

**MORTALITY OF CARDIOVASCULAR DISEASES IN GAZA DURING THE  
ISRAELI MILITARY OPERATION**

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**Background**

Gaza health system collapsed after 7 October 2023 under the destruction wrought by Israel's military operation combined with the tightening of Israel's 16-year illegal blockade. The healthcare system of Gaza was destroyed by Israeli attacks on hospitals and health facilities by blockade of medical supplies from entering Gaza and killing of healthcare workers. In this article we assess the effect of Israeli military operation of Gaza on total mortality and cardiovascular mortality.

**Methods**

We evaluate the number of total and cardiovascular death, number of cardiology centers were destroyed, the number of cardiologist still working in ministry of health hospitals and treatment options of cardiovascular diseases during Israeli military operation after 7 October 2023 (during 290 days) in Gaza Strip.

**Result**

After 290 days from 7 October 2023 of Gaza War. Applying a conservative estimate of four indirect deaths per one direct death to the 39 006 deaths reported by ministry of health in Gaza, it is not implausible to estimate that up to 195 000 or even more deaths could be attributable to the current conflict in Gaza. This would translate to 8.2% of the total population in the Gaza Strip. And the total mortality related to cardiovascular disease at least 46800 death. A 3 from 4 (75%) cardiology department were destroyed, the number of boarded cardiologist still working in Ministry of health hospitals are two (22%) from nine cardiologist. The most drugs treatment of cardiovascular diseases are not available and if available they are very expensive. No any pacemaker, ICD or CRT devices were implanted during this period.

**Conclusion**

After 7 October 2023, The Israeli army killed over 1.7 % of the Gaza's population, but the total death effect more than 8.2 % of the Gaza's population and 46800 cardiovascular death due to the dramatically destroyed of most of cardiology department, cardiac catheterization laboratory and cardiac surgery departments and lack of optimal treatment drugs and most of cardiologist were dead or injured or migrated to another countries.

**Key words;** Cardiovascular disease, Mortality rate, Gaza

### **Introduction**

The Gaza Strip is about 365 square kilometers and contains 2.3 million people, making it one of the world's most densely populated regions. The narrow area of land is located on the coast of the Mediterranean Sea. Gaza has a southern border crossing with Egypt, and the border separating Gaza and Israel is Ariz.

### **Health services in Gaza**

Four main sectors supervise the provision of health services in Gaza: the government Ministry of Health (MOH) hospitals, UNRWA, NGOs and the private sector. These sectors played a complementary role in improving health services and the health situation in Gaza over the past decade. In the last of 2021 total 35 hospitals with total number of hospital beds 3,026 in Gaza Strip (1)

### **The Palestinian population in Gaza**

The most Palestinian population is young, the percentage of individuals aged (0-14) years constituted 41% in Gaza Strip. The percentage of elderly population aged (65 years and above) at the end of 2022 reached 3% in Gaza Strip). (1)

### **Mortality and birth in 2022**

According to Palestinian ministry of health annual report in 2022 total 5518 death and 56614 birth were recoded. Daily death rate 15 cases (one death every 92 minutes) and daily birth rate 155 (one birth every 9 minutes). The most common of causes of death about (30%) between (2015-2022) in Gaza related to cardiovascular and cerebrovascular diseases. (1)

### **The prevalence of chronic diseases**

The percentage of individuals aged 18 years and above with at least one chronic disease has increased slightly over the past decade, reaching about 20% in 2021. The prevalence of chronic diseases increases with age, where data showed that more than two-thirds of the elderly in Palestine in 2021 suffer from at least one chronic disease. This percentage varied greatly between males and females, reaching 66% and 76%, respectively.

In recent Israeli military operation, such indirect deaths range from three to 15 times the number of direct deaths. Applying a conservative estimate of four indirect deaths per one direct death (2), it is not implausible to estimate that up to 186000 or even more deaths could be attributable to the current conflict in Gaza. Using the 2022 Gaza Strip population estimate of 2 375 259, this would translate to 7.9% of the total population in the Gaza Strip (3)

### **Cardiology Department resources**

There are 4 cardiology departments in Gaza Strip

### **PCI resources**

There are 6 percutaneous coronary intervention (PCI) centers which performed 2.300 PCIs in 2022; 58% of all PCI procedures were acute interventions.

### **CABG resources**

There are 4 coronary artery bypass grafting centers (CABG) centers which performed 196 PCIs in 2022; another patient (about 300 cases) who needs CABG were transferred to west Bank, Jordan, or Egypt.

### **Cardiologists and cardiac surgeon**

There are 11 boarded cardiologist, and 3 cardiac surgeons working at governmental hospitals in Gaza.

### **Programs of cardiovascular disease in Gaza**

#### **1-Over the past years two programs were successfully carried out:**

- The Gaza stroke program of prophylaxis and treatment of acute ischemic stroke 2021 (more than 95 cases with mechanical thrombectomy was done) (4)
- The Gaza primary PCI Program treatment of STEMI patients in Gaza 2014 (more than 3000 primary PCI was done). (5)

### **2-Palestinian board General Cardiologist**

Palestinian board General Cardiologist started at 2018 in Gaza.

Duration of Educations: The recommended duration of postgraduate education is a minimum of 6 years, to include 2 years of common trunk (internal medicine and/or related specialties) and a minimum of 4 years of full-time and exclusive training in cardiology.

Place of education: Al- Shifa Hospital: Cardiology and Cardiac Catheterization Department, Cardiac surgery Department, internal medicine hospital, cardiac surgery, vascular surgery and Radiology Department

### **3- Subspecialty of cardiology board**

In November 2023 we shall started the subspecialty of intervention cardiology for 2 years and echocardiography for one year. This activity was stopped duo to Gaza war.

### **Population growth rate in Gaza**

2.25% (2018 estimated)

### **Birth rate in Gaza.**

30.5 births/1,000 population (2018 estimated.)

### **Mortality rate in Gaza**

3 deaths/1,000 population (2018 estimated.). The cardiovascular disease (CVD) mortality have accounts for 46 % of the total mortality in the country

### **The leading causes of death in Gaza (6)**

According to Ministry of health annual report 2016:

- The number of reported deaths in Palestine was 10,940 with 7,177 deaths occurred in West Bank, accounting for 65.5% of the reported deaths in Palestine while in Gaza Strip 3,763 deaths occurred, accounting for 34.4% of the reported in Palestine.
- Cardiovascular disease was the main leading cause of deaths in Palestine, reported at 30.6% of total deaths in 2016, followed by cancer reported at 14.0%, while stroke was the third leading cause of death reported at 12.8% from the total deaths.
- Cardiovascular diseases remain the leading cause of death among Palestinians, accounting

for 30.3% of deaths recorded in 2017.

- Cancer was the second leading cause of death, with 14.7% of deaths.
- Cerebrovascular diseases were the third leading cause of death, with 11.7% of causes leading to death.

### **Stroke in Gaza.**

- 2450 cases with ischemic stroke in Gaza. Total Ischemic Stroke in Gaza: 2050 Cases
- Every 18.5 hrs. one Palestinian died from stroke

In the morning of October 7, 2023, Israel's military operation began with genocide of Gaza. During the Israel war on Gaza, the healthcare system of Gaza was destroyed by Israeli attacks on hospitals and health facilities, killing multiple of doctors, nurses and other healthcare workers, and blockade of medical supplies from entering Gaza. The resulting collapse of the healthcare system was part of a broader humanitarian crisis in the Gaza Strip caused by the war. The hospitals faced a lack of fuel due to the Israeli siege and relied on backup generators for the first two weeks of the war. By 23 October, Gaza hospitals began shutting down as they ran out of fuel, starting with the Indonesia Hospital. When hospitals lost power completely, multiple injured patient, cardiac patient in coronary care unit and premature babies in NICUs died. By late-October, the Gaza Health Ministry stated the healthcare system had "totally collapsed", while on January 13 out of Gaza's 35 hospitals reportedly remained partially functional. At 12 November two of Gaza's main hospitals, Al-Shifa and Al-Quds, closed down. At 18 November 2023 an evacuation of al-Shifa began. The hospital stated six doctors would remain behind with 120 patients too sick to be transferred and "we were forced to leave at gunpoint at this time. In this trial we evaluate the efficacy of Israel's military operation on health sector of Gaza after 290 days of genocide

### **Methods**

1. We calculate Estimated number of total death and cardiovascular death
2. We calculate the number of cardiac departments, cardiac catheterization laboratory and cardiac surgery department which still working after 290 days October 2023.
3. We describe the daily mortality rate in Gaza at 2023 during 290 days before of 7 October and 290 days after 7 October 2023.
4. We describe the drug availability in Gaza after 7 October 2023

### **Results**

#### **1-Estimated total death**

After 290 days of Gaza War indirect deaths range from three to 15 times the number of direct deaths. Applying a conservative estimate of four indirect deaths per one direct death to the 39 006 deaths reported [at the after 290 days], it is not implausible to estimate that up to 195 000 or even more deaths could be attributable to the current conflict in Gaza. This would translate to 8.2% of the total population in the Gaza Strip. And the total mortality related to cardiovascular disease at least 46800 death. ( with cardiovascular death estimated about 22.5 according to Palestinian ministry of health 2020-2023 annual report) (1,6)

**2-Number of cardiac departments, cardiac catheterization laboratory and cardiac surgery department which still working after 280 days October 2023**

Before 7 October 2023. total 35 hospitals with total number of hospital beds 3,026 in Gaza Strip. As of this writing, 32 hospitals were destroyed and cannot be restored. The total cardiac catheterization laboratory (CCL) was 6 in Gaza. 2 CCL in the government health hospitals (Alshifa hospital and European Gaza Hospital), 2 CCL in at NGOs (Al-Quds hospital and Public Aid hospital) and 2 CCL in private (Al-Hayat hospital and Julis special center) centers ministry of health hospitals. No of this still working after 280 days of the genocide.

4 cardiac surgery department were found in Gaza. 3 (Alshifa hospital- Al-Quds hospital and public aid hospital) in Gaza city, and one (European Gaza Hospital) in south of Gaza. After 280 days no any of these still working.

Cardiology department is found in 4 hospitals one (Alshifa hospital) in Gaza city, one (Indonesian hospital) in North of Gaza, one (Al Aqsa military hospital) in middle zone of Gaza and one (European Gaza Hospital) in south of Gaza.

After 7 October; only one hospital still working after 280 days its name is Al Aqsa military hospital in mid Gaza. Table 1

Table 1 Number of cardiac departments before and after 7 October.

|                                    | Before 7 October | After 7 October               |
|------------------------------------|------------------|-------------------------------|
| Cardiac catheterization laboratory | 6                | 0                             |
| Cardiac surgery                    | 4                | 0                             |
| Cardiology department              | 4                | 1 (Al Aqsa military hospital) |
| Boarded cardiologist               | 9                | 2                             |

**3- The daily morality rate in Gaza at 2023 during 290 days before of 7 October and 290 days after 7 October 2023**

Since the first days of the war, the Gaza health care system has suffered. The logistics of helping all patients, especially patients with combined cardiovascular pathology and oncology, severe pulmonary hypertension, and others requiring special supervision, were destroyed. With the efforts of our doctors and the help of international funds, only some of these patients were saved and continued treatment in European Gaza hospital. Medical services have been badly disrupted especially in Alshifa hospital and Naser hospital. personnel, patients, transportation, and supply depots. After 230 days of 7 October 2023, Gaza's economy and infrastructure collapsed because of destruction wrought by Israel's military operation combined with the tightening of Israel's 16-year illegal blockade. After the first month of conflict, the UN Development Program found that 96% of people in Gaza needed basic support for survival. In Gaza, Israeli forces killed 39006 Palestinians, with an average rate of 134 people a day making 2024 the deadliest years since at least 1967. Whereas the daily death rate before 7 October was 14 cases. And the most common causes of death is cardiovascular diseases about 20-25% of total death. Furthermore, Palestinian MoH data did not differentiate between whether deaths were caused directly (e.g., trauma injuries) or

indirectly (e.g., through service disruptions or inability to access health care) by the war.

#### **4-Drugs and devices availability in Gaza after 7 October 2023**

After 7 October, the most of drugs for hypertension, dyslipidemia and diabetes such as angiotensin converting enzyme inhibitors, angiotensin receptor blockers, aldosterone antagonist and statins are limited available but at same time they are very expensive and Sodium glucose cotransport inhibitors such as (dapagliflozin and empagliflozin) and Angiotensin receptor-neprilysin inhibitor are not available in Gaza.

After 7 October no any pacemaker, ICD or CRT were implanted in Gaza.

For ST elevation myocardial infarction, no primary PCI nor any thrombolytic are available, so that the mortality and Herat failure incidence is dramatically increased.

The oral anticoagulation are finished so that the thromboembolism attacks are increased among patients with prosthetic cardiac valve and atrial fibrillation.

Only available drugs are heparin, many limited of antihypertensive such as diuretics and antidiabetic drugs such as metformin and Aspirin.

Because of destroyed of Alshifa hospital and other private hospital cardiac catheterization laboratory in Gaza during Alshifa hospital siege and absent of primary PCI and pharmacoinvasive PCI facility and because of finishing of Fibrinolytics treatment the risk of total mortality, cardiovascular mortality, sudden cardiac death and developing heart failure after ST elevation myocardial infarction significantly increased.

In Gaza strip about 2500-3000 patients have Pacemaker, defibrillator and cardiac resynchronization therapy device. The programming device of pacemaker and implantable cardioverter defibrillator (St-jude, Medtronic, Biotronik and Abbot) are destroyed at Alshifa hospital during hospital siege. So that we cannot replacement or programming any arrhythmogenic cardiac device for needed patient with life threatening rhythm disorder and that leading to increasing risk of sudden cardiac death in Gaza.

We also calculate the daily number of percutaneous coronary interventions (PCI), cardiac surgery operation during 290 days before and after 7 October 2023. The PCI daily average before 7 October was 16 cases/day. After 7 October the total PCI for 290 days were 89 cases, the average cardiac surgery was 1.5 cases per day but after 7 October no any case was done.

The number of boarded cardiologists in Gaza were 11, now just 2 boarded cardiologists in Gaza. Because of 2 cardiologists died and one cardiologist injured during this war and another migrated to another countries.

#### **Discussion**

The war that started on October 7, 2023 has killed over 1.7 % of the Gaza's population. At least 80% of the population is internally displaced. Most of hospitals and cardiac departments

are destroyed. In previous trial (7) a marked increase was observed in a 65.7% increase of the frequency of STEMI admissions at war 2014 in Gaza. Oxfam calculated that the number of average deaths per day for Gaza is higher than any recent major armed conflict including Syria (96.5 deaths per day), Sudan (51.6), Iraq (50.8), Ukraine (43.9) Afghanistan (23.8) and Yemen (15.8) (8).

According to recent data from Lancet journals the recent Israeli military operation, such indirect deaths range from three to 15 times the number of direct deaths. Applying a conservative estimate of four indirect deaths per one direct death (2), and the most of death are related to cardiovascular diseases.

Another factors increased the risk mortality of cardiovascular disease Infectious diseases in Gaza during War is Infectious diseases. Existing outbreaks of diarrheal diseases and hepatitis A, amongst others, are further indicators of the dramatic state of health, affected by the dire water and sanitation conditions affecting everyone in the Gaza Strip. According to the World Health Organization (WHO) since 16 October until 13 February 2024, there have been 312,693 reported cases of acute respiratory infections, 222,620 cases of acute watery diarrhea (117,989 of which are children under 5 years old), 74,712 cases of scabies and lice, 49,052 cases of skin rashes, 6,625 cases of chickenpox and 8,829 cases of acute jaundice, surpassing by far the incidence of previous years. The cases reported so far give only a limited view of the extent of the public health catastrophe, where lack of capacities to detect, diagnose and report on infectious disease outbreaks are masking the true scale and impact of the human health emergency. Moreover, diseases spread freely, for example those presenting with hepatitis A are likely to have already been infectious to others for several weeks. Even where diseases can be detected and diagnosed based on symptoms, the availability of clean water, safe sanitation, shelter, health infrastructure and humanitarian supplies to respond to and prevent outbreaks, including isolation to prevent spread and contamination, is grossly lacking.

Call for Action: measures immediately needed to stop the worsening of an already existing public health catastrophe in the Gaza Strip:

1. An immediate and sustained ceasefire. Integral to any effective Health and WASH response is the cessation of hostilities that allows for safe and unobstructed access to populations in need, particularly in the north of Gaza where access to water, waste-water facilities, hospitals, and health centers is close to non-existent.
2. Safe, unimpeded, and at-scale humanitarian access across and within the Gaza Strip, including in the North, ensuring that essential non-food items needed for an effective Health and WASH response enter immediately and unimpeded.
3. Ensure free and safe movement of medical and humanitarian personnel into and within the Gaza Strip. Ensuring safe access, unobstructed communication, and adequate coordination of activities is essential to an effective response.
4. Immediately turn to full capacity the Mekorot water pipeline into Gaza.
5. For sufficient fuel for the operation of critical water and sanitation infrastructure. Including desalination plants and water wells, particularly in restricted areas such as the northern Gaza.
6. A viability of all needed cardiovascular drugs.
7. Activities of at least one of cardiac catheterization laboratory in any private hospital in Gaza.

## **Conclusion**

The number of average deaths per day for Gaza is higher than any recent major armed conflict in the world. The Israeli army killed over 1.7 % of the Gaza's population. It is not implausible to estimate that up to 195 000 or even more deaths could be attributable to the current conflict in Gaza. This would translate to 8.2% of the total population in the Gaza Strip. And the total mortality related to cardiovascular disease at least 46800 death. The mortality related to cardiac disease is increased duo to destruction of most cardiac surgery and cardiac catheterizations departments and related to dead or injured or migrated most of boarded cardiologist in Gaza. And to lack of availability of most cardiovascular drugs.

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