



Cancer status in the Occupied Palestinian Territories: types; incidence; mortality; sex, age, and geography distribution; and possible causes

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Abstract

Cancer is a disease in which some cells of the body grow uncontrollably and occasionally spread to other parts of the body. With a group of more than 100 different types, cancer can start almost anywhere in the body. Defective cells may form a mass called a tumor which can be cancerous (malignant), which grows and spreads to other parts of the body, or benign that can grow but not spread throughout the body. In 2021, more than 10 million people died of cancer worldwide (1 out of 6 deaths). This paper has thoroughly investigated the cancer status in the Occupied Palestinian Territories (OPT), in terms of its various types; incidence; mortality; sex, age, and geography distribution; and potential causes. In the OPT, with a population of 5.35 million, cancer mortality was 14% in 2016, being the second cause of death after cardiovascular diseases accounting 30.6% of all causes of death. Cancer mortality in the OPT increased by 136% from 2000 to 2016, and by 14% from 2016 to 2020. In addition to other types of cancer in the OPT, its main types are lung (highest in males), breast (highest in females), colorectal (highest in both sexes), and leukemia (highest in children). The high rates of different types of cancer in the OPT can be attributed to various causes, including those related to environmental pollution, nutrition, stress, and lifestyle factors (smoking, lack of activity, increased dependence on technologies, etc.), whereas only 10–30% of cancer cases are attributed to genetics.

Keywords Cancer types, sex, age and geography distribution · Possible causes of cancer · Occupied Palestinian Territories (OPT: West Bank, including East Jerusalem, and Gaza Strip)

Abbreviations

ABO	A, B, and O blood groups	EMF	Electromagnetic field
ACS	American Cancer Society	EU	European Union
AD	Anno Domini, Latin for “in the year of the Lord”	FAP	Familial adenomatous polyposis
BC	Before Christ	HIV	Human immunodeficiency virus
BC	Black carbon	HL	Hodgkin’s lymphoma
BMI	Body mass index	HTLV	Human T-lymphotropic virus
BRCA1	Breast cancer 1 gene	ICT	Information and Communication Technologies
BRCA2	Breast cancer 2 gene	IL-6	Interleukin-6 protein
CMV	Cytomegalovirus	KRAS	Kirsten rat sarcoma
COPD	Chronic obstructive pulmonary disease	LSI	Limestone industry
COVID-19	Corona virus disease 2019	MHLW	Ministry of Health, Labor and Welfare, Japan
DNA	Deoxyribonucleic acid	NHL	Non-Hodgkin’s lymphoma
DSBs	Double-strand breaks, DNA	NO	Nitric oxide
EBV	Epstein–Barr virus	NO ₂	Nitrogen dioxide
		NO ₃	Nitrates
		NO _x	Nitrogen oxides
		O ₃	Ozone
		OC	Organic carbon
		OPT	Occupied Palestinian Territories
		PAHs	Polycyclic aromatic hydrocarbons

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PET	Positron Emission Tomography
PM _s	Particulate matter
SO ₂	Sulfur dioxide
SO ₄	Sulfate
TSP	Total suspended particulates
UCSD	University of California, San Diego
UFP	Ultrafine particulate matter
UN	United Nations
UNRWA	United Nations Relief and Works Agency for Palestine Refugees
WEEE	Waste of electric and electronic equipment
WHO	World Health Organization, UN
Units	
kg	Kilogram
km ²	Kilometer square
m	Meter
m ³	Cubic meter
mg/l	Milligram per liter
µg/m ³	Microgram per cubic meter
PM ₁	Particulate matter size of 1.0 micron or less
PM _{2.5}	Particulate matter size of 2.5 micron or less
PM ₇	Particulate matter size of 7.0 micron or less
PM ₁₀	Particulate matter size of 10.0 micron or less
ppb	Parts per billion

Introduction

Cancer diseases through history

In Greek, this word “CANCER” refers to the sea animal, known as “crab”, which is most likely applied to the cancer diseases. This is because the cancer spreading in human body, which is made up of trillions of cells, is similar to the finger-like projections, as being called crab-shaped. The Roman physician Celsus (25 BC–50 AD) later translated the Greek term to cancer, which is the Latin word for crab. According to the American Cancer Society (ACS) (2018), humans and animals have had cancer throughout recorded history. So, it is not surprising that since the dawn of history people have written about cancer. The oldest description of cancer (although the word “cancer” was not used) was discovered in ancient Egypt (Pharos times), which is dated back to around 3000 BC.

Some of the oldest evidence of cancer was found amongst fossilized bone tumors, human mummies in ancient Egypt and ancient manuscripts. Tumors suggestive of bone cancer called “osteosarcoma” have been seen in Egyptian mummies. Bony skull destruction was found as evident in head and neck carcinomas. It is called the Edwin Smith Papyrus (van Middendorp et al. 2010), which is a copy of a fragment of an ancient Egyptian textbook on accident surgery. The

book describes 8 cases of breast tumors or ulcers that were removed by cauterization with an instrument called a “fire drill”. The book says about the disease, “*There is no treatment [or cure]*”. In 1761, Giovanni Morgagni (1682–1771, University of Padua, Italy) was the first to do something that is routine today, as he performed autopsies to correlate a patient’s illness with pathological outcomes after death, which laid the foundation for “Oncology”, as being, nowadays, the science of cancer. The famous Scottish surgeon John Hunter (1728–1793) suggested that some types of cancer could be cured by surgery, as he described how a surgeon could decide which types of cancer to operate on. If the tumor has not invaded nearby tissues and is “mobile,” he said, “*there is nothing wrong with removing it.*”

Islamic medicine is regarded as a comprehensive medical school with a long, glorious, and worldwide reputation. As regards to cancer, Emami et al. (2012), investigated methods of diagnosis and treatment of cancer from the viewpoint of five famous physicians (before the Mongolian attack) who used Islamic medicine, namely Rhazes, Akhaveyni, Ahwazi, Avicenna, and Jorjani, which is dated back to the period between the eighth century and fourteenth century. The nineteenth century saw the birth of oncology, using the modern microscope to study diseased tissues. Rudolf Virchow (a German physician, 1821–1902, often called the founder or “Father of Cytopathology”—modern pathology) provided the scientific basis for the modern pathological study of cancer. Since Giovanni Morgagni (mentioned above) linked the autopsy findings with the naked eye to the clinical course of the disease, so Rudolf Virchow linked microscopic pathology to the disease. However, this method not only allowed for a better understanding of the damage done by cancer, but also aided in the development of cancer therapy, including surgery. The body tissue removed by surgeons can now be examined and an approximate or accurate diagnosis can be made. The pathologist can also tell surgeons whether the operation completely removed the tumor or not.

Cancer situation worldwide: some examples

Growth rates in cancer incidence and mortality are amongst the highest globally. In 2021 (the latest year for which there are global data), more than 10 million people died of cancer worldwide—that is 1 out of every 6 deaths. More than 600,000 cancer deaths occur in the USA each year, about 80,000 deaths occur in Canada, and the rest takes place in countries all over the world. About 7 out of every 10 deaths from the disease occur in low-income or middle-income countries (Morgan 2022). Cancer deaths are rising globally, and experts expect that the number of cancer deaths will continue to rise, worldwide. It is estimated that the annual rate of cancer deaths will reach 16 million people by 2040 (Morgan 2022). The reason is that there will be more people,

and many of them will be elderly in addition to other reasons. In some parts of the world, smoking, poor diet and unhealthy food, physical inactivity, fewer pregnancies, environmental pollution, heavily use and reliance on advanced technologies, and stress are some of the factors that play a role in the high escalation of the number of cancer incidence and death cases. Following are some examples on the cancer status, worldwide. These examples include the USA, India, Japan, China, Europe, Africa, and the Arab region, as well as the Occupied Palestinian Territories (OPT), as being the focus of the present work.

USA: In the USA, the number of deaths is generally rising, though the cancer death rate per 100,000 people is declining. The estimated (projected) numbers in the United States for 2022 are about 1.92 million new diagnosed cancer cases and 609,360 cancer deaths, including approximately 350 deaths per day from lung cancer—the leading cause of cancer death (Siegel et al. 2022). The ACS estimates indicated that, in 2022, the top causes of cancer death in the USA will include lung cancer (130,180 deaths), colorectal cancer (52,580 deaths), pancreatic cancer (49,830 deaths), breast cancer (43,780 deaths), prostate cancer (34,500 deaths), liver cancer (30,520 deaths), and melanoma cancer (7,650 deaths) (Morgan 2022). According to the ACS, the risk of dying from cancer has steadily decreased in the USA over the past 25 years. The mortality rate has decreased by 32% from 1991 to 2019. Death rates in the USA are dropping down, regarding lung, colorectal, prostate, breast, oral, pharynx (throat), cervical, and skin (melanoma) cancers, but those for liver and pancreatic cancers are on the rise. This is probably due to the facts that people in the USA smoke less and that physicians also made progress in detecting the disease early and treating it immediately after being detected.

Canada: Cancer is by far the leading cause of death amongst Canadians. According to the Canadian cancer statistics 2021 (RAC 2020; CCSAC 2021), it is estimated that about 1 in 2 or 2 in 5 at most (which is translated into 40–50%) of the Canadian population will develop cancer in their lifetime, and about 1 in 4 (25%) Canadians will die of cancer (Fig. 1).

In 2021 alone, it was expected that 229,200 Canadians will be diagnosed with cancer and 84,600 Canadians will die from its several types (CCSAC 2021). An estimated 233,900 new cancer cases and 85,100 cancer deaths will occur in Canada in 2022. The most common types of cancer diagnosed are lung cancer in both sexes (30,000), breast cancer in females (28,600), and prostate cancer in males (24,600). However, lung cancer will be the leading cause of cancer death, accounting for 24.3% of all cancer deaths, followed by colorectal cancer (11.0%), pancreatic cancer (6.7%), and breast cancer (6.5%). In general, cancer incidence and death rates are expected to be higher in the eastern (Atlantic) provinces of Canada than in the western (Pacific) provinces.

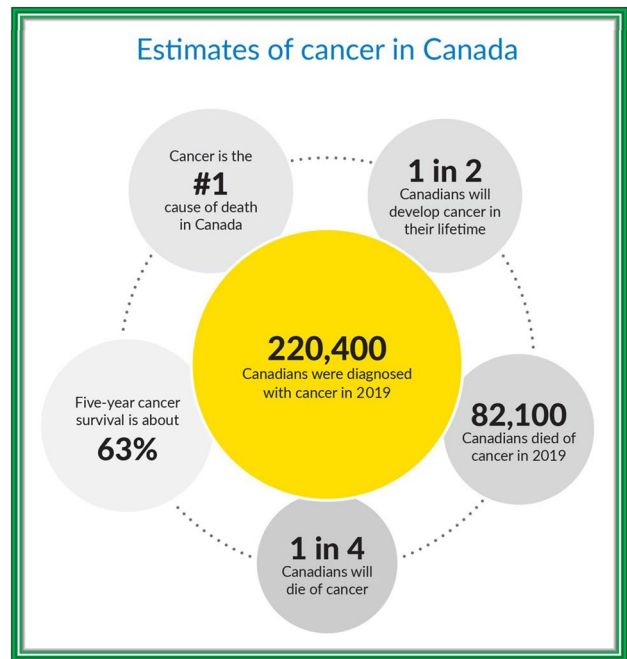


Fig. 1 Cancer status' projections in Canada in 2021 (after RAC 2020; CCSAC 2021)

These eastern provinces include Nova Scotia, Newfoundland, and Labrador (Brenner et al. 2022). The high cancer rates amongst Canadians in the eastern provinces have, particularly, been contributed by heavy tobacco smoking, heavy alcohol drinking, obesity, and aging (Rhyno 2018). Nova Scotia in eastern Canada, in particular, is the province that has the highest rates of cancer incidence and mortality. In 2015, 18 Nova Scotian residents were diagnosed daily with an invasive form of cancer. Breast, lung, and colorectal cancers accounted for 57% of all cancers diagnosed in females between 2011 and 2015. A close percentage (51%) was responsible for prostate, lung, and colorectal cancers in males (Saint-Jacques et al. 2018). In the Nova Scotia Province, the highest rates of cancer incidence and mortality were recorded in Cape Breton County, as being largely associated with lung and colorectal cancer, which exceeded the average Nova Scotia Province by 19% and 13%, respectively (Saint-Jacques et al. 2018). Exposure to carcinogens, found in the Cape Breton area, has contributed to the increased cancer risk, and is supported by the increased pattern of cancer site-specific risks (Guernsey et al. 2000).

Regarding the Indigenous population of Canada, cancer is the leading causes of death amongst them. The lack of Indigenous identifiers in health administrative databases, including cancer registries and records, has limited the measurement of Indigenous' health outcomes and the conduct of required special studies. By standard linkage, recently accumulating evidence has shown different patterns of cancer

incidence in the Indigenous population compared to the non-Indigenous population. Canada's Indigenous population has been shown to have a higher incidence of colorectal, kidney, cervical, and liver cancers, and a lower incidence of cancers of the prostate, breast, bladder, uterus, and brain, as well as non-Hodgkin's lymphoma, leukemia, and melanoma (Mazereeuw et al. 2018; Jamal et al. 2021).

India: In this country, the rates of cancer cases have increased at an average annual rate of 1.1–2.0% from 2010 to 2019, and for the same period of time cancer deaths also raised at a rate of 0.1–1.0%. This means that the rates of cancer cases (incidence and death) have increased over a 10-years' span (2010–2019) by 100%. Researchers found that the 6 main types of cancer in India are breast, lung, mouth, cervix, uterus, and tongue. Amongst males, the estimated incidence rate was 94.1 per 100,000 individuals, and amongst females, it was 103.6 per 100,000 individuals for 2020, according to the 2020 Cancer Statistics Report (Kocarnik 2022; Krishnamurthy 2022).

Japan: Cancer in Japan has been the leading cause of death since 1981, i.e., for the last 41 years and continues, accounting for 30% of all deaths recently. Ironically, according to data from the National Cancer Registry of Japan, approximately 20,000 adolescents and young adults (15–39 years old) are diagnosed with cancer each year (Nakata et al. 2022). Improvements in the treatment and care of adolescents and youth with cancer are included in a basic phase III plan to strengthen cancer's control programs in Japan.

The Japanese Government formulated a comprehensive 10-year strategy for cancer control (1984–1993) and a new 10-year strategy to beat cancer (1994–2003) for cancer treatment, followed by another 10-year strategy (2004–2013). Since 2004, the Comprehensive Ten-Year Cancer Control Strategy has been implemented to promote cancer research and disseminate high-quality cancer medical services, under the motto “Sharply Reducing Cancer Incidence and Mortality.” In May 2005, the Japanese Ministry of Health, Labor, and Welfare (MHLW) developed headquarters for cancer control to promote interdisciplinary activity for comprehensive cancer control, and formulated the 2005 Action Plan to strengthen cancer control (CSJ 2021; FPCR 2021).

Despite all the intensive efforts and much more made by the Japanese Government to combat cancer, the case rates amongst both sexes are still high. Estimated number of cancer incidence in Japan in 2020 was approximately 1,012,000 (582,200 males 429,900 females). For the same year (2020), the number of males died from cancer was 220,500 (about 38% of the incidence rate) and the number of females died was 158,900 (about 37% of the incidence rate). This means that the cancer's death percentage amongst males and females is almost the same. The top eight types of cancer in Japanese males (given in order from highest to lowest) are

lung, colorectal, stomach, pancreas, liver, prostate, gallbladder and bile ducts, esophagus; and in females (given in order from highest to lowest) are colorectal, lung, pancreas, breast, stomach, gallbladder and bile ducts, liver, and uterus (CSJ 2021; FPCR 2021). The site distribution of cancer deaths varies across age groups. For males aged 40 years or older, bowel (stomach, colorectal, liver, etc.) cancers were responsible for 50–60% of cancer deaths, and lung and prostate cancers were significant amongst those 70 years of age or older. For females aged 40–49 years, nearly half of all cancer deaths were caused by breast, uterus, and ovary cancers, while the proportion of those sites decreased and the incidence of cancer in the intestine increased with age. For both males and females under the age of 40, the incidence of bowel and lung cancer was small, and the incidence of leukemia (blood cancer) was significant compared to the older age groups. Amin et al. (2018) concluded that leukemia is a deadly hematological malignancy that usually affects all age groups and imposes a significant burden on public finances and society. Leukemia patients in Japan were examined in a pooled analysis and found that they are three exposed groups: Japanese atomic bomb survivors, women treated for cervical cancer, and irradiated patients for ankylosing spondylitis (Little et al. 1999). The treatment of leukemia patients costed the Japanese Government approximately USD 2.5 billion during the period of 1996–2014 (Amin et al. 2018).

China: The number of cancer incidence in China is estimated to increase in 2022 to reach approximately 4.82 million cases, and around 3.21 million cancer deaths, whereas the most common cancer is the lung cancer which is also the leading cause of cancer death (Xia et al. 2022). In their comparison study between China and the USA, regarding cancer status in both countries, Xia et al. (2022) found that the lower burden of cancer is in the liver, stomach, and esophagus, and the increased burden is on the lung, colorectal, breast, and prostate. This means that the profiles of cancer in China and the USA are converging. Population's aging is an increasing determinant of the increasing burden of cancer. Advances in cancer's prevention and caring, as well as measures taken to effectively respond to an aging population may help China reduce the burden of cancer.

Europe: Dyba et al. (2021) conducted a study, presenting the incidence and mortality estimates for 25 major cancer types in 40 individual countries within Europe and the European Union (EU-27) for the year 2020. They estimated that there were 4 million new cases of cancer (excluding non-melanoma skin cancer) and 1.9 million cancer-related deaths. The most common cancers are breast in women (530,000), colorectal (520,000), lung (480,000), and prostate in men (470,000). These four cancer types represent half of the total cancer burden in Europe. The most common types of cancer deaths are lung cancer (380,000), colorectal cancer (250,000), breast cancer (140,000), and pancreatic

cancer (130,000). In EU-27 and as for 2022, the estimated new cancer cases are 1.4 million in males and 1.2 million in females, with more than 710,000 cancer deaths in males and 560,000 in females.

Africa: Sharma et al. (2022) examined the burden of 34 cancer types in 54 African countries in 2020. They found that the number of cancer cases increased from 715,000 in 2008 to 1.1 million in 2020 (an increase of about 54%), and the number of cancer deaths increased, for the same period, from 542,000 to 711,000 (an increase of about 31%). They also found that geographic disparities are evident in Africa, particularly in the major cancer types. By location, breast, cervix, prostate, liver, and colorectal were the main cancer types, accounting for 48% and 45% of new cases and deaths, respectively. Egypt, Nigeria, South Africa, Ethiopia, and Morocco had the highest cancer incidence and death rates in 2020. These mentioned-African countries (that include two Arab countries: Egypt and Morocco) are also responsible for 45% of cancer cases and 44% of cancer deaths.

Arab region: In the Arab region, cancer is growing at an alarming pace (Arafa et al. 2020; Al-Shamsi et al. 2022). The six Gulf countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and United Arab Emirates) and the Eastern Mediterranean region show alarming rise in the number of incidence and death cases amongst cancer patients. Long-term projections show that by 2030 there will be a 1.8-fold increase in cancer cases in the Arab region. Breast cancer (in women) is, by far, the most prevalent cancer type, followed by lung cancer, cervical cancer, colorectal cancer, and prostate cancer, in addition to the liver and bladder cancers in Egypt. As estimated for the year 2020, 29,576 new cases of lung cancer occurred; up from 16,596 in 2008, representing an increase of more than 78% in 12 years (2008–2020). This increased burden is attributed, mainly, to the increased number of smokers and rate of smoking of cigarettes and other tobacco products, especially amongst youth. While only 10–30% of all cancer incidents in the Arab region are due to genetic predisposition, lifestyle factors (such as smoking, increased use of transportation, increased use of communication's technology, lack of exercise, and consumption of unhealthy foods that lead to weight increase) have contributed to 70–90% of cancer cases, which are exacerbated by other factors such as emotional stress and environmental pollution (Wu et al. 2016; Arafa et al. 2020).

OPT: The Occupied Palestinian Territories (OPT) is the focus of this research paper. The OPT, as part of Historic Palestine in the Arab region, with an area of approximately 6,000 km², includes the West Bank (including East Jerusalem) and the Gaza Strip, and has a total population, as for 12 August 2022, of more than 5.35 million (PCBS 2022a; Worldometer 2022). Abu-Rmeileh et al. (2016) conducted a study on the occupied West Bank for the period of 2009–2016 and found that the most common cause of

death amongst all types of cancer was lung cancer in males (22.8%) and breast cancer in females (21.5%), followed by colorectal cancer in both sexes (11.4%), and prostate cancer in males (9.5%). Despite the small area of the occupied West Bank (5,640 km²), regional or geographic differences were noted in cancer-specific causes of death. For instance, the central West Bank's governorates recorded the lowest mortality rate for most types of cancer amongst males and females. Lung cancer mortality was higher in the northern parts of the West Bank amongst males. For prostate cancer mortality rate was higher in the northern and southern parts of the West Bank, and for breast cancer mortality rate was higher in the southern part of the West Bank. Similar mortality rate patterns were found in urban, rural, and refugee camps' settings. Abu-Rmeileh et al. (2016) concluded that the results in the West Bank's governorates show different mortality rates, which can be explained by personal, contextual, and environmental factors that need, future-wise, in-depth investigations. According to WHO (2020a), 4779 new cancer cases and 2895 cancer-related deaths were reported in 2020 (Das 2022; Knell 2022). The most frequently reported cancers in 2020 included breast, lung, colorectal, and leukemia (blood cancer, especially amongst children).

Methodology

This research paper goes beyond the information gathering process; rather, it is also about providing answers to unanswered questions as part of discovering and/or creating new knowledge, implications, and applications related to the cancer status in the Occupied Palestinian Territories. To recognize or observe this represented knowledge, it proves to be valid, applicable, and useful to a wide audience who may be involved in cancer- and other related issues. Such audience includes cancer patients and their families and loved ones, general physicians, and cancer specialists, research scientists and academics, graduate students and postdocs, hospital administrations, environmental scientists and, most importantly, planners and decision- and policy-makers. The methodology of this research paper is mainly based on interviews with some people affected by or related to cancer issues, as well as on data collection, generation, analysis, interpretation, and discussion, as well as drawing conclusions and recommendations about the researched data. Accordingly, this research paper was established through two distinct paradigms, positivistic and phenomenological, or in other words, qualitative and quantitative approaches, as they play important roles in determining the data collection process used for the purpose of this research paper.

Results and discussion

Cancer types in the Occupied Palestinian Territories (OPT)

Palestinians in the Occupied Palestinian Territories have, unfortunately, experienced several and various types of cancer, spreading amongst different ages of males and females, including children. These types of cancer include lung cancer, breast cancer, blood cancer (leukemia), anal cancer, bladder cancer, colon and rectal cancer (colorectal cancer), gastrointestinal carcinoid cancer, pancreatic cancer, endometrial cancer, kidney cancer, liver cancer, skin cancer (melanoma), Hodgkin's lymphoma cancer, non-Hodgkin's lymphoma cancer, prostate cancer, and thyroid cancer. Halahleh and Gale (2018) and Gale and Halahleh (2018) presented the top 10 types of carcinomas found in the OPT amongst Palestinian males and females (Table 1).

Cancer diseases, in general, are shown to be the second leading cause of death in the OPT at 14%, and is only surpassed by heart (cardiovascular) diseases at 30% (Halahleh and Gale 2018). In more detail, Abu-Rmeileh et al. (2016) conducted a survey on Palestinian males and females in the West Bank (occupied by Israel since 1967) and found that the most common cause of death amongst all cancers was lung cancer in males (at 22.8%) and breast cancer in females (at 21.5%), followed by colon (colorectal) cancer in females (at 11.4%) and prostate cancer in males (at 9.5%). Together, these cancer diseases constitute 65.2% of cancer types in the West Bank, while the remaining

(34.8%) represent other types of cancer. Such results also confirmed by Halahleh et al. (2022).

Regarding the Gaza Strip, which is also occupied by Israel since 1967 and totally besieged since 2007, the number of the registered cancer cases was, for the period 2015–2016, 2328 cases, including 1626 cases in 2015 and 1702 cases in 2016 (Yaghi 2017). For the same period of time, the cancer incidence rate per 100,000 people in the Gaza Strip was nearly the same: 88 and 89. Breast cancer was the most common type (20.5%) of all cancer cases, ranked first amongst female cancers, representing 36.9% of all cancers amongst females in the Gaza Strip, while colon (colorectal) cancer was the most common cancer type in males, accounting for 15.5% of all male cancers. In adolescents and children (under 18 years of age), 210 cancer cases were reported, constituting 6.5% of the total cancer cases in the Gaza Strip. Also, around 1118 cancer deaths were reported for the same period of time, with a cancer-specific mortality rate of 29.7 per 100,000 people. The most common deaths from cancer were due to lung cancer (16.9%), colorectal cancer (11%), and breast cancer (10%).

Recent statistics showed that the number of prevalent cases of cancer diseases for 6 years (2015–2020) was 10,566, including 4477 (42.4%) males and 6089 (57.6%) females (WHO 2020a). For the year 2020, the number of cancer cases was 4779 new patients, representing various types of cancer, whereas the number of cancer deaths was 2895 (61%) (WHO 2020a). This figure (4779 patients) included 2274 (47.6%) new cancer cases in males and 2505 (52.4%) new cancer cases in females. These figures and their percentages for males and females are demonstrated in Table 2.

Table 1 Top 10 most common cancer types amongst Palestinian males and females in the Occupied Palestinian Territories (OPT) in 2015 (modified after Halahleh and Gale 2018; Salem 2019a)

Males			Females		
Cancer kind	Number of cases	Percentage %	Cancer kind	Number of cases	Percentage %
Lung	163	14	Breast	244	34
Leukemia	124	11	Colon (Colorectal)	119	9
Colon (Colorectal)	109	9	Leukemia	79	6
Prostate	102	9	Brain	71	6
Bladder	81	7	Thyroid	51	4
Brain	77	7	NHL (Non-Hodgkin Lymphoma)	48	4
Liver	44	4	Lung	46	4
NHL (Non-Hodgkin Lymphoma)	42	4	HL (Hodgkin Lymphoma)	44	4
Skin	40	4	Ovarian	42	3
Pancreas	37	3	Liver	33	3
<i>Sub-Total</i>	<i>819</i>	<i>72</i>	<i>Sub-Total</i>	<i>777</i>	<i>77</i>
Other Types	319	28	Other Types	232	23
<i>Total</i>	<i>1138</i>	<i>100</i>	<i>Total</i>	<i>1009</i>	<i>100</i>

Table 2 Cancer types in both sexes, as well as in males and in females amongst Palestinians in the West Bank and Gaza Strip for the year 2020 (modified after WHO 2020a)

Both sexes		Males			Females						
Rank	Cancer type	No. of cases	Percentage %	Rank	Cancer type	No. of cases	Percentage %	Rank	Cancer type	No. of cases	Percentage %
1	Breast	892	18.7	1	Lung	436	19.2	1	Breast	892	35.6
2	Lung	547	11.4	2	Colorectal	274	12.0	2	Colorectal	246	9.8
3	Colorectal	520	10.9	3	Prostate	191	8.4	3	Thyroid	150	6.0
4	Leukemia	219	4.6	4	Bladder	145	6.4	4	Lung	111	4.4
5	Non-Hodgkin's Lymphoma	216	4.5	5	Leukemia	124	5.5	5	Non-Hodgkin's Lymphoma	104	4.2
6	Other types	2,385	49.9	6	Other types	1,104	48.5	6	Other types	1,002	40
	Total	4,779	100		Total	2,274	100		Total	2,505	100

Note: The other types of cancer disease (49.9% in both sexes: 48.5% in males and 40% in females) registered in 2020 were: liver (3.4%), brain (central nervous system) (3.1%), stomach (3.0%), pancreas (2.8%), kidney (2.2%), Hodgkin's lymphoma (HL) (2.1%), corpus uteri (2.0%), multiple myeloma (1.9%), larynx (1.6%), ovary in females (1.5%), cervix uteri in females (1.3%), gall-bladder (0.92%), testis in men (0.88), lip (oral cavity) (0.73%), nasopharynx (0.65%), oesophagus (0.50%), melanoma of skin (0.46%), salivary glands (0.27%), anus (0.19%), Kaposi's sarcoma (0.10%), mesothelioma (0.10%), vulva in females (0.10%), vagina in females (0.08%), oropharynx (0.04%), and hypopharynx (0.04%) (WHO 2020a)

Incidence of various types of cancer and their possible causes in the OPT

The following represents analyses, interpretation, and discussion of the data given in Tables 1 and 2. It is a thorough insight of both Tables that indicates the following:

- (1) *Breast cancer*: The higher rate of cancer diseases amongst both sexes is breast cancer followed by lung cancer, and then colorectal, leukemia, and non-Hodgkin's lymphoma. In males, prostate and bladder cancers were registered, while in females, thyroid cancer was registered. About 5–10% of breast cancer cases and 10% of ovarian cancer cases are believed to be hereditary (genetic), which means they are directly caused by genetic changes (inherited mutations) passed on from a parent (CDCP 2020; ACS 2021; MNT 2021). The most common cause of hereditary breast cancer is an inherited mutation in the BRCA1 (Breast Cancer 1) and/or BRCA2 (Breast Cancer 2) gene. In normal cells, these genes help make proteins that repair damaged Deoxyribonucleic Acid (DNA). DNA is defined as the molecule inside cells that contains the genetic information responsible for an organism's development and function. DNA molecules allow this information to pass from one generation to the next (NCI 2022; NHGRI 2022). The mutated versions of these genes can lead to abnormal cell growth, which can, in turn, lead to cancer. These DNA damages can be associated with exposure to estrogen, inherited genetic defects, or inherited genes (BRCA1 and/or BRCA2 genes) that can cause cancer. Estrogen's exposure could involve starting periods at an early age or entering menopause at a later age. Between these times, estrogen levels in the body are higher, which may be one of the reasons behind breast cancer in women.

Breast cancer, similar to other types of cancer, leads to the weakness of the body's immune system. When a person is healthy, his/her immune system attacks any abnormal DNA or growths and, on the other hand, when a person has cancer, this does not happen. Aside from being a hereditary (genetic) disease, breast cancer can also result from air pollution. There is, however, increasing evidence to suggest that air pollution is a risk factor of breast cancer. Nitrogen oxides (NO_x: NO, NO₂ and NO₃); total suspended particulates (TSP) or fine particulates (PM_s) that include PM₁, PM_{2.5}, PM₇, and PM₁₀; and polycyclic aromatic hydrocarbons (PAHs) have been reported to associate with breast cancer incidence (Hwang et al. 2020).

According to Table 1, the number of males having cancer is 819, while the number of females having

cancer is 777, meaning that the female-male percentage is 95%. It was found that, globally, males are hit by cancer diseases more than females. This may be explained by the findings published in the Harvard Magazine, suggesting that out of approximately 800 genes located on the “X Chromosome”, scientists identified 6 genes more frequently mutated in males than in females—and 5 fell into the subset of genes that escape X-inactivation in females (O’Donnell 2017). However, Table 2 shows that the cases amongst males (2274) are less than that amongst females (2505), resulting in a male–female percentage of 91%. This change is due to the higher cases of cancers amongst females, which can be attributed to the increased rate of breast cancer amongst women. However, differences between males and females in cancer rates can be related to the fact that health and illness are influenced by individual genetic and physiological configurations, as well as by individual’s interactions with environmental and experiential factors (Cook et al. 2009). Breast cancer was found to be the most common kind of cancer amongst women (34%) for the year 2015 (Table 1) which increased by 1.6 percentage-points to become 35.6% in 2020 (Table 2), in comparison with zero cases amongst men (Tables 1, 2). A man’s lifetime risk of developing breast cancer is about 1/10 of 1% or 1 in 1000 (0.001), as rates of male breast cancer have remained fairly stable for the past 30 years (Stöppler 2017). However, in 2016, cancer statistics showed that 32% of breast cancer cases occurred in Hebron Governorate (southern West Bank), which is the highest percentage compared with the other governorates in the OPT, while the lowest percentage was in Jenin Governorate at 2% (northern West Bank) (WNA 2018). These results show big discrepancies in females’ breast cancer rates between Hebron (32%) in southern West Bank, and Jenin (2%) in northern West Bank.

- (2) Lung cancer: Lung cancer is the most common kind of cancer amongst men, accounting for 14% of all types of male cancers in 2015 (Table 1), which jumped to 19.2% in 2020 (Table 2). Meanwhile, for females it was 4.0% in 2015 (Table 1) and increased slightly to 4.4% in 2020 (Table 2). Smoking is indisputably linked to lung cancer, yet only a small fraction of smokers develops this disease, worldwide (Stapelfeld et al. 2019). However, if the high rate of lung cancer amongst males in the Palestinian society is, presumably, attributed to smoking, one should look at the smoking status there, considering the fact that the number of smokers is really high and it is getting even much higher. In 2021, the percentage of individuals aged 18 years and over in the OPT, who smoke one

or more tobacco products (manufactured cigarettes, hand-rolled cigarettes, electronic cigarettes, cigars, and water-pipe “hookah”, “shisha”, “argeleleh” as called in Palestine, or “goza” as called in Egypt), has increased to about 31%, while it was about 23% in 2010, according to the Palestinian Central Bureau of Statistics (PCBS 2022b). Regarding water-pipe, at least 51% of those who use water-pipe are females, according to Tucktuck et al. (2018). Although tobacco-derived carcinogens and enzyme polymorphisms have been identified to increase smoking risks amongst smokers, recent epidemiological data point to “gender specificity” as a new and additional factor.

It has become evident that smokers amongst women are more likely to develop lung cancer than men (Stapelfeld et al. 2019). In general, the odds ratio of developing lung cancer is approximately three times greater for females than for males. This is because DNA affinity levels are higher in females than in males, and mutations in the p53 tumor suppressor gene and the KRAS (Kirsten Rat Sarcoma) proto-oncogene were also found frequently in women more than in men (Stapelfeld et al. 2019). However, the situation in the Palestinian society tells us a different story that, as mentioned above, the percentage of the lung cancer cases amongst males (14% and 19.2% for the years 2015 and 2020, respectively) is 3.5–4.4 times higher than that amongst females (4% and 4.4% for the years 2015 and 2020, respectively). This means that lung cancer in the OPT may be caused by various reasons, including smoking, amongst others.

Nevertheless, if smoking is considered as one of the main contributors to lung cancer in the OPT, campaigns should focus on prevention’s awareness programs to reduce the number of smokers. Despite the fact that the Palestinian Authority’s taxes on smoking products is greater than 80% of the prices of the tobacco products (WHO 2020b), the number of smokers is very high and even getting higher and higher. In the OPT, tobacco products (cigarettes, water-pipe, etc.) are highly taxed at the same level, so that the tobacco taxes represent a large percentage of the retail price of the tobacco products. On the other hand, very little of the tobacco high taxes go to the treatment of cancer patients, particularly the lung cancer’s patients. Accordingly, the anti-smoking campaigns may include anti-smoking and anti-tobacco messages (such as labels that should appear on the tobacco products), as well as governmental policies and regulations that should be of high-impact interventions and positive effects, as related to the risks of smoking associated to lung cancer (Elshami et al. 2022).

Besides direct smoking, air pollution is definitely another cause of lung cancer. Over time, inhaling small particulates released into the air can cause cancer. Small particulates, such as PM_s can become trapped in the lungs, and the buildup of these particulates can damage the cells of the lungs, leading to inflammation of the lungs (see, for example, Wang et al. 2021, 2022; Chen et al. 2022). Additionally, passive smoking increases the risk of smoking-related diseases. It is clear that second-hand smoke can cause lung cancer, heart disease, and stroke. It may also increase the risk of developing some other types of cancer, and a serious lung condition called chronic obstructive pulmonary disease (COPD) (CR UK 2021a).

- (3) *Colorectal cancer*: In 2015 (Table 1), males and females developed colorectal cancer at the same rate (9%); while in 2020 (Table 2) the rate had increased to 12% in males and to 9.8% in females. These results indicate that: (i) colorectal cancer is one of the main cancers that hit both males and females at various ages; (ii) from 2015 to 2020 its rate had increased by 3 percentage-points amongst males, and by approximately 1 percentage-point amongst females; and (iii) these rates of colorectal cancer is almost 2.5–3 times greater than the global rates. This is based on the fact that the lifetime risk of developing colorectal cancer is, overall, about 1 in 23 (4.3%) for men and 1 in 25 (4.0%) for women (ACS 2022a). Studies found that males develop colorectal cancer more than females, though the rate difference is, relatively, small (Majek et al. 2013; White et al. 2018).

A number of lifestyle factors, such as unhealthy diet, extra weight, and lack of exercise, can possibly increase the risk of colorectal cancer. Regarding the possibility of air pollution's association with colorectal cancer, Jenwitheesuk et al. (2020) found that each 10 µg/m³ increase in black carbon (BC), organic carbon (OC), and dust (PM_{2.5}) were associated, respectively, with a 4%, 4%, and 15% increase in colorectal cancer risk. Interestingly noticing is that the presence of only 10 µg/m³ particulate matter (PM_{2.5}) in the air increases the risk of developing colorectal cancer by 15%. This is approximately 4 times greater than the risk resulting from the presence of the same amount of BC and OC in the air. Another study found that the exposure to NO₂ was associated with colorectal cancer death, with a 6% increase per each 6.5 parts per billion (ppb) increment (IS Global 2017; Turner et al. 2017). These observations indicate that air pollution is a risky factor in developing colorectal cancer amongst males and females alike.

- (4) *Prostate cancer*: This kind of cancer, affecting men in the Palestinian society, occurred at 9% in 2015 (Table 1) and at 8.4% in 2020 (Table 2). Prostate Cancer is the second most common type of cancer in males, worldwide, while it was the fourth in the Occupied Palestinian Territories in 2015 (Table 1) and the third in 2020 (Table 2). Prostate cancer is the cancer that affects the prostate which is a small, walnut-shaped gland in males that produces semen that nourishes and transports sperm. It is known that prostate cancer begins when cells in the prostate develop changes in their DNA.

Some of the factors that can increase the risk of developing prostate cancer are: (i) Older age: as it is most common after age of 50; (ii) Race: for reasons not known, in black people prostate cancer is more likely to be aggressive or advanced. However, a largest study of its kind found that societal factors and access to quality care, rather than genetics, underlie higher prostate cancer mortality rates for black men (Dess et al. 2019; Imhoff 2019); (iii) Family history: if a blood relative (such as a parent, sibling, or child) has been diagnosed with prostate cancer, the risk of developing prostate cancer may be increased; and (iv) Obesity: people who are obese may be more likely to develop prostate cancer than people of a healthy weight, although studies have had mixed results. In people who are obese, the cancer is more likely to be more aggressive and more likely to return after initial treatment (Mayo Clinic 2022). Considering other factor that may cause prostate cancer, air pollution resulting from several sources (transportation, industry, agriculture, smoking, etc.) may be one of them (Multigner et al. 2008; Parent et al. 2013; Datzmann et al. 2018; Schroeder 2021).

- (5) *Blood cancer (leukemia)*: In 2015, this kind of cancer was almost double in males (11%) than in females (6%) (Table 1), while in 2020 (Table 2) it was 5.5% in men and 4.6% in both sexes. However, there is no mention for leukemia in women in 2020, which is probably included in "Other Types" of cancer. Though this phenomenon is not widely explained in the literature, a relatively old study (Jackson et al. 1999) indicated that the presence of a "sex-responsive" gene near to the ABO gene locus on "Chromosome 9" relatively protects group "O" women against leukemia. Leukemia is the most frequent malignant disease affecting children, unfortunately. It is the most common type of cancer amongst Palestinian children, with an estimated incidence of 2.6 per 100,000 children (Halahleh and Gale 2018; Zaid et al. 2018; Elnuweiry 2019; Salman et al. 2021; Shawahna et al. 2021; Alshaer 2022; Mills et al. 2022). However, to date,

the etiology of childhood leukemia remains largely unknown.

Leukemia is a type of cancer that affects lymphocytes in the bone marrow or lymphatic system. It most commonly affects white blood cells, making it difficult for the body's immune system to fight infection. Signs of leukemia include fever, chills, body aches, and other flu-like symptoms, such as excessive fatigue and weakness. Also, anorexia, frequent infections, easy bleeding, bruising, nosebleeds, swollen lymph nodes, and unexplained weight loss may be other signs of leukemia. Regarding the specific genetic and environmental factors that are thought to be associated with leukemia, and what causes bone marrow cells to mutate, they may include: (i) genetic predisposition; (ii) down syndrome; (iii) human T-lymphotropic virus (HTLV); (iv) human immunodeficiency virus (HIV); (v) exposure to petrochemicals, such as benzene; (vi) intense exposure to artificial ionizing radiation, which is generated artificially by X-ray tubes, particle accelerators, and nuclear fission, and is not immediately detectable by human senses, so instruments such as Geiger counters are used to detect and measure it (WHO 2016a); (vii) alkylating chemotherapeutic agents administered to treat other types of cancer; (viii) use of tobacco; and (ix) use of certain hair dyes (MCC 2018a). Furthermore, some studies found an association between leukemia and exposure to air pollution (Filippini et al. 2015; Hvidtfeldt et al. 2020).

- (6) *Brain cancer*: In 2015, brain cancer hit both males and females with a small difference at rates of 7% and 6%, respectively (Table 1), while in 2020 (Table 2) brain cancer was categorized as “Other Types” of cancer with a rate of 3.1% for both sexes. However, the small rate difference (1%) between males and females, regarding brain cancer in 2015, is often related to sex hormones, such as testosterone or estrogen, contributing to many biological differences between males and females. Brain cancer, commonly known as an intracranial tumor, is an abnormal mass of tissue in which cells grow and multiply uncontrollably by mechanisms that control normal cells.

More than 150 different brain tumors have been documented, but the two main groups of brain tumors are described as “primary” and “metastatic” (AANS 2022). Primary brain tumors include tumors that originate from the tissues of the brain or the brain's immediate surroundings. Metastatic brain tumors include tumors that originate elsewhere in the body (such as the breast or lungs, for instance) and migrate to the brain, usually through the bloodstream. However, both primary and metastatic brain tumors are considered cancerous and malignant. Glioblastoma is the most

common malignant brain tumor (Rubin 2019). Brain tumors are thought to arise when certain genes on chromosomes of a cell are damaged and do not function properly. These genes normally regulate the rate at which a cell divides (if it divides at all) and repair genes that fix defects in other genes, as well as genes that should cause the cell to self-destruct if the damage is beyond repair.

In some cases, an individual may be born with partial defects in one or more of these genes. Environmental factors may then lead to further damages in the cells of the brain. In other cases, environmental damages to genes may be the only cause. It is not known, however, why some people living in, and affected by, the same environment develop brain tumors, while others do not. Unfortunately, up to 40% of people with lung cancer will develop metastatic brain tumors (AANS 2022). Based on these data, smoking and air pollution, which are primary causes of lung cancer, could also be causes for developing brain cancer. Ultrafine particulate matter (UFP), produced by industrial activities, burning fuels, etc. and more exposure of people to UFP increase the chances of a fatal cancer, such as brain cancer. Weichenthal et al. (2020) identified 1400 brain tumors during the follow-up period, and concluded that each 10,000/cm³ increase in UFP was positively associated with brain tumor incidence after adjusting for PM_{2.5} and NO₂, in addition to sociodemographic factors. Nanoparticles, carrying cancer-causing chemicals, can enter the brain and work on developing brain tumors. As a result of air pollution, researchers identified signs of elevated inflammation, DNA damage, deterioration of the blood–brain barrier, and even Alzheimer's-type pathology (Carrington 2019; Makowski 2019; Offord 2019; Weichenthal et al. 2020).

A key role for related processes of neuro-inflammation and oxidative stress, which is an excessive production of reactive oxygen species, can cause cellular damage, in response to pollutants that reach the brain through the nose and lungs. Generally speaking, brain tumor can develop as a result of one or more of the following reasons (Cancer.Net 2021a): (a) Age: brain tumors are more common in children and the elderly, although people of any age can develop a brain tumor; (b) Sex: in general, males are more likely than females to develop a brain tumor. However, some specific types of brain tumors, such as a “meningioma”, are more common in females. Meningioma is most common in people between the ages of 40 and 70, and it is more common in women than in men, whereas 74% of meningioma patients are female (BSF 2022). Currently, the two predisposing factors associated with

meningioma for which there is the strongest evidence are exposure to ionizing radiation and hormones. However, these factors remain largely unexplored and extensive examination on this population-based data set is needed to help elucidate the roles of these risk factors in the development of meningioma tumors; (c) Exposure to solvents, pesticides, oil products, rubber, or vinyl chloride may increase the risk of developing a brain tumor. However, there is still no scientific evidence to support this possible linkage; (d) Family history: about 5% of brain tumors may be associated with genetic factors or genetic conditions, including Li–Fraumeni syndrome, neurofibromatosis, basal cell carcinoma syndrome, tuberous sclerosis, Turcot syndrome, and von Hippel–Lindau disease. Also, it has been found that clusters of brain tumors exist within some families without association with these known genetic conditions; (e) Exposure to infections, viruses, and allergens: infection with the Epstein–Barr virus (EBV) increases the risk of lymphoma of the central nervous system. EBV is more commonly known as the virus that causes mononucleosis, or “mono”. Also, high levels of a common virus called cytomegalovirus (CMV) were found in brain tumor tissue; (f) Electromagnetic field (EMF): conflicting studies, evaluating the role of electromagnetic fields needed to generate energy from power lines, or to transmit signals to mobile (cell)-phones from towers, as well as heavy usage of cell-phones, have shown strong links, weak links, or no links between EMF and increased risks of developing brain tumor. For instance, Bhargav et al. (2015) indicated that exposure to EMF may affect brain physiology and lead to various health risks, including brain tumors. Some studies used positron emission tomography (PET) and found changes in cerebral blood flow after acute exposure to EMF. It is widely accepted that DNA double-strand breaks (DSBs) (Jeggo and Löbrich 2007) and their poor repair in stem cells are critical events in the onset of leukemia and multistage tumors, including brain tumors such as gliomas (Bhargav et al. 2015). However, because of conflicting information regarding the risks to children, the World Health Organization (WHO) recommends limiting the use of mobile phones and encourages the use of a hands-free headset for both adults and children; (g) Race and ethnicity: in the USA, white people are more likely to develop gliomas but less likely to develop meningioma than blacks. People from northern Europe are more than twice as likely to develop a brain tumor than people from Japan, for instance; (h) Ionizing radiation: previous treatment of the brain or head with ionizing radiation, including X-rays, has been shown

to be a risk factor for developing a brain tumor; (i) Head injury and seizures: serious head trauma has long been studied in relation to brain tumors. Some studies have shown a link between head trauma and meningioma but not between head trauma and glioma. A history of seizures has also been linked to brain tumors, but because a brain tumor can cause seizures, it is not known whether seizures increase the risk of brain tumors or not, if seizures are caused by a tumor, or if anti-seizure medications increase the risk of developing brain tumors; (j) N-nitroso compounds: some studies of diet and vitamin supplements seem to indicate that dietary N-nitroso compounds may increase the risk of brain tumors in childhood and adults. Dietary N-nitroso compounds are formed in the body from nitrites or nitrates found in some processed meats, tobacco (cigarettes’ and water-pipe smoking), and cosmetics; and (k) In addition to the above-mentioned possible reasons that may cause brain cancer, long exposure to air pollution should also be considered as a potential reason for brain cancer.

- (7) *Thyroid cancer*: This kind of cancer was found at a rate of 4% in 2015 (Table 1) and at 6% in 2020 (Table 2), and it is primarily found amongst females but not amongst males. Detection bias may be the reason for the higher incidence of thyroid cancer in females. This can be attributed to the fact that thyroid nodules are more common in females, leading to higher rates of incidence amongst them. Thus, females are more likely to undergo diagnostic tests for thyroid cancer (Rahbari et al. 2010). Regarding the possible drives behind thyroid cancer, it occurs when there is a change in DNA within the cells of the thyroid gland that causes them to grow uncontrollably and produce a mass. It is not usually clear what causes this change; however, there are a number of things that can increase the risk of developing this kind of cancer. These include (i) thyroid conditions, such as thyroiditis (inflammation of the thyroid gland) or goiter—but not hyperthyroidism (overactive) or hypothyroidism (underactive) thyroid; (ii) a family history of thyroid cancer, where the risk is higher if one of close relatives has it; (iii) childhood radiation’s exposure, such as radiation therapy (radiotherapy); (iv) a bowel condition called “Familial Adenomatous Polyposis” (FAP); (v) acromegaly, which is a rare condition where the body produces too much growth hormone; and (vi) obesity (NHS 2019). Regarding the relationship between thyroid cancer and air pollution, the effect of air pollution on incidence and mortality of thyroid cancer has not yet been fully elucidated. However, some studies have shown a statistically sig-

nificant positive association between thyroid cancer incidence and environmental pollutants (Giannoula et al. 2020; Karzai et al. 2022).

- (8) *Liver cancer*: In 2015, liver cancer showed close rates in incidence amongst males and females at 4% and 3%, respectively (Table 1), while in 2020 (Table 2) it was classified as “Other Types” of cancer – with a rate of around 3.4% for both sexes. In comparison with other parts of the world, the USA, for example, shows high rates of liver cancer amongst males and females. Each year in the USA, about 24,500 men and 10,000 women develop liver cancer, and about 18,600 men (76% of incidence cases) and 9,000 (90% of incidence cases) women die from this disease (CDCP 2022). The percentage of Americans diagnosed with liver cancer has been on the rise for several decades, but it may be starting to stabilize.

Production of a protein—known as Interleukin-6 (IL-6)—that promotes inflammation, appears to be linked to a higher incidence of liver cancer in males more than in females, as researchers at the University of California, San Diego’s (UCSD) School of Medicine identified in studies carried out on mice (Kain 2007). Liver cancer may be caused by, amongst other reasons, overweight, obesity, long-term hepatitis B virus or hepatitis C virus infections, smoking, alcohol, etc. Regarding air pollution’s association with liver cancer, So et al. (2021) found that average annual exposure to NO₂, dust (PM_{2.5}), black carbon, warm season ozone (O₃), and eight elemental components of PM_{2.5} (copper, iron, zinc, sulfur, nickel, vanadium, silicon, and potassium) are environmental pollutants causing liver cancer. So et al. (2021) suggested that ambient air pollution may increase the risk of developing liver cancer, even at concentrations below the current European Union’s (EU) standards.

- (9) *Bladder cancer*: In 2015, this kind of cancer that usually hits males more than females occurred in males at a rate of 7% (Table 1), while in 2020 it occurred at a rate of 6.4% (Table 2). However, no cases were registered amongst females in both years 2015 (Table 1) and 2020 (Table 2). Worldwide, bladder cancer is the fourth most common type of cancer in men, and it is 3–4 times more common in males than in females (Zhang 2013; MCC 2018b). Bladder cancer occurs when cells in the bladder change and grow uncontrollably. This malignancy can affect men and women differently. The carcinogenicity and biotransformation of bladder carcinogens, as well as the effect of sex hormones on these processes indicate that the gender disparity in bladder cancer’s risk may result primarily from the interaction of androgens, estrogens, and

the liver, with the liver acting through its metabolic enzymes as a key determinant.

Exposure of the bladder to carcinogens in the urine and male and female hormones exert opposite effects on carcinogenesis in the bladder and possibly also on liver enzymes that deal with the carcinogens in the bladder. So, it is important to be aware of the risk factors, causes, and symptoms of bladder cancer, so that any unusual changes can be reported to a physician, immediately. Though smoking appeared to be the greatest risk factor for bladder cancer in men and women alike, environmental factors should also be considered as risk factors, though there is no clear evidence for association between air pollution and bladder cancer’s risk (Castaño-Vinyals et al. 2008; UCF 2016; Turner et al. 2019; Sakhvidi et al. 2020).

- (10) *Pancreas (pancreatic) cancer*: This kind of cancer occurred, in 2015 (Table 1), in males at a rate of 3%, while no cases were reported in females, and in 2020 (Table 2), this kind of cancer was reported at 2.8% in both sexes; though, most likely in males. In comparison, pancreatic cancer accounts for about 3% of all cancer cases and about 7% of all cancer deaths in the USA, and it is more common in men than in women (ACS 2020, 2022b). Several reasons can cause pancreatic cancer, including, amongst others, overweight, diabetes, chronic pancreatitis, inherited (genetic) syndromes, and exposure to certain chemicals, as well as air pollution. Exposure to certain chemicals, such as pesticides, benzene, certain dyes, and petrochemicals, may increase the risk of developing pancreatic cancer (Cancer.Net 2021b). For instance, Bogumil et al. (2021) findings supported previous research that identified the relationship between particulate matter PM_{2.5} and pancreatic cancer. Although this association is not statistically heterogeneous, it was more pronounced amongst Hispanics (as a race) and smokers (as an addiction or behavior). Bogumil et al. (2021) recommended that future studies are needed to replicate these findings in an urban setting and in a racially/ethnically diverse population.

- (11) *Skin cancer (melanoma)*: In 2015, skin cancer (melanoma) was found at 4% amongst men but none amongst women (Table 1), and in 2020 (Table 2) it was found at a much lower rate (0.46), as being considered one of the “Other Types” of cancer. However, compared to women, men are more likely to develop basal or squamous cell carcinomas. The reason for that is the more exposure of men to sunlight, as it is believed that men are more exposed to sunlight than women (Saladi and Persaud 2005). Before the age of 50, women are more likely to develop skin cancer, and after that men are more likely to develop it (Banner

Health 2019; St. LH 2020; AADA 2022). Regarding the possible causes of melanoma, other than exposure to sunlight, air pollution and its impacts could be a reason for skin cancer, though this area is not well investigated. Baudouin et al. (2002) identified some chemical pollutants that cause skin cancer, and An (2020) observed that an increased risk of skin cancer by 20% is associated with 10 $\mu\text{g}/\text{m}^3$ increase in particulate matter $\text{PM}_{2.5}$.

- (12) *Hodgkin's lymphoma (HL) and non-Hodgkin's lymphoma (NHL) cancers*: In 2015 (Table 1), females developed Hodgkin's lymphoma (HL) cancer at a rate of 4%, while men did not. At the same time, males and females developed non-Hodgkin's lymphoma (NHL) cancer at the same rate (4%) (Table 1). In 2020 (Table 2), females developed NHL at a rate of 4.2%, while both sexes developed NH at a rate of 2.1%. The terms HL and NHL can easily be confused. Although they are named after the British scientist Thomas Hodgkin (1798–1866, London, UK), who discovered them, they are two different diseases that require different treatments to ensure the best results for patients.

Both HL and NHL are hematological malignancies, affecting the lymphoma system in human's body, and NHL is more common than HL. However, the incidence of both cancer diseases (HL and NHL) has been rising for several decades, and in the past 20 years it has reached, worldwide, a plateau. The incidence of HL and NHL is related to several factors including, amongst others, genetic, environmental, geographic, racial (ethnicity), gender, age, lifestyle (exercise, alcohol use, smoking, etc.), nutrition, stress, socio-economics, and, in some cases, medications (Maggioncalda et al. 2010). Gravity (the number of times that a woman has been pregnant), in particular, has a protective role against the occurrence of NHL in females (Horesh and Horowitz 2014). More than four pregnancies indicated a possible lower risk of developing NHL (Lee et al. 2008). However, the lower rate of NHL amongst females, globally, may be explained by the direct effects of the estrogen hormone on lymphoma cell's proliferation, or by its effect on the anti-tumor immune response.

Nevertheless, some studies indicated an increased trend in the incidence of Hodgkin's lymphoma in young adults, especially females (Li et al. 2013). Increasing evidence indicates that some of the risk factors associated with HL may vary by female's age. Recent studies have reported an increased risk of HL associated with increased body mass index (BMI), but results have been inconsistent. Regarding air pollution, there is limited evidence on a possible association between exposure to air pollutants and the risk

of developing HL or NHL. Previous epidemiological studies have relied on preliminary estimates of exposure to air pollution and small numbers of lymphoma disease cases. For instance, Taj et al. (2020) conducted a study on air pollutants that included $\text{PM}_{2.5}$, O_3 , SO_2 , SO_4 , NO , NO_2 , and NO_3 , and found that there was no association between exposure to these pollutants and overall risk of NHL. However, several air pollutants were associated with higher risk of follicular lymphoma, but statistically insignificant.

- (13) *Ovary (ovarian) cancer and other types of female cancer*: Ovary (ovarian) cancer, affecting women in the Palestinian society, occurred at 3% in 2015 (Table 1) and at 1.5% in 2020 (Table 2). This is in addition to other kinds of female cancers, such as cervix uteri (1.3%), vulva (0.10%), and vagina (0.08%), as reported in 2020 (Table 2). The ovarian cancer begins in the ovaries—each about the size of an almond—that produce eggs and the hormones estrogen and progesterone. Ovarian cancer is a growth of cells that form in the ovaries, where those cells multiply rapidly and can invade and destroy healthy cells in healthy body tissues. Risk factors for ovarian cancer generally include (i) middle aged or older; (ii) have close family members (such as one's mother, sister, aunt, or grandmother) on mother's or father's side, who have had ovarian cancer; (iii) have a genetic mutation (abnormality) in the breast cancer genes (BRCA1 or BRCA2, as discussed above), or a mutation associated with "Lynch Syndrome", which is an inherited condition that increases the risk of ovarian cancer, colorectal cancer, endometrial cancer, and other kinds of female cancers; (iv) have had breast, uterine, or colorectal cancer; (v) have an Eastern European or Ashkenazi Jewish background (Robles-Díaz et al. 2004; Goldberg 2019); (vi) have endometriosis (a condition in which tissues from the lining of the uterus grow elsewhere in the body); and (vii) have never given birth or had conceiving problems (CDCP 2021). Moreover, some studies examined the possibility of air pollution's association with ovarian cancer and found that exposure to ambient ozone, particulate matter $\text{PM}_{2.5}$, and NO_2 , as well as residential proximity to major roadways, because of traffic that heavily pollutes the air, affect ovarian cancer survival, as well as other cancer patients, considering age and race/ethnicity differences, as well as socioeconomic conditions (Hung et al. 2012; Villanueva et al. 2021).

Cancer types, regarding incidence and mortality rates in the OPT (West Bank and Gaza Strip) in terms of geographic distribution and age

Regional differences were noted in cancer-specific causes of death. It was found that the central governorates in the occupied West Bank have the lowest mortality rate for most types of cancer amongst men and women (Abu-Rmeileh et al. 2016). Lung cancer's mortality was higher in the northern West Bank amongst men, while for prostate cancer, the mortality rate was highest in the northern and the southern parts of the West Bank. On the other hand, the mortality rate, due to breast cancer, was higher in the southern parts of the West Bank. In addition, similar mortality rates' patterns were found in urban and rural areas of the West Bank, as well as in refugee camps scattered throughout the occupied West Bank and the besieged Gaza Strip. However, in terms of the geographic distribution of documented cancer cases in 2016, the highest percentage was observed in the Bethlehem Governorate, where 160.1 cases out of 100,000 people were diagnosed with cancer, followed by the Jericho Governorate, where 123.2 cases per 100,000 people were diagnosed with the disease. The lowest percentage was in the Jerusalem Governorate, where 13.8 people out of 100,000 people were diagnosed with cancer (WNA 2018). In the Gaza Strip, geography has also a print on the number of incidence of various types of cancer, as it varies according to the Gaza Strip's geography. It was found that the highest number of cases was registered in the Gaza Governorate (42.5%), followed by the Khan Younis Governorate (18.7%), the Middle Zone of the Gaza Strip (13.5%), the Northern Zone of the Gaza Strip (13.2%), and the Rafah Governorate (12.1%) (Yaghi 2017).

It was also found that about 30% of new cancer cases in the Occupied Palestinian Territories (in both West Bank and Gaza Strip) are in people over 65 years of age, 60% in people between 15 and 64 years of age, and 10% in children under 15 years of age (Gale and Halahleh 2018; Salem 2019a). These statistics indicate that cancer affects Palestinian males and females in the OPT at all ages. Regarding cancer types that hit children in the OPT, the three most common types of cancer in them are leukemia (30%), brain (central nervous system) cancer (20%), and lymphoma (HL and NHL) (14%) (Gale and Halahleh 2018; Salem 2019a). However, there is no data available regarding cancer mortality of children, associated with air pollution, as being a possible reason behind cancers in children. According to UNICEF (2021), 77% of children under five with symptoms of acute respiratory infection were sought from health facilities or care-givers, but there was no mention of health problems related to air pollution, due to lack of data, instrumentation, and measurements. However, it is believed that newborns in Israeli waste dumping's neighborhoods and industrial zones

in the Occupied Palestinian Territories should be steadily monitored and checked for the effects of heavy air pollution on their body development and well-being.

There are many reasons behind the high rates of cancer amongst males and females in the OPT. These include, amongst other reasons, adopting an unhealthy lifestyle, including consumption of processed foods, limiting a healthy Mediterranean diet, excessive smoking, and lack of physical activity. This is in addition to the health and environmental impacts resulting from air pollution caused by Israeli waste dumped in the occupied West Bank, and from industrial activities, such as the limestone industry (LSI), resulting in exposure to suspended particulate matter (PM_s) (Salem 2020, 2021).

Cancer incidence and exposure to particulate matter, with some examples worldwide

Su et al. (2019) performed a geographical correlation study that revealed positive associations between PM_{2.5} levels and age-adjusted cancer rates, which remained significant after careful corrections for multiple comparisons. In the UK, for example, one in every 10-lung cancer patients suffers from cancer due to exposure to outdoor air pollution (CR UK 2021b). As indicated above, exposure to particulate matter's (PM_s) air pollution can cause several lung diseases, which, in some cases, lead to lung cancer, due to the damage caused to DNA. There are several different ways in which suspended particulate matter in air pollution can damage DNA in cells and cause lung cancer and other types of cancer, as well. For example, PM_s may accumulate in the lungs and change how cells multiply. This can lead to DNA damage that can result in lung cancer. Genetic instability is the hallmark of various types of cancer with increased accumulations of DNA damage, so that the application of radiotherapy and chemotherapy in the treatment of cancer is usually based on this characteristic of the cancer (Alhmoud et al. 2020; Huang and Zhou 2021). As indicated above and below, air pollution can be associated with several types of cancer, with an increased risk of mortality. For every 10 µg/m³ increased exposure to PM_{2.5}, there is a significant risk of death from various types of cancer (Wong et al. 2016) (Table 3).

Air pollution, resulting from ultrafine particulates, has health effects even at extremely low concentrations of particulates. In fact, no threshold of PM_s has been set without which no harm to health can be observed (WHO 2021). Therefore, the limits of the WHO's global guidelines of PM_s aim to achieve the lowest possible particulate concentrations. Regarding the health effects of air pollution (outdoors and indoors), polluted air can enter the chest and cause or exacerbate chronic bronchitis, asthma, pneumonia, emphysema, stroke, heart disease, acute and chronic respiratory disease, and different types of cancer (Sivacoumar et al. 2001; Salem

Table 3 Risk percentage (percentage of mortality – death risk) of different types of cancer, as related to increased exposure to PM_{2.5} by every 10 µg/m³ (Wong et al. 2016; Salem 2021)

Percentage of mortality (death) risk	Kind of cancer
22% higher	For any kind of cancer
35% higher	For accessory digestive organs, including the liver, bile ducts, gallbladder, and pancreatic cancer
36% higher	For lung cancer
42% higher	For cancers of the upper digestive tract
80% higher	For breast cancer

2015; Wong et al. 2016; Salem 2017; Leon-Kabamba et al. 2018; Salem 2019a, b; Enciclopedia.Com 2019; Salem 2021; Wang et al. 2021; WHO 2022a; Wang et al. 2022; WHO 2022b, 2022c). These health effects of ambient air pollution can lead to deaths from chronic exposure to particulate matter of various sizes (PM_s), including PM₁₀, PM₇, PM_{2.5}, and PM₁. While PM₁₀ and PM₇ can penetrate and settle deep within the lungs, the most harmful to health are PM_{2.5} and PM₁ (EPA 2004; Wong et al. 2016; Salem 2019b, 2020, 2021; WHO 2021, 2022c). PM_{2.5} particulates can penetrate the lung barrier and enter the bloodstream, act through the circulatory system and contribute to the risk of cardiovascular and respiratory diseases and various types of cancer. The WHO considers PM₁ (group 1 of carcinogens) to be the most harmful, dangerous, and deadly component of PM_s, due to its (PM₁) ultrafine size and, thus, its ability to easily penetrate the lungs and bloodstream, causing mutation in the DNA, heart attack, and even infant mortality (EPA 2004; EEA 2014; Akther et al. 2019; Clarity 2021; Salem 2021; ERS 2022).

Wong et al. (2016) identified some possible explanations for the increased association between PM_{2.5} exposure and cancer's incidence. Air pollution may cause defects in DNA's repair function, changes in the body's immune system and its response, inflammation that leads to angiogenesis, and/or the growth of new blood vessels that allow tumors to spread. In the case of the gastrointestinal tract (digestive organs), air pollution can affect the gut microbiota—the human's gastrointestinal microbiota (GMfH 2021; Vona et al. 2021) and, thus, can influence the development of cancer. To reduce the air pollution's effects and their associated diseases and mortality resulted from various types of cancer and other health problems, the World Health Organization (WHO 2005a, b) recommended the reduction of PM_s. For example, by reducing PM₁₀ from 70 µg/m³ to 20 µg/m³ (that is by 350%), air pollution's mortality rate can be reduced by about 15%. Thus, lower levels of air pollution can improve the health of a population, with respect to cardiovascular and respiratory diseases, various types of

cancer, women's pregnancy, neonatal defects, etc. at both short run and long run.

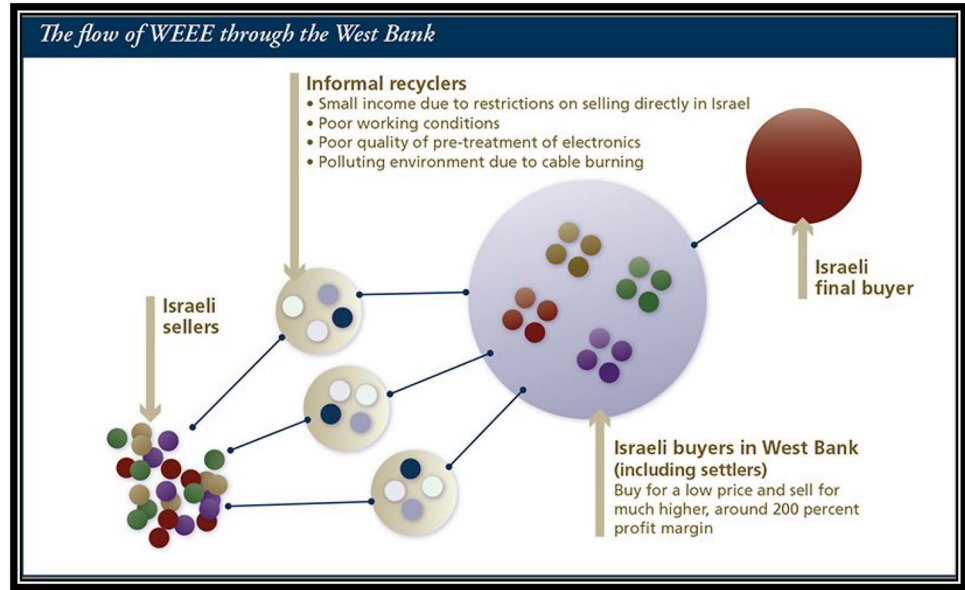
It is estimated that hundreds of thousands of deaths from lung cancer, annually worldwide, are attributable to air pollution; that is from air pollution, in general, and from PM_s, in particular. Some studies reported that air pollution is associated with an increased risk of mortality for several types of cancer, including lung cancer, breast cancer, liver cancer, bladder cancer, and pancreatic cancer (AACR 2013; Wong et al. 2016; Turner et al. 2019, 2020; CR UK 2021b), as discussed above. However, epidemiological evidence on outdoor air pollution and the risk of various types of cancer is still limited and, accordingly, it requires more intensive and comprehensive research.

Cancer incidence resulting from Israeli pollution in the OPT: some examples

Israeli scrap: Nowadays, it is believed that a primary source of illnesses, including cancer diseases, in the OPT and worldwide as well is air-, water-, and soil-pollution, resulting from burning of waste (electric, electronic, etc.), radioactive waste, medical waste, nuclear waste, and other types of toxic and hazardous wastes. For instance, according to Israeli observers, burning Israeli scrap for valuable raw metals is a fatal livelihood for tens of thousands or probably hundreds of thousands of Palestinian citizens, which leads to higher rates of various types of cancer in villages near Hebron, southern occupied West Bank (Peters 2018; Boxerman 2022). These villages are Beit Awwa, Idhna, and Deir Samit, with a combined population of around 43,000, in addition to the population of neighboring villages, who all live in the unfortunate confluence of poverty, inadequate environmental regulations, and porous limits to the flow of waste materials (Fig. 2).

Most of the world's waste is not recycled; instead, rich countries around the world ship their waste to poor countries. The same dynamics emerged between Israel and the Occupied Palestinian Territories which are under the Israeli military control since June 1967, and where Palestinians are living and working. This reflects a rich country (Israel) dumping its harmful waste in poor Palestinian communities in the OPT, which results in high levels of pollution generated from burning most of that waste, as well as from gaseous, liquid, and solid pollutants that pollute the air, surface water, groundwater, and soils. The Israeli scrap, transported to repair and renewal workshops in the village of Beit Awwa, for example, amounts around 62 trucks per day, each carrying a load of 2.5 metric tons. This is equivalent to about 155 metric tons of scrap dumped daily in one village; not to mention the other villages. This is with the consideration that 98% of the trucks come from Israel, and the remaining 2% comes

Fig. 2 Israeli scrap (waste of electrical and electronic equipment—WEEE) dumped in the occupied West Bank (after Peters 2018)



from elsewhere in the occupied West Bank. About 45% of the scrap's ingredients are classified as WEEE waste. This is, by weight, 66% electrical household appliances waste; 31% electronics' waste; and 3% information and communication technologies' (ICT) waste (Peters 2018).

According to official estimates, Israel produces, annually, about 130,000 tons (130 million kg) of scrap (waste of electric and electronic equipment—WEEE) (Boxerman 2022). Much of it is smuggled into the occupied West Bank, where it is stripped by Palestinians, looking for the precious metals within. High levels of dangerous lead and other heavy cancerous metals were found in the bodies of children, who were diagnosed with various types of cancer (such as leukemia, brain, HL, and NHL), as well as long-term damages to their neurological system (Boxerman 2022). Other Palestinian citizens suffered from sudden and debilitating respiratory illnesses after exposure to burning remnants of the scrap, resulting in many cases of cancer of various types, including lung cancer and its complications. Elevated levels of several toxic metals were also found in both tap water and groundwater throughout the burn-areas. Furthermore, statistically significant increases in the incidence of cancer, respiratory diseases and miscarriage, in addition to higher levels of toxic metals in Palestinian citizens' blood were found. These include, but not limited to, aluminum (Al), barium (Ba), cadmium (Cd), chromium (Cr), copper (Cu), gallium (Ga), iron (Fe), lead (Pb), silver (Ag), and vanadium (V) (Peters 2018). People, as young as 4 years of age, got leukemia (blood cancer), resulting from burning the Israeli WEEE waste to extract valuable raw metals. "There isn't a house on our street without someone who's had cancer or passed away," said Israa, who lives in the small town of Beit Awwa, near the city of Hebron (Boxerman 2022).

Israeli nuclear waste: In addition to the Israeli waste dumped in Palestinian areas, observers (internationals and Palestinian locals) contribute the high rates of breast cancer and other types of cancer in the southern parts of the occupied West Bank (as indicated above) to the impacts of the Dimona's Nuclear Reactor in southern Israel on public health of Palestinians and the environment (POICA 2008; Al-Rjoub 2009; Abu Arqoub 2015; Pontin et al. 2015; WHO

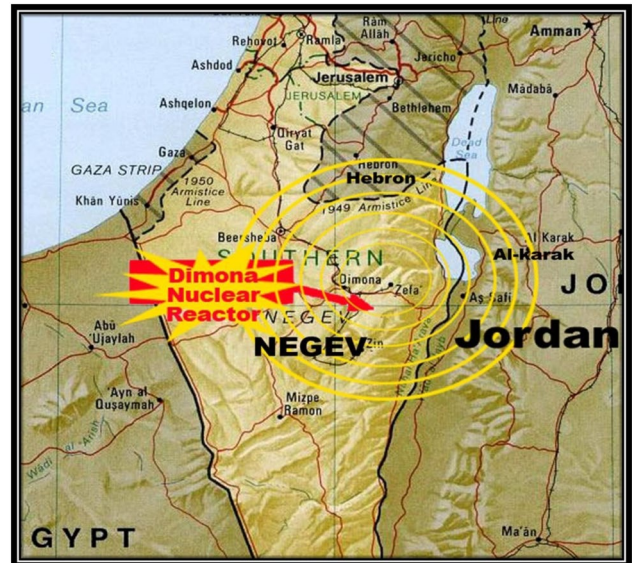


Fig. 3 A map showing the geographical location of the Israeli Dimona's Nuclear Reactor, Negev Desert, and its geographical effects of the radiations emitted from it on the southern parts of the occupied Palestinian West Bank and the southern areas of neighboring Jordan (after POICA 2008)

2016b; FoEME 2020; AAA 2021; Gambrell 2021; Melman 2021; Taha 2022) (Fig. 3).

“The cases of cancer in areas south of Hebron are the highest in Palestine, due to the burying of waste in a nearby location and the presence of a nuclear reactor. We need to end the Israeli occupation, which has turned the occupied Palestinian West Bank into a massive landfill for dangerous and toxic wastes. Since 1967, Israeli authorities uprooted 2.5 million trees, including 800,000 Palestinian olive trees,” said Palestinian Prime Minister—M. Shtayyeh—during a conference on climate change organized by the Environment Quality Authority in Ramallah, West Bank, Palestine (AAA 2021).

Israeli skunk liquid: Salem (2019a) conducted a study on the effects of skunk liquid used by the Israeli occupation forces against Palestinians in the Occupied Palestinian Territories. Salem (2019a) concluded that although there is no single indication of a relationship between the spread of cancer in the OPT and Israel’s use of the skunk liquid against Palestinians, it is worth noting that examinations, such as medical and laboratory examinations including blood, tissue, and other analyzes, are necessary and urgent to establish whether such a relationship exists or not, directly or indirectly. However, Palestinians reported that skunk liquid causes, among other negative effects, fatal effects and hair loss, as well as serious injuries (Hawari 2021), due to spraying skunk liquid under extremely high pressure (Salem 2019a; Hawari 2021).

Conclusions and recommendations

All over the world, the annual rates of cancer incidence and mortality are really high—second only to cardiovascular diseases. This situation also applies to the Occupied Palestinian Territories (OPT), where the already high rates of cancer incidence and mortality are rising and even escalating. They strike adult males and females of all ages, as well as children at very young ages. The OPT’s cancer types with the highest rates are lung cancer amongst males, breast cancer amongst females, colorectal cancer amongst both sexes, and leukemia (blood cancer) amongst children. Besides hereditary (genetic) as a common cause of cancer, there are also other causes, including (i) nutrition (what people eat and drink); (ii) air pollution (what people breathe in and inhale, including smoking); and (iii) stress (how people think and what they think, based on the fact that people in the OPT are living under unprecedented levels of stress, due to both internal and external factors requiring what is widely known as “stress management” to adapt stress and live with it.

Unfortunately, all three causes or sources related to cancer incidence and death are found, abundantly, in the OPT. This is in terms of poor quality of food that people eat, especially

due to the high prices of food products; consuming large amounts of sugary (carbonated) drinks; eating genetically modified foods; high rates of smoking (cigarettes, hookah, etc.); highly polluted air that people breathe, resulting from various sources of pollution that affect not only the air, but also the water and the soil; and the heavy burden of stressors that affect all individuals, families, and communities within the Palestinian society, whether they are rich or poor, young or old. This is also linked to excessive smoking amongst men and women of all ages, as well as lack of exercise. Moreover, the extraordinary dependence of many people on new technologies, such as computers, mobile phones, digital games, etc., and related things such as mobile-phone towers, are all powerful drives of cancer. These factors definitely restrict people’s movements and limit their activities. Parts of these reasons are certainly attributable to the ongoing Israeli military occupation since June 1967, and partly contributed to the political system that controls the Palestinian people in the OPT, where there is no democracy, no free elections, no freedom of expression, no critical and creative thinking, and no freedom of movement.

Additionally, the various kinds of the Israeli waste dumped in the Occupied Palestinian Territories, including electrical and electronic waste, solid waste, liquid waste, toxic waste, hazardous waste, industrial waste, and nuclear waste, are all anthropogenic sources causing cancer. Long-term exposure to these kinds of dangerous wastes definitely increases the risk of developing cancer amongst male and female adults, adolescents and young children. However, more research is urgently needed to further clarify whether there are real risks to public health, the environment, ecosystems, and quality of life, arising from these sources of waste. However, people must not give up the fight for the right to breathe clean fresh air, by putting more pressure on politicians, policy- and strategy-makers, and human rights’ and civil rights’ organizations, locally, nationally and internationally, such as the World Health Organization, United Nations Environment Program, UNRWA, Amnesty International, Human Rights Watch, and cancer societies around the world. This is to ensure that the maximum levels of various pollutants recommended by the World Health Organization are not violated in the Occupied Palestinian Territories by the Israelis and otherwise. Also, more pressure must be exerted on the Israel occupation authorities to reduce or completely stop dumping waste in the OPT, to protect people’s health, the environment, and the ecological systems.

In light of the above findings and discussions, it appears that the burden of cancer in the OPT is expected to increase, reaching levels that have further challenged the financial resources and health infrastructure currently available. The welfare system, whose financial and political uncertainty exacerbates the problem, is in a very bad shape. However, it is hoped that scientists and clinicians will conduct surveys

and analyses, focusing on the prevalence of cancers in the Occupied Palestinian Territories, as well as the possible causes and effects of the various types of cancer, in relation to the harsh living conditions under the Israeli military occupation in the OPT, politically, economically, socially, environmentally, and healthily, as well as with regard to stress, diet, pollution, activity, and working conditions. The inhumane Israeli practices against Palestinian citizens in the Occupied Palestinian Territories, as well as the extremely stressful way of life that Palestinians have been experiencing all the time under the protracted military occupation since 1967, must always be looked into and investigated. Moreover, strict regulations and rules must be imposed on everyone who pollutes the environment with a view to protect the environment and reduce the negative impacts of waste and pollution on public health and the environment.

Challenges and hardships facing cancer patients, as well as the treatments available will be investigated by the same author in other research paper(s).

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Ethical approval This paper was not published before and is not considered for publication anywhere else.

Human/animal rights statement The research presented herein does not involve human participants and/or animals.

Consent to participate No individual participants or material were involved in this study and, thus, there is no need to obtain informed consent.

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