2024 (six months). To our knowledge, no such detailed projections have been issued during an ongoing humanitarian response, and the methods employed for this project are mostly novel. Periodic updates of the projections are planned until May 2024. This discussion synthesizes the findings and underscores the critical and lifesaving health challenges and policy implications in Gaza. While some key interventions are highlighted, we refrain here from detailed public health recommendations, since these are the purview of humanitarian actors and relatively clear given the scale and nature of population needs. We note, however, that the overriding challenge for humanitarian response is to have the safety, security, and humanitarian space to provide sufficient supplies and services to the population and ensure a functioning health system.

Under all scenarios, death rates are elevated. Employing the CDR metric most familiar to humanitarian actors, mortality is projected to rise 0.34, 1.70 and 2.16 deaths per 10,000 person-days under the ceasefire, status quo and escalation scenarios, respectively. The Sphere standards state that a doubling of the baseline crude or under-5-year mortality rates indicates a significant public health emergency and requires an immediate response [6]. Using the counterfactual baseline of 0.05 deaths/10,000 person-days, our projections constitute an increase of 6.8 times, 34 times, and 43.2 times according to the respective scenarios.

Death rates according to age (annualised age-specific death rates) show increases across all scenarios, particularly for children (1 month to 14 years) followed by older children and young adults (15 to 29 years). For example, children 10 to 14 years show the highest relative mortality ratio ranging from 292 for the ceasefire scenarios to 3,051 for the escalation scenario. Under all scenarios, a large proportion of mortality will occur among children (defined as <18 years) with approximately 40% in the status quo and escalation scenarios each).

In summary, the projections suggest that even in the best-case ceasefire scenario beginning 7 February, thousands of excess deaths would continue to occur, mainly from infectious diseases due to the time it would plausibly take to improve WASH and shelter conditions, address malnutrition and restore functioning healthcare services in Gaza. The excess deaths in the status quo and escalation scenarios show extremely high and escalating mortality, particularly for traumatic injuries followed by infectious diseases.

Cause-specific mortality

Traumatic injuries

Traumatic injuries are generally among the top causes of mortality in conflict [43], and their burden is particularly high during high-intensity and urban warfare [44]. The current war is characterized by protracted and intense bombardment in dense civilian areas and has resulted in a rapidly rising death toll due to both direct violence and delays in accessing or receiving trauma care secondary to the destruction of health infrastructure and security challenges to free movement of patients. As basic and specialty healthcare services in Gaza continue to deteriorate, an increase in excess deaths due to traumatic injuries that would otherwise be survivable with timely and appropriate care is expected.

A ceasefire scenario is projected to avert most trauma-related deaths, but even in this scenario, residual traumatic deaths (3,250) would persist due to complications such as infections and pulmonary emboli, as well as unexploded ordnance. This increase is largely attributable to the time it will require the healthcare system to

regain functionality. In contrast, excess deaths due to trauma are extremely high and predominate under the status quo (53,450) and escalation (68,560) scenarios. In the status quo and escalation scenarios, those who immediately die of their traumatic injury constitute the majority of the deaths; 31% (status quo scenario) and 40% (escalation scenario) die at some point after their traumatic injury but could possibly survive if trauma surgery and related services were functioning adequately.

An examination of the age and sex distribution of traumatic injury deaths shows that the risk of traumatic injury mortality is broadly similar across age and sex, unlike many other wars where males of military age (ages 20 to 49) constitute a much higher proportion [45–47]. The overlap among the distribution of traumatic deaths and the distribution of ages and sex of the Gaza population reflects the intensity and widespread nature of bombardment. Forty-three percent of the trauma deaths occur among females, and 42% are among children under 19 years. Slightly more male deaths occur in the age group 20 to 49 years, possibly reflecting men's higher probability of being combatants, first responders, or finding themselves outdoors and exposed to violence.

These projections necessitate urgent attention so that acute and longer-term quality trauma care can be provided in safe and secure conditions. Political and security agreements are imperative to ensure the security of healthcare facilities and workers, along with sufficient supply, quality, and access to lifesaving medications. Adherence to international humanitarian law and deconfliction agreements so that all hospitals can become secure and operational combined with safe passage corridors for civilians to access and leave hospitals are needed. Longer-term care of individuals with severe and debilitating injuries will be lifelong and warrant intensive follow-up including wound care, rehabilitation, prostheses, mental health services and more.

Nutritional status and other epidemiological risk factors

Most of the population in Gaza are food insecure and at risk of starvation [22]. Children between the ages of 6 to 59 months particularly face a dire nutritional emergency. Before the current conflict, GAM and SAM prevalence were low amongst this group (3.2% and 0.4%, respectively). As of 7 Feb 2024, limited ground data collection broadly corroborated our projections that malnutrition prevalence has already risen significantly (14% and 3%, respectively), albeit with a likely uneven geographic pattern.

While GAM and SAM will eventually decrease during the ceasefire scenario (12.4% and 2.7% at 6 months, respectively), they still remain high relative to the pre-war baseline, even if, as we assumed for this scenario, nutrient intake is deliberately increased to above the target caloric intake. Both measures increase to extreme levels in the status quo and escalation scenarios, with each worsening between the two 3-month time periods. While these estimates feature wide uncertainty intervals, they are typically associated with exponential increases in child mortality [48].

The war poses a particular threat to the nutritional well-being of neonates and infants, whose health depends heavily on breastfeeding. The stress and privacy issues faced by mothers in war zones are known to severely disrupt breastfeeding practices [49] and push families towards formula feeding, which, if this occurs under suboptimal WASH conditions, risks contamination and subsequent infection. We project significant breastfeeding interruptions, which are not expected to improve even in a ceasefire scenario, given the time required for recovery. Failure to initiate or sustain breastfeeding is likely to harm infant and child health in the long term, as evidenced by interruption rates in past conflicts [50–52]. Food insecurity and war also increase rates of pre-term and small for gestational age babies, who also face feeding challenges [53].

The above nutrition-related factors, combined with the current extremely poor WASH and shelter conditions exacerbate many of the outcomes across all modules examined within our projections. Consequently, a concerted effort to provide sufficient and diversified food through a variety of means (e.g. cross border,

airdrops) as well as specialised nutritious products are urgently needed. These critical interventions combined with a concerted effort to provide sufficient water and improve sanitation and shelter will have significant immediate and downstream effects that will save many lives.

Infectious diseases

Excess infectious disease deaths due to exacerbation of endemic diseases and potential epidemics are included in the projections. Across all scenarios, infectious diseases emerge as a major cause of excess deaths.

The endemic diseases that are projected to cause the largest number of excess deaths are transmitted mainly through airborne-droplet routes and include COVID-19, influenza/para-influenza and pneumococcal disease. Mortality from these diseases is mostly preventable but will increase considerably in the absence of adequate diagnosis, antibiotics, and respiratory support.

There have not been large-scale epidemics in Gaza for over a decade before the ongoing crisis. The projections suggest that cholera, measles, polio (both wild-type and vaccine-derived) and meningococcal meningitis pose the greatest mortality threat under the three scenarios. Measles could cause moderate-size epidemics; over a longer time horizon than our projections, declining immunity due to vaccination disruptions would increase vaccine-preventable disease risk. While a cholera outbreak has not occurred in Gaza since 1981 [54] cholera has been circulating in the region [55]. Given the breakdown of the water and sanitation in Gaza, together with the possibility of potential importation as aid workers enter Gaza, cholera and, to a lesser extent, polio, are notable threats.

Infectious diseases are projected to be the largest cause of excess death in the ceasefire scenario. This increase is attributed to numerous and interacting factors such as WASH inadequacies, malnutrition, and overcrowding that cannot be operationally addressed immediately. Consequently, there would still possibly be thousands of deaths due to infectious diseases even with a ceasefire.

These findings are consistent with the status quo and escalation scenarios, where infectious diseases, especially outbreaks, follow trauma deaths as the second-largest category of excess deaths. The uncertainty related to the potential of such epidemics occurring, emphasizes the need for robust health surveillance and intervention strategies.

Maternal and neonatal health

Since October 2023, pregnancy, childbirth, and the postpartum period have become fraught with heightened risks, particularly in the absence of adequate medical care. Projections for the six-month period from 7 February to 6 August 2024 suggest troubling increases in the relative risk of maternal, neonatal, and stillbirth deaths across all conflict scenarios compared to the pre-war period. These are linked to deterioration with respect to water, sanitation, and food security. Most importantly, they are linked to deterioration in the ability for women and their babies to access childbirth, antenatal, and postnatal services, and in the ability of such services to ensure good quality care, with skilled staff and effective interventions. The ceasefire scenario predicts numbers and rates will increase slightly, while the escalation scenario suggests a grim return to mortality numbers and rates not seen for nearly a quarter of a century, eroding at least two decades of health progress. Adding to the gravity of the situation, injury-related deaths during pregnancy or postpartum have not been included in our LiST projections. When these are added, there are substantial increases in the numbers and risk of deaths in the status quo and escalation scenarios. In the ceasefire scenario, very few of these traumatic injury deaths of pregnant women or neonates would occur.

Despite these groups constituting small subsets of the population, their deaths contribute significantly to measures of disease burden such as years of healthy life lost, highlighting the profound implications of conflict on the most vulnerable populations. The death of parents, especially mothers, pose substantial risks to the future survival and well-being of children, further emphasizing the need for targeted health interventions to support maternal and neonatal health in the context of conflict.

Non-communicable diseases

NCDs were the leading cause of death in 2022 in Gaza. The war has exacerbated NCD mortality, not only by increasing the risk of acute exacerbation of NCDs, but also straining the healthcare system's ability to cope and effectively treat patients.

The primary cause of excess mortality within the NCDs model is due to ischaemic heart disease, specifically myocardial infarctions, due lack of access to cardiac catheterization labs, interventional cardiologists, and thrombolytics. Excess mortality for stroke is projected from haemorrhagic stroke due to the lack of availability of operating room and neurosurgeons, while excess deaths from ischaemic stroke are due to lack of access to thrombolytics and neuro-interventionists. Excess mortality from DM1 is projected due to the disruption in insulin supply, while excess mortality from chronic kidney disease is attributed to the disruption in haemodialysis sessions. Complications from chronic kidney disease can be attributed to various causes including missed dialysis sessions in patients with end-stage renal disease on haemodialysis.

In the ceasefire scenario, the projected excess NCD deaths are lower than the other scenarios and reflect the improvement over time of health service access and quality, including increased referrals outside of Gaza. Unsurprisingly, across the three scenarios, most deaths are projected to occur among individuals aged $\geq$ 50 years (91%, 88% and 86% in the ceasefire, status quo, and escalation scenarios, respectively).

Mental health

The mental health crisis in Gaza, exacerbated by the events since October 2023 and compounded by a history of conflict and blockade, is deeply intertwined with the region's physical health challenges. Prior to the conflict, nearly half a million individuals with diagnosed mental health conditions were already facing treatment interruptions [35]. With the ongoing war, it is anticipated that the need for mental health services, including medications, will escalate further. The impact on children is particularly alarming; UNICEF's depiction of Gaza as a perilous environment for children [38] is supported by data showing widespread depression, grief, and fear among the young due to long-term conflict exposure [39]. Moreover, the prevalence of intimate partner violence, which historically has been high in Gaza, presents an additional layer of concern. A survey from 2018/2019 revealed disturbing levels of psychological aggression, physical assault, economic deprivation, and sexual coercion among women [40], underscoring the extensive mental health implications of the ongoing strife. Projections on mental health may be included in the next report.

Main limitations

With the exception of maternal and neonatal mortality, our estimates are based on novel models developed explicitly with the aim of projecting cause-specific mortality in this context. Our models relied on a synthesis of comprehensive pre-conflict data, but several parameters relevant to the current health situation for which data were not available were estimated through expert elicitations and publicly available data from comparable conflicts, including previous conflicts in Gaza. Expert judgements and data from other conflicts may have led us to make conservative estimates. Moreover, our models do not capture the totality of risk factors (specifically

upstream risk factors) and causal pathways involved in disease onset and subsequent mortality. A more comprehensive and complex analysis may have included additional risk factors and modifiers. The estimates of risk factors are based on the best available information, but this may not be representative or accurate; they will improve over time as more data become available.

Additionally, our use of the Cooke Classical Model [56] is a novel contribution to modelling excess mortality. While considered a rigorous and scientifically sound method for quantifying uncertainty of expert opinion, the use of this method in modelling excess mortality has not been frequently attempted, and its performance has not been extensively examined. It is thus possible that this method exhibited overconfidence, or conversely overestimated uncertainty around our central tendency estimates. However, this method has been shown to outperform alternative approaches to aggregating expert opinion [56].

The LiST model has several limitations that are described elsewhere [3, 57]. Our quantification of changes in contacts with maternal and neonatal health services and in coverage of effective interventions, which are key inputs in the model, is subject to a large degree of uncertainty given the dearth of data on current intervention coverage and contact with services in Gaza.

The current NCD model does not consider new (incident) cases, nor does it include all NCDs mortality (specifically chronic obstructive pulmonary disease (COPD), asthma, DM2, among others. Due to the lack of oxygen supply, excess morality from COPD and asthma is expected to be high, but further expert elicitation is needed to estimate these diseases. While we expect an increase in mortality due to the inability to access medications, the current model does not estimate excess deaths attributable to disruptions in management of antecedent conditions such as DM2 and hypertension, or in environmental exposures, such as cold and dust, that might exacerbate COPD. As such, the model has underestimated the excess deaths that could result from NCDs.

More specific limitations by cause-specific mortality are included in the Methods Technical Document. Future reports may aim to strengthen NCD estimates, more explicitly incorporate malnutrition into the analysis, and address the mental health consequences of the conflict, ensuring a holistic view of the health challenges faced by the population in Gaza.

Conclusion

These scenario-based health impact projections underscore the critical need for a multi-faceted health response tailored to the unique and evolving challenges of the war in Gaza. Enhancing trauma care, prioritizing infectious disease control and response, safeguarding maternal and child health and providing continuity of care for NCDs are imperative to mitigating the health impacts of the conflict. Furthermore, addressing the root causes of health vulnerabilities, such as improving WASH infrastructure, nutrition status, and reducing overcrowding, are crucial for health resilience.

These projections highlight the urgent and lifesaving need for an immediate ceasefire to reduce excess mortality in Gaza. The role of humanitarian agencies, primarily UNRWA, is crucial in providing food and healthcare in Gaza, and their continued support is vital in this crisis [58]. Indeed, our scenarios make an explicit assumption that humanitarian actors will continue to support Gaza at scale, despite security challenges. Without this support, our projections would plausibly worsen catastrophically. International diplomacy and humanitarian efforts must prioritize the cessation of hostilities. Governments and humanitarian organizations must continue to prepare for various scenarios and the different causes of excess mortality that may occur accordingly. Other aspects, such as morbidity, quality of life, and the dignity of persons to live in a safe and secure environment, while not projected in this report at this time, are also essential factors that must be considered.

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Annex: Additional tables and figures

Overall modules

Table S9. Diseases included in projections

Cause-specific module	Diseases or conditions included in each module
Traumatic injuries	Immediate deaths, deaths due to wounds, uncounted deaths, and mild, moderate and severe injuries.
Infectious diseases - endemic	Airborne droplet transmission: Hib bacterial meningitis and pneumonia, Pneumococcal invasive disease and pneumonia, Respiratory syncytial virus disease (RSV), COVID-19, Influenza and para-influenza disease. Faecal-oral transmission: Rotavirus gastroenteritis, Other viral gastroenteritis, Bacterial gastroenteritis.
Infectious diseases - epidemic	Diphtheria, measles, pertussis, meningococcal meningitis, polio – wildtype 1 and 3, polio – vaccine-derived type 2, hepatitis A, hepatitis E, cholera, typhoid fever, bacterial dysentery.
Maternal, neonatal, and stillbirths	Direct and indirect maternal deaths: antepartum & postpartum haemorrhage, hypertensive diseases of pregnancy, sepsis, miscarriage, obstructed labour, ectopic pregnancy, other maternal causes of death. Neonatal: Birth asphyxia, prematurity, sepsis/pneumonia, congenital anomalies, tetanus, diarrhoea, all other causes of death. Stillbirths: ante- and intra-partum
NCDs	Ischemic heart disease, haemorrhagic and ischaemic stroke, chronic kidney disease on haemodialysis, diabetes type 1, cancer (breast, colorectal, lung).

Detailed scenarios

Table S10. Detailed scenarios considered in the report.

Scenario	Intensity and typology of military activity and population movement	Occurrence and duration of pauses/ceasefires	Humanitarian space and operational adaptation
Ceasefire	▪ A permanent ceasefire occurs, and ariel bombing stops, and violence reduces. ▪ Gaza remains under blockade with border checks and military policing at the border. ▪ Telecommunication resume ▪ The population starts to return home, but the majority remain in shelters/informal settlements due to destroyed dwellings.	▪ Ceasefire is agreed to over the entire period	▪ A large influx of humanitarian assistance enters Gaza but is limited at the beginning & increases over time as logistics improve in Gaza (roads, storage); ▪ More goods allowed in. ▪ The international community supports an emergency response. Rebuilding and repairing damaged health facilities, homes and infrastructure. ▪ Health services at all levels can operate safely with adequate access, supplies and quality improving over time; primary health services expand to areas where no services exist; paucity of specialized healthcare (e.g. surgeries) and functioning referral pathways occur within and outside of Gaza over time. ▪ Large vaccination campaigns and other distributions occur. ▪ Water, sanitation and hygiene (WASH) improve in shelters and open areas, reducing the probability of epidemics. ▪ Food provision increases. ▪ Humanitarian actors adapt their operations by shifting activities closer to the populations and with international community works to repair damaged healthcare services and hospitals to increase access and quality of services; this will be slow due to extensive damage. ▪ International communities work to rebuild housing infrastructure to eventually reduce overcrowding; this will also be slow to occur due to extensive damage.
Status quo	▪ Aerial bombing continues, but the military campaign evolves towards more urban ground warfare. ▪ An offensive against South Gaza occurs. ▪ Humanitarian pauses reduce violence, occasional bombings and ground attacks occur, then continue as soon as pauses end. ▪ Gaza remains under *de facto* military control with stringent border checks and limited goods entry. ▪ A near-total telecommunications blackout across the Gaza Strip most of the days. ▪ Displacement persists and as people continue to move south. ▪ People shelter in open areas (streets,) as shelters are full; most are unable to return to their houses (many of which are destroyed).	▪ Two or three humanitarian pauses are agreed, each of about 5-7 days.	▪ A limited increase in aid being allowed to enter Gaza, in particular food, but all items remain insufficient (water, fuel, medicines and supplies). ▪ Humanitarian action remains very constrained by operating restrictions, and large pockets of Gaza's Palestinian population are only intermittently accessible if at all, particularly in North and Middle areas. ▪ Functionality of health services remains at current low levels including low or unavailable stocks of essential medication and supplies; referrals within or outside of Gaza are extremely limited. Quality of services, and intervention coverage, remain very constrained. ▪ Epidemics and acute malnutrition are likely to occur. ▪ Some adaptation of humanitarian services in South, e.g. by moving health services closer to Internally displaced persons (IDPs), optimizing supply chains, implementing vaccination campaigns and making health facilities more resilient to attacks.
Escalation	▪ Military campaign intensifies during the period including aerial bombardment and ground force operations with increased intensity shifting the focus to	▪ None	▪ The humanitarian and health situation worsens in all areas of Gaza. ▪ Humanitarian space constrained – worsened insecurity for humanitarian actors and Gazan health

Scenario	Intensity and typology of military activity and population movement	Occurrence and duration of pauses/ceasefires	Humanitarian space and operational adaptation
	the crowded area in the South of Gaza and resume in the North. ▪ Gaza remains under *de facto* military control with stringent border checks and limited goods entry. ▪ A total telecommunications blackout across the Gaza Strip. ▪ Continued large-scale displacement, now into more open areas as shelters are full (increasing displacement requiring more outdoor tents). ▪ More health facilities become partially - or non-functional and many people are in areas where there were fewer health facilities to begin with. ▪ Most of the population will have less access to care due to limited hospitals, clinics, and transportation to healthcare facilities.		workers; limited services provided compared to current situation; humanitarian community does not/cannot respond to these challenges by adapting. ▪ North has with very limited assistance provided. ▪ Closed or reduced health facilities at all levels with stockouts of essential medicines and equipment; difficulties in providing health care to those in open/remote places. Clear deterioration of health services re: access, supply, quality; epidemics likely to occur. ▪ The amount of water, food, fuel, and medicines is even more limited.

Overall mortality

Table S11. Age distribution of projected excess deaths, by cause, period and scenario.

Age	Period	Scenario		
		ceasefire	status quo	escalation
0mo	months 1 to 3	50 (40 to 140)	110 (80 to 300)	170 (120 to 470)
	months 4 to 6	60 (40 to 200)	120 (80 to 420)	180 (120 to 600)
	total	110 (80 to 340)	220 (150 to 720)	350 (240 to 1,070)
1 to 11mo	months 1 to 3	90 (30 to 480)	520 (370 to 1,330)	680 (480 to 2,180)
	months 4 to 6	150 (20 to 1,690)	640 (370 to 3,250)	860 (480 to 4,500)
	total	240 (50 to 2,170)	1,160 (740 to 4,580)	1,540 (960 to 6,670)
12 to 59mo	months 1 to 3	410 (160 to 2,040)	2,790 (2,130 to 5,990)	3,590 (2,770 to 8,590)
	months 4 to 6	450 (100 to 4,500)	3,060 (2,130 to 10,740)	3,990 (2,760 to 14,050)
	total	860 (260 to 6,540)	5,860 (4,250 to 16,730)	7,580 (5,530 to 22,640)
5 to 9yo	months 1 to 3	390 (190 to 2,000)	3,190 (2,560 to 6,470)	4,100 (3,310 to 9,250)
	months 4 to 6	450 (110 to 4,720)	3,490 (2,560 to 11,450)	4,470 (3,300 to 14,470)
	total	840 (310 to 6,730)	6,680 (5,110 to 17,930)	8,570 (6,610 to 23,720)
10 to 14yo	months 1 to 3	350 (190 to 1,880)	3,050 (2,460 to 6,180)	3,910 (3,180 to 8,850)
	months 4 to 6	430 (110 to 4,570)	3,360 (2,460 to 11,110)	4,300 (3,180 to 14,050)
	total	790 (300 to 6,450)	6,410 (4,920 to 17,280)	8,220 (6,360 to 22,900)
15 to 19yo	months 1 to 3	330 (170 to 1,720)	2,740 (2,190 to 5,700)	3,530 (2,840 to 8,370)
	months 4 to 6	420 (100 to 4,740)	3,050 (2,190 to 10,760)	3,920 (2,830 to 13,710)
	total	760 (270 to 6,460)	5,790 (4,390 to 16,460)	7,450 (5,670 to 22,080)
20 to 29yo	months 1 to 3	690 (390 to 2,810)	6,200 (5,070 to 10,900)	7,970 (6,560 to 15,950)
	months 4 to 6	810 (230 to 8,240)	6,720 (5,070 to 20,180)	8,640 (6,550 to 25,800)
	total	1,490 (620 to 11,050)	12,920 (10,140 to 31,080)	16,610 (13,110 to 41,750)
30 to 39yo	months 1 to 3	620 (310 to 2,730)	4,950 (3,950 to 9,400)	6,370 (5,110 to 14,330)
	months 4 to 6	740 (190 to 8,060)	5,400 (3,940 to 18,130)	6,960 (5,100 to 23,360)
	total	1,370 (490 to 10,790)	10,350 (7,890 to 27,530)	13,330 (10,210 to 37,680)
40 to 49yo	months 1 to 3	490 (190 to 2,820)	2,740 (2,010 to 7,220)	3,540 (2,600 to 11,000)
	months 4 to 6	630 (120 to 7,230)	3,140 (2,000 to 14,670)	4,040 (2,590 to 18,520)
	total	1,120 (310 to 10,050)	5,880 (4,010 to 21,890)	7,580 (5,190 to 29,520)
50 to 59yo	months 1 to 3	500 (200 to 2,230)	2,170 (1,510 to 5,390)	2,780 (1,950 to 8,090)
	months 4 to 6	520 (140 to 4,910)	2,360 (1,510 to 10,030)	3,030 (1,950 to 12,750)
	total	1,020 (340 to 7,150)	4,520 (3,020 to 15,420)	5,820 (3,900 to 20,840)
60 to 69yo	months 1 to 3	490 (210 to 1,830)	1,640 (1,060 to 4,100)	2,090 (1,380 to 5,910)
	months 4 to 6	490 (150 to 3,770)	1,780 (1,050 to 7,610)	2,280 (1,370 to 9,600)
	total	980 (370 to 5,600)	3,430 (2,110 to 11,710)	4,380 (2,750 to 15,500)
70 to 79yo	months 1 to 3	520 (200 to 1,700)	1,010 (410 to 3,000)	1,260 (560 to 4,120)
	months 4 to 6	430 (160 to 2,350)	980 (400 to 4,290)	1,260 (550 to 5,420)
	total	950 (360 to 4,060)	1,990 (820 to 7,290)	2,520 (1,110 to 9,540)
≥ 80yo	months 1 to 3	610 (250 to 1,620)	830 (330 to 2,390)	970 (360 to 2,950)
	months 4 to 6	450 (210 to 1,370)	680 (330 to 2,170)	830 (350 to 2,810)
	total	1,050 (460 to 2,990)	1,520 (660 to 4,560)	1,790 (700 to 5,760)
All ages	months 1 to 3	5,550 (2,530 to 24,000)	31,940 (24,130 to 68,370)	40,980 (31,220 to 100,040)
	months 4 to 6	6,020 (1,670 to 56,370)	34,780 (24,080 to 124,810)	44,770 (31,140 to 159,640)
	total	11,580 (4,200 to 80,370)	66,720 (48,210 to 193,180)	85,750 (62,350 to 259,680)

Traumatic injuries

Table S12. Projected excess death toll among **females** (mean and 95% uncertainty interval) due to traumatic injuries, by age, scenario and period.

Age	Period	Scenario		
		ceasefire	status quo	escalation
0 mo	months 1 to 3	0	5 (0 to 23)	3 (0 to 18)
	months 4 to 6	1 (1 to 1)	5 (0 to 22)	3 (0 to 18)
	total	2 (2 to 2)	9 (0 to 45)	6 (0 to 35)
1 to 11mo	months 1 to 3	15 (14 to 17)	260 (228 to 296)	202 (176 to 232)
	months 4 to 6	9 (8 to 10)	259 (228 to 295)	202 (175 to 232)
	total	24 (22 to 27)	519 (456 to 591)	404 (351 to 464)
12 to 59mo	months 1 to 3	88 (79 to 98)	1,500 (1,324 to 1,709)	1,170 (1,020 to 1,338)
	months 4 to 6	53 (47 to 60)	1,498 (1,322 to 1,707)	1,169 (1,019 to 1,337)
	total	141 (126 to 158)	2,998 (2,646 to 3,416)	2,340 (2,039 to 2,676)
5 to 9yo	months 1 to 3	109 (98 to 121)	1,873 (1,656 to 2,128)	1,466 (1,281 to 1,673)
	months 4 to 6	65 (58 to 74)	1,871 (1,654 to 2,126)	1,465 (1,280 to 1,672)
	total	174 (155 to 195)	3,745 (3,310 to 4,253)	2,931 (2,561 to 3,345)
10 to 14yo	months 1 to 3	93 (84 to 104)	1,608 (1,422 to 1,827)	1,259 (1,099 to 1,438)
	months 4 to 6	56 (49 to 63)	1,606 (1,421 to 1,825)	1,257 (1,098 to 1,437)
	total	149 (133 to 167)	3,213 (2,843 to 3,651)	2,516 (2,197 to 2,876)
15 to 19yo	months 1 to 3	76 (68 to 84)	1,304 (1,153 to 1,481)	1,021 (892 to 1,166)
	months 4 to 6	45 (40 to 51)	1,302 (1,152 to 1,479)	1,020 (891 to 1,164)
	total	121 (108 to 136)	2,606 (2,305 to 2,961)	2,040 (1,784 to 2,330)
20 to 29yo	months 1 to 3	171 (154 to 191)	2,948 (2,606 to 3,349)	2,307 (2,017 to 2,635)
	months 4 to 6	102 (91 to 116)	2,943 (2,602 to 3,344)	2,305 (2,014 to 2,632)
	total	274 (244 to 307)	5,891 (5,208 to 6,692)	4,612 (4,031 to 5,266)
30 to 39yo	months 1 to 3	129 (116 to 144)	2,214 (1,955 to 2,516)	1,731 (1,512 to 1,976)
	months 4 to 6	77 (69 to 87)	2,210 (1,951 to 2,512)	1,729 (1,510 to 1,973)
	total	207 (184 to 232)	4,424 (3,906 to 5,028)	3,459 (3,022 to 3,949)
40 to 49yo	months 1 to 3	71 (64 to 79)	1,200 (1,052 to 1,370)	935 (811 to 1,076)
	months 4 to 6	43 (38 to 48)	1,198 (1,050 to 1,368)	934 (810 to 1,074)
	total	114 (102 to 128)	2,399 (2,102 to 2,738)	1,868 (1,621 to 2,150)
50 to 59yo	months 1 to 3	57 (51 to 64)	934 (799 to 1,078)	720 (608 to 842)
	months 4 to 6	34 (30 to 39)	932 (798 to 1,077)	719 (607 to 841)
	total	92 (82 to 103)	1,866 (1,596 to 2,155)	1,439 (1,215 to 1,682)
60 to 69yo	months 1 to 3	42 (38 to 47)	660 (548 to 778)	504 (406 to 604)
	months 4 to 6	25 (22 to 28)	658 (547 to 777)	503 (405 to 604)
	total	67 (60 to 75)	1,318 (1,095 to 1,555)	1,007 (811 to 1,208)
70 to 79yo	months 1 to 3	16 (15 to 18)	200 (109 to 288)	140 (53 to 225)
	months 4 to 6	10 (9 to 11)	200 (109 to 288)	140 (53 to 225)
	total	26 (23 to 29)	401 (219 to 576)	280 (105 to 451)
≥ 80yo	months 1 to 3	8 (7 to 9)	42 (0 to 129)	26 (0 to 102)
	months 4 to 6	5 (4 to 5)	43 (0 to 131)	27 (0 to 103)
	total	13 (11 to 14)	85 (0 to 260)	53 (0 to 206)

Table S13. Projected excess death toll among **males** (mean and 95% uncertainty interval) due to trauma injuries, by age, scenario and period.

Age	Period	Scenario		
		ceasefire	status quo	escalation
0 mo	months 1 to 3	2 (1 to 2)	6 (0 to 25)	4 (0 to 20)
	months 4 to 6	1 (1 to 1)	6 (0 to 25)	4 (0 to 20)
	total	2 (2 to 3)	11 (0 to 50)	7 (0 to 40)
1 to 11mo	months 1 to 3	17 (15 to 19)	284 (250 to 323)	221 (192 to 253)
	months 4 to 6	10 (9 to 11)	283 (249 to 323)	221 (192 to 253)
	total	27 (24 to 30)	567 (499 to 646)	442 (384 to 507)
12 to 59mo	months 1 to 3	95 (86 to 106)	1,626 (1,436 to 1,852)	1,269 (1,106 to 1,451)
	months 4 to 6	57 (51 to 65)	1,624 (1,435 to 1,850)	1,268 (1,105 to 1,449)
	total	152 (136 to 171)	3,249 (2,871 to 3,701)	2,537 (2,211 to 2,900)
5 to 9yo	months 1 to 3	108 (97 to 121)	1,865 (1,649 to 2,119)	1,460 (1,275 to 1,666)
	months 4 to 6	65 (57 to 73)	1,863 (1,647 to 2,117)	1,458 (1,274 to 1,665)
	total	173 (155 to 194)	3,729 (3,296 to 4,235)	2,918 (2,550 to 3,331)
10 to 14yo	months 1 to 3	115 (103 to 128)	1,987 (1,758 to 2,258)	1,556 (1,358 to 1,779)
	months 4 to 6	69 (61 to 78)	1,985 (1,756 to 2,256)	1,555 (1,357 to 1,777)
	total	184 (164 to 206)	3,972 (3,515 to 4,514)	3,111 (2,716 to 3,555)
15 to 19yo	months 1 to 3	110 (98 to 122)	1,893 (1,675 to 2,151)	1,482 (1,294 to 1,694)
	months 4 to 6	66 (58 to 74)	1,890 (1,672 to 2,148)	1,481 (1,293 to 1,692)
	total	175 (157 to 197)	3,783 (3,347 to 4,299)	2,963 (2,587 to 3,386)
20 to 29yo	months 1 to 3	258 (231 to 288)	4,446 (3,933 to 5,052)	3,481 (3,041 to 3,978)
	months 4 to 6	154 (137 to 175)	4,439 (3,927 to 5,044)	3,477 (3,037 to 3,973)
	total	412 (368 to 462)	8,885 (7,860 to 10,096)	6,958 (6,078 to 7,951)
30 to 39yo	months 1 to 3	206 (185 to 230)	3,537 (3,129 to 4,019)	2,768 (2,418 to 3,159)
	months 4 to 6	123 (109 to 139)	3,532 (3,124 to 4,013)	2,764 (2,415 to 3,155)
	total	329 (294 to 369)	7,069 (6,252 to 8,032)	5,532 (4,832 to 6,314)
40 to 49yo	months 1 to 3	99 (88 to 110)	1,673 (1,474 to 1,908)	1,305 (1,136 to 1,494)
	months 4 to 6	59 (52 to 67)	1,670 (1,471 to 1,904)	1,304 (1,134 to 1,492)
	total	157 (141 to 177)	3,343 (2,944 to 3,812)	2,609 (2,269 to 2,985)
50 to 59yo	months 1 to 3	71 (64 to 79)	1,170 (1,013 to 1,347)	906 (775 to 1,050)
	months 4 to 6	43 (38 to 48)	1,169 (1,011 to 1,345)	905 (774 to 1,049)
	total	114 (101 to 127)	2,339 (2,024 to 2,691)	1,811 (1,548 to 2,100)
60 to 69yo	months 1 to 3	47 (42 to 52)	744 (624 to 873)	570 (465 to 679)
	months 4 to 6	28 (25 to 32)	743 (623 to 871)	570 (464 to 678)
	total	75 (67 to 84)	1,488 (1,247 to 1,744)	1,140 (929 to 1,358)
70 to 79yo	months 1 to 3	22 (20 to 24)	295 (198 to 392)	214 (122 to 303)
	months 4 to 6	13 (12 to 15)	295 (198 to 392)	214 (122 to 304)
	total	35 (31 to 39)	590 (396 to 783)	428 (244 to 607)
≥ 80yo	months 1 to 3	6 (5 to 6)	22 (0 to 91)	14 (0 to 72)
	months 4 to 6	3 (3 to 4)	22 (0 to 92)	14 (0 to 73)
	total	9 (8 to 10)	44 (0 to 183)	28 (0 to 145)

Malnutrition

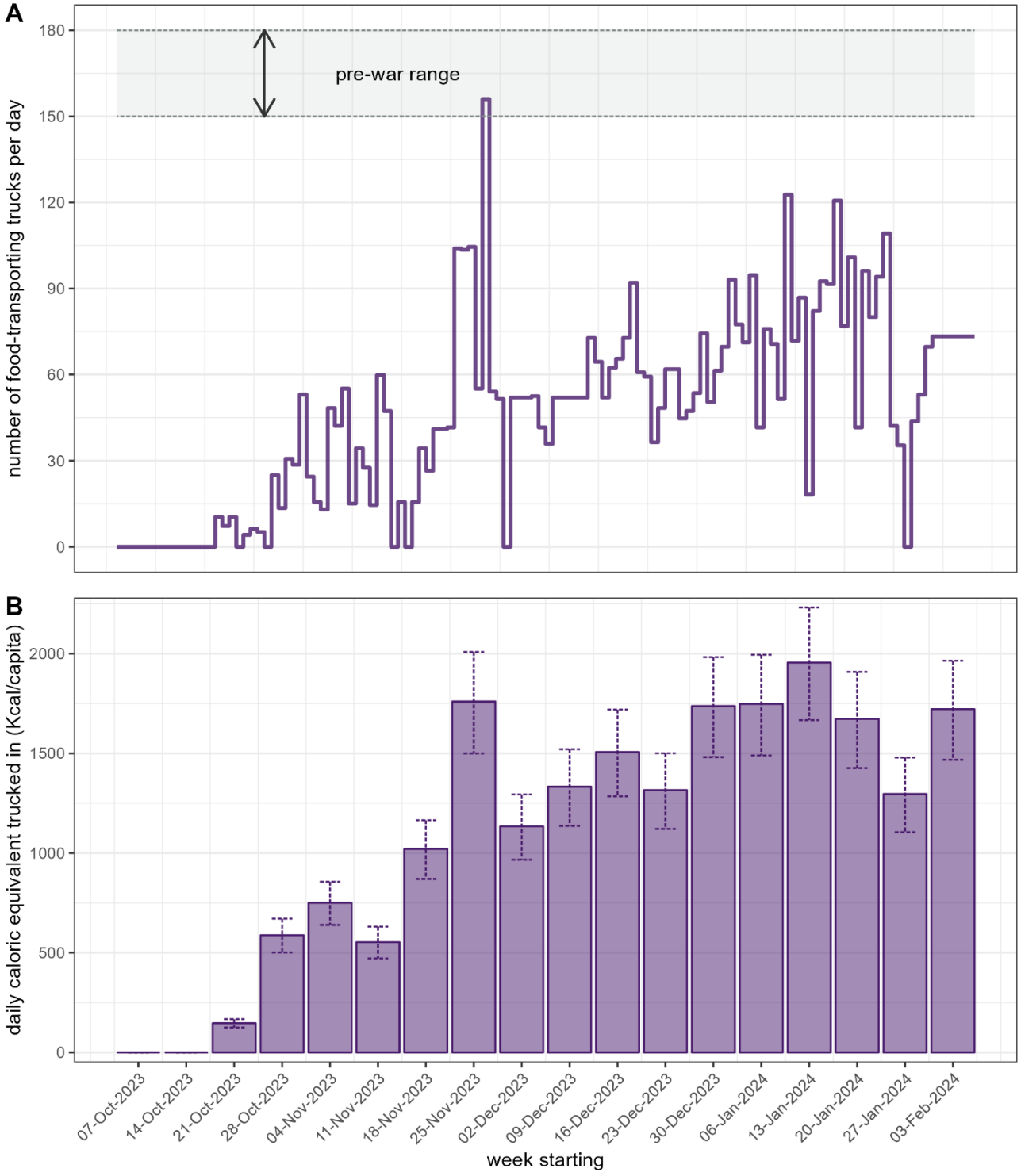

Figure 10. Panel A: Estimated number of food-carrying trucks per day during the period to date, compared to the range before the war [22]. Panel B: Estimated daily caloric availability per capita from food aid trucked into Gaza, by week since the war's start. Error bars indicate the 95% uncertainty interval.

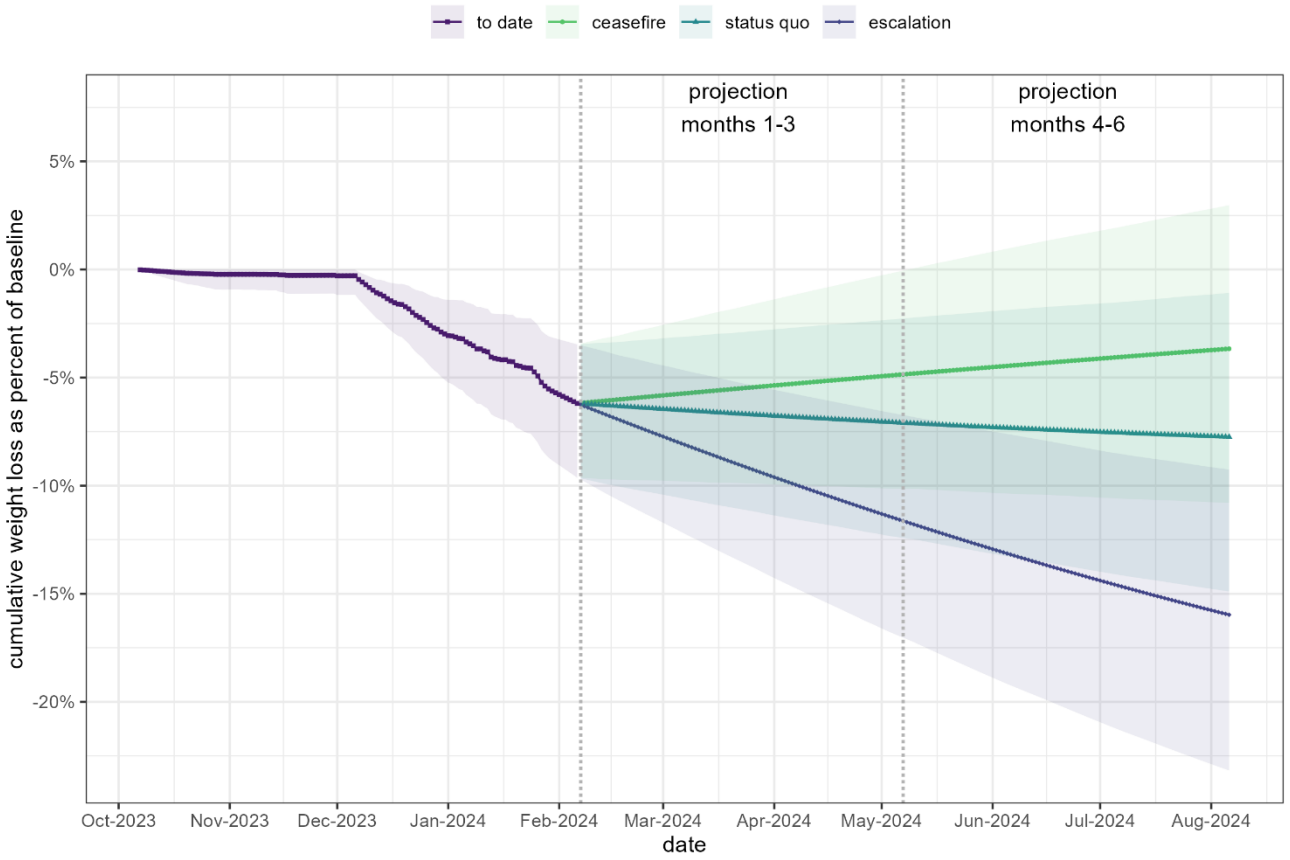

Figure 11. Estimated and projected cumulative weight loss, as a percent of baseline, among adults aged ≥ 40yo in Gaza, given alternative scenarios. Shaded areas indicate the 95% uncertainty interval.

Table S14. Estimated and projected SAM and GAM prevalence, by period and scenario. Quantities are the mean of simulation runs, and its median and 95% uncertainty interval (in parentheses).

period	scenario	SAM prevalence	GAM prevalence
pre-war	n/a	0.40%	3.20%
to date	n/a	2.8% (1.8%, 0.7% to 8.9%)	14.1% (11.5%, 5.7% to 32.3%)
months 1 to 3	ceasefire	2.7% (1.4%, 0.5% to 10.0%)	13.4% (10.3%, 4.3% to 34.2%)
months 4 to 6		3.8% (2.0%, 0.6% to 13.6%)	16.6% (12.5%, 5.4% to 41.9%)
months 1 to 3	status quo	6.9% (4.0%, 1.0% to 23.8%)	24.5% (19.3%, 7.5% to 58.5%)
months 4 to 6		2.7% (1.0%, 0.3% to 12.6%)	12.4% (7.8%, 2.2% to 39.9%)
months 1 to 3	escalation	6.2% (2.6%, 0.5% to 26.7%)	21.6% (14.9%, 4.2% to 61.5%)
months 4 to 6		22.2% (13.1%, 1.8% to 72.0%)	46.4% (41.0%, 11.3% to 92.8%)

Infectious diseases

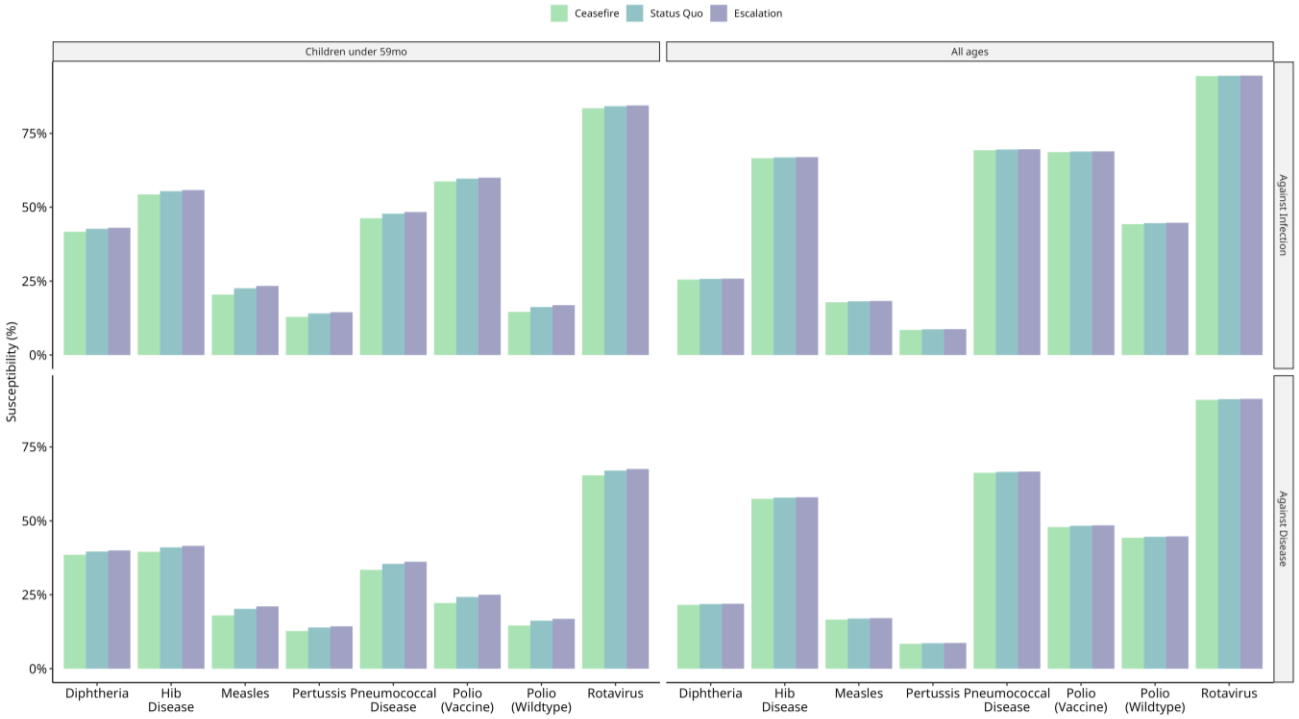

Figure 12. Projected proportions of children aged < 59mo (left) and all age groups (right) who are susceptible to infection (top) or disease (bottom), by vaccine-preventable pathogen and scenario.

Table S15. Projected excess death toll (mean and 95% uncertainty interval) due to endemic infections, by age, scenario and period.

Age	Period	Scenario		
		ceasefire	status quo	escalation
0mo	months 1 to 3	2 (0 to 8)	4 (0 to 13)	3 (0 to 11)
	months 4 to 6	1 (0 to 4)	2 (0 to 7)	2 (0 to 5)
	total	3 (0 to 12)	6 (0 to 20)	5 (0 to 16)
1 to 11mo	months 1 to 3	24 (0 to 88)	42 (1 to 144)	35 (0 to 118)
	months 4 to 6	12 (0 to 43)	24 (1 to 77)	18 (1 to 56)
	total	36 (0 to 131)	67 (2 to 221)	53 (1 to 175)
12 to 59mo	months 1 to 3	9 (0 to 35)	16 (0 to 57)	13 (0 to 47)
	months 4 to 6	5 (0 to 20)	11 (0 to 36)	8 (0 to 25)
	total	15 (0 to 54)	27 (0 to 94)	21 (0 to 72)
5 to 9yo	months 1 to 3	106 (-2 to 384)	183 (3 to 627)	152 (1 to 515)
	months 4 to 6	51 (0 to 187)	106 (4 to 336)	79 (2 to 244)
	total	158 (-2 to 571)	289 (7 to 963)	231 (3 to 760)
10 to 14yo	months 1 to 3	9 (0 to 33)	15 (0 to 55)	13 (0 to 44)
	months 4 to 6	4 (0 to 14)	8 (0 to 27)	6 (0 to 19)
	total	13 (0 to 48)	23 (0 to 81)	18 (0 to 63)
15 to 19yo	months 1 to 3	27 (-1 to 102)	46 (0 to 169)	38 (-1 to 136)
	months 4 to 6	10 (0 to 40)	21 (0 to 74)	15 (0 to 51)
	total	38 (-2 to 141)	68 (0 to 243)	53 (-1 to 186)
20 to 29yo	months 1 to 3	53 (-3 to 200)	90 (0 to 335)	73 (-1 to 267)
	months 4 to 6	17 (-1 to 64)	33 (0 to 121)	23 (0 to 81)
	total	70 (-4 to 263)	124 (0 to 456)	97 (-2 to 348)
30 to 39yo	months 1 to 3	60 (-3 to 225)	101 (-1 to 376)	82 (-2 to 300)
	months 4 to 6	21 (-1 to 83)	43 (0 to 159)	30 (0 to 105)
	total	81 (-4 to 308)	144 (0 to 536)	112 (-2 to 405)
40 to 49yo	months 1 to 3	29 (-1 to 110)	50 (0 to 184)	41 (-1 to 147)
	months 4 to 6	9 (0 to 34)	18 (0 to 64)	13 (0 to 43)
	total	38 (-2 to 144)	68 (0 to 248)	54 (-1 to 190)
50 to 59yo	months 1 to 3	117 (-7 to 440)	197 (-1 to 737)	160 (-4 to 586)
	months 4 to 6	41 (-2 to 159)	82 (1 to 307)	57 (-1 to 201)
	total	158 (-9 to 599)	279 (-1 to 1,044)	217 (-5 to 787)
60 to 69yo	months 1 to 3	134 (-8 to 506)	226 (-1 to 847)	183 (-4 to 673)
	months 4 to 6	72 (-4 to 282)	144 (1 to 542)	100 (-2 to 354)
	total	206 (-12 to 788)	370 (-1 to 1,388)	284 (-6 to 1,028)
70 to 79yo	months 1 to 3	203 (-11 to 762)	343 (-1 to 1,264)	280 (-5 to 1,012)
	months 4 to 6	107 (-5 to 413)	213 (2 to 783)	151 (-2 to 521)
	total	310 (-16 to 1,175)	556 (1 to 2,047)	430 (-7 to 1,533)
≥ 80yo	months 1 to 3	259 (-15 to 975)	431 (-3 to 1,609)	352 (-8 to 1,289)
	months 4 to 6	138 (-8 to 537)	271 (2 to 1,017)	191 (-3 to 672)
	total	397 (-23 to 1,512)	702 (-1 to 2,626)	543 (-11 to 1,960)

Table S16. Projected excess death toll (mean and 95% uncertainty interval) due to epidemic infections, by age, scenario and period.

Age	Period	Scenario		
		ceasefire	status quo	escalation
0mo	months 1 to 3	3 (0 to 34)	5 (0 to 58)	7 (0 to 86)
	months 4 to 6	7 (0 to 82)	13 (0 to 148)	17 (0 to 174)
	total	10 (0 to 116)	18 (0 to 206)	24 (0 to 260)
1 to 11mo	months 1 to 3	35 (0 to 480)	61 (0 to 866)	93 (0 to 1,218)
	months 4 to 6	115 (0 to 1,206)	200 (0 to 2,013)	297 (0 to 2,769)
	total	150 (0 to 1,686)	261 (0 to 2,879)	390 (0 to 3,987)
12 to 59mo	months 1 to 3	135 (0 to 1,602)	216 (0 to 2,832)	300 (0 to 4,279)
	months 4 to 6	301 (0 to 3,836)	536 (0 to 6,971)	698 (0 to 8,504)
	total	436 (0 to 5,438)	752 (0 to 9,803)	998 (0 to 12,783)
5 to 9yo	months 1 to 3	120 (0 to 1,473)	198 (0 to 2,540)	281 (0 to 3,876)
	months 4 to 6	291 (0 to 3,571)	546 (0 to 6,658)	756 (0 to 8,064)
	total	411 (0 to 5,044)	744 (0 to 9,198)	1,037 (0 to 11,940)
10 to 14yo	months 1 to 3	136 (0 to 1,719)	215 (0 to 2,651)	301 (0 to 3,917)
	months 4 to 6	307 (0 to 3,528)	530 (0 to 6,368)	699 (0 to 7,765)
	total	443 (0 to 5,247)	745 (0 to 9,019)	1,000 (0 to 11,682)
15 to 19yo	months 1 to 3	222 (0 to 2,794)	349 (0 to 4,507)	498 (0 to 6,070)
	months 4 to 6	531 (0 to 5,806)	902 (0 to 10,139)	1,202 (0 to 12,478)
	total	753 (0 to 8,600)	1,251 (0 to 14,646)	1,700 (0 to 18,548)
20 to 29yo	months 1 to 3	219 (0 to 2,947)	342 (0 to 4,692)	489 (0 to 6,041)
	months 4 to 6	513 (0 to 5,528)	850 (0 to 9,026)	1,145 (0 to 11,068)
	total	732 (0 to 8,475)	1,192 (0 to 13,718)	1,634 (0 to 17,109)
30 to 39yo	months 1 to 3	211 (0 to 2,645)	332 (0 to 4,265)	464 (0 to 5,899)
	months 4 to 6	463 (0 to 5,159)	786 (0 to 9,062)	1,037 (0 to 11,088)
	total	674 (0 to 7,804)	1,118 (0 to 13,327)	1,501 (0 to 16,987)
40 to 49yo	months 1 to 3	140 (0 to 1,697)	222 (0 to 2,893)	308 (0 to 4,365)
	months 4 to 6	309 (0 to 3,923)	549 (0 to 7,129)	712 (0 to 8,707)
	total	449 (0 to 5,620)	771 (0 to 10,022)	1,020 (0 to 13,072)
50 to 59yo	months 1 to 3	137 (0 to 1,717)	215 (0 to 2,784)	301 (0 to 3,764)
	months 4 to 6	303 (0 to 3,349)	513 (0 to 5,878)	678 (0 to 7,134)
	total	440 (0 to 5,066)	728 (0 to 8,662)	979 (0 to 10,898)
60 to 69yo	months 1 to 3	94 (0 to 1,152)	147 (0 to 1,783)	208 (0 to 2,687)
	months 4 to 6	220 (0 to 2,553)	380 (0 to 4,632)	495 (0 to 5,609)
	total	314 (0 to 3,705)	527 (0 to 6,415)	703 (0 to 8,296)
70 to 79yo	months 1 to 3	52 (0 to 661)	82 (0 to 1,048)	113 (0 to 1,524)
	months 4 to 6	112 (0 to 1,363)	192 (0 to 2,386)	249 (0 to 2,920)
	total	164 (0 to 2,024)	274 (0 to 3,434)	362 (0 to 4,444)
≥ 80yo	months 1 to 3	17 (0 to 231)	29 (0 to 398)	38 (0 to 509)
	months 4 to 6	32 (0 to 380)	54 (0 to 695)	73 (0 to 837)
	total	49 (0 to 611)	83 (0 to 1,093)	111 (0 to 1,346)

Maternal and neonatal health

Table S17. Additional maternal deaths expected to occur over the six-month projection period, by intervention.

Total excess by intervention	ceasefire	status quo	escalation
Micronutrient supplementation (iron and multiple micronutrients)	0	0	0
Hypertensive disorder case management	0	1	1
Clean birth environment	0	1	2
Antibiotics for preterm PROM	0	1	2
MgSO4 for eclampsia	1	2	3
Uterotonics for postpartum haemorrhage	4	6	9
Antibiotics for maternal sepsis	1	3	5
Assisted vaginal delivery	0	0	1
Manual removal of placenta	0	1	1
Removal of retained products of conception	0	1	1
Caesarean delivery	0	0	0
Blood transfusion	0	2	3
Total excess by grouped intervention			
Antenatal care	0	1	1
Health facility childbirth care	6	17	27
Total excess maternal deaths	**7**	**18**	**28**
Total maternal deaths including those occurring at pre-war levels	**15**	**27**	**37**

* some number do not add up due to rounding of interventions

Table S18. Additional neonatal deaths expected to occur over the six-month projection period, by intervention.

Total excess by intervention	Ceasefire	Status Quo	Escalation
Syphilis detection and treatment	1	1	2
Thermal protection	11	21	34
Clean cord care	4	8	13
Clean birth environment	2	4	7
Immediate drying and additional stimulation	6	12	20
Neonatal resuscitation	16	28	41
Antibiotics for preterm PROM	4	8	10
Assisted vaginal delivery	6	20	33
Caesarean delivery	0	3	6
Age-appropriate breastfeeding practices	13	21	48
External shock to food security	0	1	1
Basic sanitation	0	0	0
Point-of-use filtered water	0	0	0
Piped water	0	0	0
Hand washing with soap	0	0	0
Case management of neonatal sepsis/pneumonia	28	62	85
ORS - oral rehydration solution	0	0	0
Antibiotics for treatment of dysentery	0	0	0
Total excess by grouped intervention			
Antenatal care	1	1	2
Health facility childbirth care	49	103	162
Breastfeeding	13	21	48
WASH	0	0	0
Curative neonatal care	28	63	87
Food insecurity	0	1	1
Total excess neonatal deaths (excluding traumatic injury deaths)	**91**	**189**	**300**
Total deaths including pre-war levels (excluding traumatic injury deaths)	**426**	**523**	**634**

Table S19. Additional stillbirths expected to occur over the six-month projection period, by intervention.

Total excess by intervention	Ceasefire	Status Quo	Escalation
Syphilis detection and treatment	6	9	10
Hypertensive disorder case management	1	2	3
Diabetes case management	3	5	5
Assisted vaginal delivery	10	35	57
Caesarean delivery	0	6	10
Induction of labour for pregnancies lasting 41+ weeks	5	13	15
External shock to food security	15	43	58
Total excess by grouped intervention			
Antenatal care	11	16	18
Health facility childbirth care	15	54	82
Food insecurity	15	43	58
Total excess stillbirths (excluding traumatic injury deaths)	**40**	**113**	**158**
Total stillbirths including pre-war levels (excluding traumatic injury)	**380**	**453**	**499**

Non-communicable diseases

Table S20. Projected excess death toll (mean and 95% uncertainty interval) due to non-communicable diseases, by age, scenario, and period.

Age	Period	Scenario		
		ceasefire	status quo	escalation
0mo	months 1 to 3	0 (0 to 0)	0 (0 to 0)	0 (0 to 0)
	months 4 to 6	0 (0 to 0)	0 (0 to 0)	0 (0 to 0)
	total	0 (0 to 0)	0 (0 to 0)	0 (0 to 0)
1 to 11mo	months 1 to 3	0 (0 to 0)	1 (0 to 1)	1 (1 to 1)
	months 4 to 6	0 (0 to 0)	1 (0 to 1)	1 (1 to 1)
	total	0 (0 to 1)	1 (1 to 2)	2 (1 to 3)
12 to 59mo	months 1 to 3	0 (0 to 1)	3 (1 to 5)	4 (2 to 6)
	months 4 to 6	0 (0 to 1)	3 (1 to 4)	4 (2 to 6)
	total	1 (0 to 3)	5 (3 to 9)	8 (4 to 12)
5 to 9yo	months 1 to 3	1 (0 to 2)	3 (2 to 5)	4 (2 to 6)
	months 4 to 6	1 (0 to 2)	3 (1 to 5)	4 (2 to 6)
	total	1 (0 to 3)	6 (3 to 10)	8 (5 to 13)
10 to 14yo	months 1 to 3	1 (0 to 2)	3 (2 to 5)	4 (2 to 6)
	months 4 to 6	1 (0 to 2)	3 (1 to 5)	4 (2 to 6)
	total	1 (0 to 3)	6 (3 to 9)	8 (5 to 12)
15 to 19yo	months 1 to 3	3 (1 to 6)	11 (6 to 18)	15 (9 to 23)
	months 4 to 6	2 (0 to 6)	11 (6 to 17)	14 (9 to 22)
	total	5 (1 to 13)	22 (12 to 35)	30 (17 to 45)
20 to 29yo	months 1 to 3	8 (4 to 15)	22 (14 to 35)	30 (18 to 44)
	months 4 to 6	7 (3 to 14)	22 (13 to 33)	28 (18 to 41)
	total	15 (6 to 29)	44 (26 to 68)	58 (36 to 85)
30 to 39yo	months 1 to 3	16 (11 to 25)	31 (21 to 44)	38 (25 to 52)
	months 4 to 6	14 (8 to 22)	30 (20 to 42)	35 (24 to 49)
	total	30 (19 to 46)	61 (41 to 86)	73 (50 to 100)
40 to 49yo	months 1 to 3	51 (37 to 71)	83 (62 to 111)	96 (71 to 126)
	months 4 to 6	43 (30 to 61)	81 (59 to 107)	91 (67 to 120)
	total	94 (67 to 132)	164 (120 to 217)	188 (138 to 246)
50 to 59yo	months 1 to 3	118 (93 to 151)	166 (132 to 205)	180 (143 to 222)
	months 4 to 6	99 (74 to 129)	159 (125 to 199)	172 (135 to 213)
	total	217 (167 to 281)	325 (257 to 404)	352 (278 to 435)
60 to 69yo	months 1 to 3	176 (140 to 220)	236 (192 to 287)	253 (206 to 306)
	months 4 to 6	146 (112 to 188)	227 (183 to 278)	241 (194 to 294)
	total	322 (252 to 408)	464 (375 to 565)	494 (400 to 600)
70 to 79yo	months 1 to 3	223 (177 to 278)	293 (239 to 353)	311 (254 to 374)
	months 4 to 6	186 (142 to 238)	283 (228 to 344)	297 (241 to 361)
	total	409 (320 to 515)	576 (467 to 697)	609 (495 to 735)
≥ 80yo	months 1 to 3	318 (256 to 387)	409 (340 to 485)	431 (359 to 509)
	months 4 to 6	267 (209 to 334)	398 (328 to 475)	416 (344 to 497)
	total	585 (466 to 722)	807 (669 to 960)	847 (703 to 1,005)