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RESEARCH

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
ACS	American Cancer Society
AD	Anno Domini, Latin for "in the year of the Lord"
BC	Before Christ
BC	Black carbon
BMI	Body mass index
BRCA1	Breast cancer 1 gene
BRCA2	Breast cancer 2 gene
CMV	Cytomegalovirus
COPD	Chronic obstructive pulmonary disease
COVID-19	Corona virus disease 2019
DNA	Deoxyribonucleic acid
DSBs	Double-strand breaks, DNA
EBV	Epstein–Barr virus
EMF	Electromagnetic field
EU	European Union
FAP	Familial adenomatous polyposis
HIV	Human immunodeficiency virus
HL	Hodgkin's lymphoma
HTLV	Human T-lymphotropic virus
ICT	Information and Communication Technologies
IL-6	Interleukin-6 protein
KRAS	Kirsten rat sarcoma
LSI	Limestone industry
MHLW	Ministry of Health, Labor and Welfare, Japan
NHL	Non-Hodgkin's lymphoma
NO	Nitric oxide
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
$\mu g/m^3$	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.

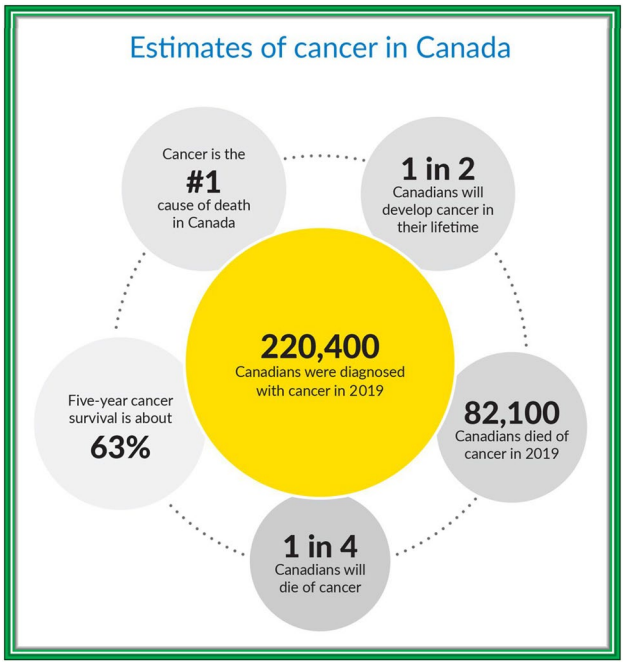

Fig. 1 Cancer status' projections in Canada in 2021 (after RAC 2020; CCSAC 2021)

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 Briton 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 km^2, 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 km^2), 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
Sub-Total	*819*	*72*	*Sub-Total*	*777*	*77*
Other Types	319	28	Other Types	232	23
Total	*1138*	*100*	*Total*	*1009*	*100*

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%), gallbladder (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, NO_2 and NO_3); total suspended particulates (TSP) or fine particulates (PM_s) that include PM_1, $PM_{2.5}$, PM_7, and PM_{10}; 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 $\mu g/m^3$ 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 $\mu g/m^3$ 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 NO_2 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 (xi) 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/cm^3 increase in UFP was positively associated with brain tumor incidence after adjusting for $PM_{2.5}$ and NO_2, 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 NO_2, dust ($PM_{2.5}$), black carbon, warm season ozone (O_3), 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 μg/m^3 increase in particulate matter $PM_{2.5}$.

(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, socioeconomics, and, in some cases, medications (Maggioncalda et al. 2010). Gravidity (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 antitumor 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 $PM_{2.5}$, 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 $PM_{2.5}$, 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 $\mu g/m^3$ 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/m^3 (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; Encecopedia.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 PM_{10}, PM_7, $PM_{2.5}$, and PM_1. While PM_{10} and PM_7 can penetrate and settle deep within the lungs, the most harmful to health are $PM_{2.5}$ and PM_1 (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 PM_1 (group 1 of carcinogens) to be the most harmful, dangerous, and deadly component of PM_s, due to its (PM_1) 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 PM_{10} from 70 μg/m^3 to 20 μg/m^3 (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

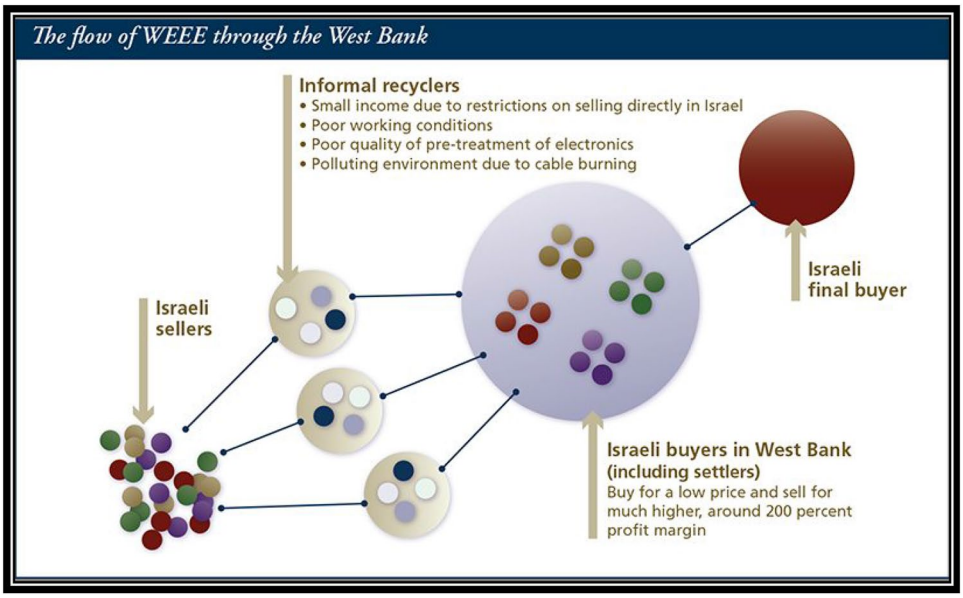

Fig. 2 Israeli scrap (waste of electrical and electronic equipment—WEEE) dumped in the occupied West Bank (after Peters 2018)

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

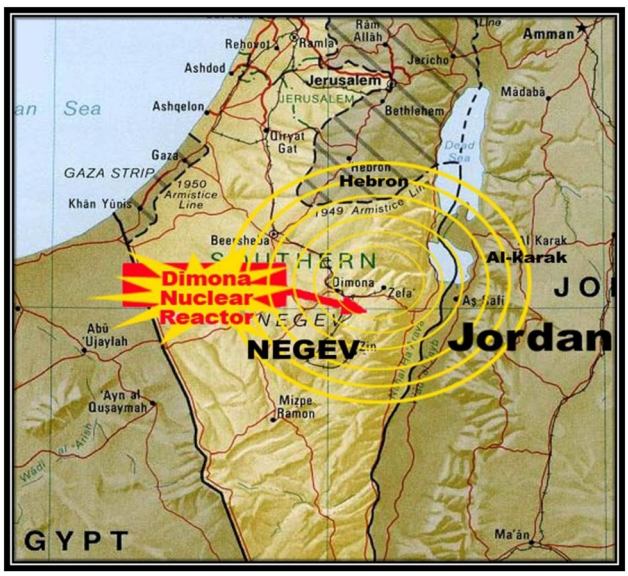

Fig. 3 A map showing the geographical location of the Israeli Dimona's Nuclear Reactor, Negev Desert, and its geographical effects of the radiations emitted from it on the southern parts of the occupied Palestinian West Bank and the southern areas of neighboring Jordan (after POICA 2008)

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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References

AAA (Asharq Al-Awsat) (2021) Shtayyeh calls for probe into Israel's burial of nuclear waste in West Bank. https://english.aawsat.com/home/article/3347851/shtayyeh-calls-probe-israel%E2%80%99s-burial-nuclear-waste-west-bank. Accessed 12 Aug 2022

AACR (American Association for Cancer Research) (2013) Air pollution may be associated with many types of cancer. Researchers urge better regulation to protect public health. https://www.aacr.org/patients-caregivers/progress-against-cancer/air-pollution-associated-cancer/ http://thisweekinpalestine.com/marble-from-the-holy-land-the-pillar-of-the-palestinian-export-sector/. Accessed 12 Aug 2022

AADA (American Academy for Dermatology Association) (2022) Melanoma strikes men harder. https://www.aad.org/public/diseases/skin-cancer/types/common/melanoma/men-50. Accessed 12 Aug 2022

AANS (American Association of American Surgeons) (2022) Brain tumors: Types of brain tumors. https://www.aans.org/en/Patients/Neurosurgical-Conditions-and-Treatments/Brain-Tumors. Accessed 12 Aug 2022

Abu Arqoub A (2015) Is waste from Israel's nuclear programme poisoning Palestinians? The New Arab, June 30, 2015. https://english.alaraby.co.uk/analysis/waste-israels-nuclear-programme-poisoning-palestinians. Accessed 12 Aug 2022

Abu-Rmeileh NME, Gianicolo EAL, Bruni A, Mitwali S, Portaluri M, Bitar J, Hamad M, Giacaman R, Vigotti MA (2016) Cancer mortality in the West Bank, Occupied Palestinian Territory. BMC Public Health 16(76). https://doi.org/10.1186/s12889-016-2715-8. https://bmcpublichealth.biomedcentral.com/articles/. https://doi.org/10.1186/s12889-016-2715-8#citeas

ACS (American Cancer Society) (2018) Understanding what cancer is: Ancient times to present – oldest descriptions of cancer. https://www.cancer.org/treatment/understanding-your-diagnosis/history-of-cancer/what-is-cancer.html#:~:text=Origin%20of%20the%20word%20cancer&text=In%20Greek%2C%20these%20words%20refer,the%20Latin%20word%20for%20crab. Accessed 12 Aug 2022

ACS (American Cancer Society) (2020) Pancreatic cancer risk factors. https://www.cancer.org/cancer/pancreatic-cancer/causes-risks-prevention/risk-factors.html. Accessed 12 Aug 2022

ACS (American Cancer Society) (2021) Breast cancer risk factors you cannot change. https://www.cancer.org/cancer/breast-cancer/risk-and-prevention/breast-cancer-risk-factors-you-cannot-change.html#:~:text=About%205%25%20to%2010%25%20of,the%20BRCA1%20or%20BRCA2%20gene. Accessed 12 Aug 2022

ACS (American Cancer Society) (2022a) Key statistics for colorectal cancer. How common is colorectal cancer? https://www.cancer.org/cancer/colon-rectal-cancer/about/key-statistics.html. Accessed 12 Aug 2022

ACS (American Cancer Society) (2022b) Key statistics for pancreatic cancer. How common is pancreatic cancer? https://www.cancer.org/cancer/pancreatic-cancer/about/key-statistics.html#:~:text=Pancreatic%20cancer%20accounts%20for%20about,in%20men%20than%20in%20women. Accessed 12 Aug 2022

Akther T, Ahmed M, Shohel M, Ferdousi FK, Salam A (2019) Particulate matters and gaseous pollutants in indoor environment and association of ultra-fine particulate matters (PM1) with lung function. Environ Sci Pollut Res 26:5475–5484. https://doi.org/10.1007/s11356-018-4043-2. https://doi.org/10.1007/s11356-018-4043-2

Alhmoud JF, Woolley JF, Al Moustafa AE, Malki MI (2020) DNA damage/repair management in cancers. Cancers (Basel), 12(4):1050. https://doi.org/10.3390/cancers12041050. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7226105/

Al-Rjoub A (2009) Dimona is carcinogenic to the Palestinians (an article in Arabic). AlJazeera. https://www.aljazeera.net/news/healthmedicine/2009/7/21/%D8%AF%D9%8A%D9%85%D9%88%D9%86%D8%A9-%D8%AA%D8%B3%D8%B1%D8%B7%

D9%86-%D8%A7%D9%84%D9%81%D9%84%D8%B3%D8%B7%D9%8A%D9%86%D9%8A%D9%8A%D9%86. Accessed 12 Aug 2022

Alshaer N (2022) Health Ministry: Leukemia is the most common type of cancer among children. J24106.1 https://jerusalem.24fm.ps/11406.html. Accessed 12 Aug 2022

Al-Shamsi HO, Abu-Gheida IH, Iqbal F, Al-Awadhi A (Eds) (2022) Cancer in the Arab World. Springer, Singapore. https://doi.org/10.1007/978-981-16-7945-2_1

Amin R, Matsumoto K, Hosaka H, Kitazawa T, Fujita S, Seto K, Hasegawa T (2018) Cost of illness of leukemia in Japan – Trend analysis and future projections. J Chinese Med Assoc 81(9-September):796–803. https://doi.org/10.1016/j.jcma.2018.02.005 https://www.sciencedirect.com/science/article/pii/S1726490118301369

An S (2020) The Role of Ambient Particulate Matter Air Pollution in Cutaneous Malignant Melanoma and Non-Melanoma Skin Cancer in the Women's Health Initiative. Master Thesis in Environmental and Occupational Health Sciences, University of Washington, USA. http://hdl.handle.net/1773/45997 https://digital.lib.washington.edu/researchworks/handle/1773/45997

Arafa MA, Rabah DM, and Farhat KH (2020) Rising cancer rates in the Arab World: now is the time for action. Eastern Mediterranean Health J 26(6):638640. https://doi.org/10.26719/emhj.20.073 http://www.emro.who.int/emhj-volume-26-2020/volume-26-issue-6/rising-cancer-rates-in-the-arab-world-now-is-the-time-for-action.html#:~:text=Among%20Arabs%2C%20cancer%20is%20growing,cancer%20incidence%20(Table%201)

Banner Health (2019) Skin cancer: men vs. women. https://www.bannerhealth.com/healthcareblog/teach-me/skin-cancer-men-vs-women#:~:text=Compared%20to%20women%2C%20men%20are,more%20likely%20to%20develop%20it. Accessed 12 Aug 2022

Baudouin C, Charveron M, Tarroux R, Gall Y (2002) Environmental pollutants and skin cancer. Cell Biol Toxicol 18(5): 341–348. https://doi.org/10.1023/a:1019540316060. https://pubmed.ncbi.nlm.nih.gov/12240965/

Bhargav H, Srinivasan TM, Varambally S, Gangadhar BN, Koka P (2015) Effect of mobile phone-induced electromagnetic field on brain hemodynamics and human stem cell functioning: Possible mechanistic link to cancer risk and early diagnostic value of electronphotonic imaging. J Stem Cells, 10(4):287–294. https://pubmed.ncbi.nlm.nih.gov/27144830/

Bogumil D, Wu AH, Stram D, Yang J, Tseng CC, Le Marchand L, Wu J, Cheng I, Setiawan VW (2021) The association between ambient air pollutants and pancreatic cancer in the Multiethnic Cohort Study. Environ Res 202:111608. https://doi.org/10.1016/j.envres.2021.111608. PMID: 34214566; https://pubmed.ncbi.nlm.nih.gov/34214566/

Boxerman A (2022) A deadly trash trade is poisoning Palestinians in the West Bank. Burning Israeli scrap for valuable raw metals is a lethal livelihood for thousands of Palestinians, sending cancer rates skyrocketing in villages near Hebron. The Times of Israel. https://www.timesofisrael.com/a-deadly-trash-trade-is-poisoning-palestinians-in-the-west-bank/. Accessed 12 Aug 2022

Brenner DR, Poirier A, Woods RR, Ellison LF, Billette JM, Demers AA, Zhang SX, Yao C, Finley C, Fitzgerald N, Saint-Jacques N, Shack L, Turner D, Holmes E. (2022) Projected estimates of cancer in Canada in 2022. Canadian Cancer Statistics Advisory Committee. CMAJ 194(17):E601-E607. https://doi.org/10.1503/cmaj.212097. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9067380/#:~:text=An%20estimated%20233%20900%20new,in%20males%20(24%20600).

BSF (Brain Science Foundation) (2022) Meningioma risk factors. https://www.brainsciencefoundation.org/brain-tumor-resources/meningioma/risk-factors/. Accessed 12 Aug 2022

Cancer.Net (2021a) Brain tumor: risk factors. September 2021. https://www.cancer.net/cancer-types/brain-tumor/risk-factors. Accessed 12 Aug 2022

Cancer.Net (2021b) Pancreatic cancer: risk factors. September 2021. https://www.cancer.net/cancer-types/pancreatic-cancer/risk-factors#:~:text=Chemicals.,risk%20of%20developing%20pancreatic%20cancer. Accessed 12 Aug 2022

Carrington D (2019) Air pollution nanoparticles linked to brain cancer for first time. Exclusive: tiny particles produced by motor traffic can invade the brain and carry carcinogens. The Guardian, November 13, 2019. https://www.theguardian.com/environment/2019/nov/13/air-pollution-particles-linked-to-brain-cancer-in-new-research. Accessed 12 Aug 2022

Castaño-Vinyals G, Cantor KP, Malats N, Tardon A, Garcia-Closas R, Serra C, Carrato A, Rothman N, Vermeulen R, Silverman D, Dosemeci M, Kogevinas M (2008) Air pollution and risk of urinary bladder cancer in a case-control study in Spain. Occupat Environ Med 65(1):56–60. https://doi.org/10.1136/oem.2007.034348. https://pubmed.ncbi.nlm.nih.gov/17634245/

CCSAC (Canadian Cancer Statistics Advisory Committee) in collaboration with the Canadian Cancer Society, Statistics Canada and the Public Health Agency of Canada. Canadian Cancer Statistics (2021) Toronto, ON: Canadian Cancer Society, 2021. https://cdn.cancer.ca/-/media/files/research/cancer-statistics/2021-statistics/2021-pdf-en-final.pdf

CDCP (Centers for Disease Control and Prevention) (2020) Hereditary breast and ovarian cancer: The BRCA1 and BRCA2 Genes. U.S. Department of Health & Human Services. Accessed 12 Aug 2022

CDCP (Centers for Disease Control and Prevention) (2021) What are the risk factors for ovarian cancer? U.S. Department of Health & Human Services. https://www.cdc.gov/cancer/ovarian/basic_info/risk_factors.htm. Accessed 12 Aug 2022

CDCP (Centers for Disease Control and Prevention) (2022) Liver cancer. U.S. Department of Health & Human Services. https://www.cdc.gov/cancer/liver/index.htm#:~:text=Each%20year%20in%20the%20United,be%20beginning%20to%20level%20off. Accessed 12 Aug 2022

Chen K-C, Tsai S-W, Shie R-H, Zeng C, Yang HY (2022) Indoor air pollution increases the risk of lung cancer. Int J Environ Res Public Health 19:1164. https://doi.org/10.3390/ijerph19031164

Clarity (2021) Particulate matter – Air quality measurements series: particulate matter. September 16, 2021. https://www.clarity.io/blog/air-quality-measurements-series-particulate-matter. Accessed 12 Aug 2022

Cook MB, Dawsey SM, Freedman ND, Inskip PD, Wichner SM, Quraishi SM, Devesa SS, McGlynn KA (2009) Sex disparities in cancer incidence by period and age. Cancer Epidemiol Biomarkers Prev 18(4):1174–1182. https://doi.org/10.1158/1055-9965.EPI-08-1118. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2793271/

CR UK (Cancer Research UK) (2021a) What is passive smoking? March 23, 2021. https://www.cancerresearchuk.org/about-cancer/causes-of-cancer/smoking-and-cancer/what-is-passive-smoking#:~:text=Passive%20smoking%20puts%20people%20at,obstructive%20pulmonary%20disease%20(COPD). Accessed 12 Aug 2022

CR UK (Cancer Research UK) (2021b) How can air pollution cause cancer? Last reviewed: August 17, 2021. https://www.cancerresearchuk.org/about-cancer/causes-of-cancer/air-pollution-radon-gas-and-cancer/how-can-air-pollution-cause-cancer. Accessed 12 Aug 2022

CSJ (Cancer Statistics in Japan) (2021) Cancer Statistics in Japan 2021. https://ganjoho.jp/public/qa_links/report/statistics/2021_en.html. Accessed 12 Aug 2022

Das M (2022) Cancer care crisis in the Palestinian territories. Lancet Oncol 23(5):575. https://doi.org/10.1016/S1470-2045(22)00218-2

Datzmann T, Markevych I, Trautmann F, Heinrich J, Schmitt J (2018) Outdoor air pollution, green space, and cancer incidence in Saxony: a semi-individual cohort study. BMC Public Health, 18:715. https://doi.org/10.1186/s12889-018-5615-2. https://bmcpublichealth.biomedcentral.com/articles/. https://doi.org/10.1186/s12889-018-5615-2#citeas

Dess RT, Hartman HE, Mahal BA, Soni PD, Jackson WC, Cooperberg MR, Amling CL, Aronson WJ, Kane CJ, Terris MK, Zumsteg ZS, Butler S, Osborne JR, Morgan TM, Mehra R, Salami SS, Kishan AU, Wang C, Schaeffer EM, Roach M 3rd, Pisansky TM, Shipley WU, Freedland SJ, Sandler HM, Halabi S, Feng FY, Dignam JJ, Nguyen PL, Schipper MJ, Spratt DE (2019) Association of black race with prostate cancer-specific and other-cause mortality. JAMA Oncol 5(7):975–983. https://doi.org/10.1001/jamaoncol.2019.0826. https://pubmed.ncbi.nlm.nih.gov/31120534/

Dyba T, Randi G, Bray F, Martos C, Giusti F, Nicholson N, Gavin A, Flego M, Neamtiu L, Dimitrova N, Negrão Carvalho R, Ferlay J, Bettio M (2021) The European cancer burden in 2020: Incidence and mortality estimates for 40 countries and 25 major cancers. Eur J Cancer, 157:308–347. https://doi.org/10.1016/j.ejca.2021.07.039. https://pubmed.ncbi.nlm.nih.gov/34560371/#:~:text=In%20EU%2D27%2C%20the%20estimated,cancer%2Dcontrol%20measures%20across%20Europe.

EEA (European Environmental Agency) (2014) Health impacts of air pollution: Air pollutants can have a serious impact on human health. Children and the elderly are especially vulnerable. https://www.eea.europa.eu/signals/signals-2013/infographics/health-impacts-of-air-pollution/view. Accessed 12 Aug 2022

Elnuweiry HA (2019) Environment risk factors for childhood leukemia in the Gaza Strip: Case-control study. International Conference on Pediatrics & Neonatal Healthcare, March 14–15, 2019, London, UK. https://doi.org/10.4066/0971-9032-C1-012. https://www.alliedacademies.org/proceedings/environment-risk-factors-for-childhood-leukemia-in-the-gaza-strip-casecontrol-study-4499.html

Elshami M, Abukmail H, Aqel W, Alser M, Al-Slaibi I, Shurrab H, Qassem S, Usrof FD, Alruzayqat M, Nairoukh R, Mansour A, Kittaneh R, Sawafta, N, Habes YMN, Ghanim O, Aabed WA, Omar O, Daraghmeh M, Aljbour J, Elian R, Zuhour A, Habes H, Al-Dadah M, Abu-El-Noor N, Bottcher B (2022) Awareness of Palestinians about lung cancer symptoms: a national cross-sectional study. BMC Pulmon Med 22(135). https://doi.org/10.1186/s12890-022-01923-1 and https://bmcpulmmed.biomedcentral.com/articles/. https://doi.org/10.1186/s12890-022-01923-1

Emami SA, Sahebkar A, Tayarani-Najaran N, Tayarani-Najaran Z. Cancer and its Treatment in Main Ancient Books of Islamic Iranian Traditional Medicine (7th to 14th Century AD) (2012) Iranian Red Crescent Med J 14:747–57. https://doi.org/10.5812/ircmj.4954. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3587862/

Encecopedia.Com (2019) Total suspended particles (TSP). Encyclopedia of Public Health. The Gale Group Inc. https://www.encyclopedia.com/education/encyclopedias-almanacs-transcripts-and-maps/total-suspended-particles-tsp. Accessed 12 Aug 2022

EPA (Environmental Protection Agency, USA) (2004) Air Quality Criteria for Particulate Matter; Vols. I and II, EPA/600/P-99/002 aF-bF. US Environmental Protection Agency, Research Triangle Park, NC, USA.

ERS (European Respiratory Society) (2022) Air pollution linked to increased risk of infant death and reduced lung function in children. https://www.ersnet.org/news-and-features/news/air-pollution-linked-to-increased-risk-of-infant-deaths-and-reduced-lung-function-in-children/

Filippini T, Heck JE, Malagoli C, Del Giovane C, Vinceti M (2015) A review and meta-analysis of outdoor air pollution and risk of childhood leukemia. J Environ Sci Health Part C Environ Carcinogen Ecotoxicol Rev 33(1):36–66. https://doi.org/10.1080/10590501.2015.1002999. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4586078/

FoEME (Friends of Earth Middle East – Asia Pacific) (2020) Palestine: Poisoned by Israel's nuclear industry? September 2, 2020. https://foeasiapacific.org/2020/09/02/palestine-poisoned-by-israels-nuclear-industry/. Accessed 12 Aug 2022

FPCR (Foundation for Promotion of Cancer Research) (2021) Cancer Statistics in Japan ─ 2021. FPCR, Tokyo, March 2021. Japan. ISSN 2433–3212. https://ganjoho.jp/public/qa_links/report/statistics/pdf/cancer_statistics_2021.pdf

Gale RP, Halahleh K (2018) Cancer care in the Palestinian Territories. The ASCOPost, October 25, 2018. https://www.ascopost.com/issues/october-25-2018/cancer-care-in-the-palestinian-territories/. Accessed 12 Aug 2022

Gambrell J (2021) A soccer field-sized dig, stories deep: Israel expands Dimona nuclear facility. Reactor appears to be getting most extensive new construction work in decades, satellite photos show; reason unclear. The Times of Israel, February 25, 2021. https://www.timesofisrael.com/soccer-field-sized-and-stories-deep-israel-expands-dimona-nuclear-facility/. Accessed 12 Aug 2022

Giannoula E, Melidis C, Frangos S, Papadopoulos N, Koutsouki G, Iakovou I (2020) Ecological study on thyroid cancer incidence and mortality in association with European Union Member States' air pollution. Int J Environ Res Public Health 18(1):153. https://doi.org/10.3390/ijerph18010153. https://pubmed.ncbi.nlm.nih.gov/33379238/

GMfH (Gut Microbiota for Health) (2021) Gut microbiota info. Everything you always wanted to know about the gut microbiota. https://www.gutmicrobiotaforhealth.com/en/about-gut-microbiota-info/. Accessed 12 Aug 2022

Goldberg C (2019) Cancer patient says question could save lives: 'do you have Eastern European Jewish Ancestry?' WBUR, August 21, 2019. https://www.wbur.org/news/2019/08/21/cancer-patient-brca-ashkenazi-jew. Accessed 12 Aug 2022

Guernsey JR, Dewar R, Weerasinghe S, Kirkland S, and Veugelers, PJ (2000) Incidence of cancer in Sydney and Cape Breton County, Nova Scotia 1979–1997. Canadian J Public Health, 91:285–292. https://doi.org/10.1007/BF03404291. https://doi.org/10.1007/BF03404291#citeas

Halahleh K, Gale RP (2018) Cancer care in the Palestinian Territories. Lancet Oncol 19:e359–e364. https://doi.org/10.1016/S1470-2045(18)30323-1 and https://www.thelancet.com/journals/lanonc/article/PIIS1470-2045(18)30323-1/fulltext

Halahleh K, Abu-Rmeileh NME, Abusrour MM (2022) General oncology care in Palestine. In: Al-Shamsi HO, Abu-Gheida IH, Iqbal F, Al-Awadhi A (Eds.): Cancer in the Arab World. Springer, Singapore. Ch. 13, pp.196–213. https://doi.org/10.1007/978-981-16-7945-2_13

Hawari Y (2021) 'The Skunk': Another Israeli weapon for collective punishment. Israeli forces are using a 'crowd control' weapon with which they collectively punish Palestinian civilians for daring to protest. Aljazeera, May 12, 2021. https://www.aljazeera.com/opinions/2021/5/12/the-skunk-another-israeli-weapon-for-collective-punishment. Accessed 12 Aug 2022

Horesh N, Horowitz NA (2014). Does gender matter in non-Hodgkin lymphoma? Differences in epidemiology, clinical behavior, and therapy. Rambam Maimonides Med J 29,5(4):e0038. https://doi.org/10.5041/RMMJ.10172. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4222427/

Huang R, Zhou P-K (2021) DNA damage repair: historical perspectives, mechanistic pathways and clinical translation for targeted

cancer therapy. Signal Transduct Targeted Therapy, 6: 254. https://doi.org/10.1038/s41392-021-00648-7 and https://www.nature.com/articles/s41392-021-00648-7#citeas

Hung LJ, Chan TF, Wu CH, Chiu HF, Yang CY (2012) Traffic air pollution and risk of death from ovarian cancer in Taiwan: fine particulate matter (PM2.5) as a proxy marker. J Toxicol Environm Health, Part A 75(3):174–182. https://doi.org/10.1080/15287394.2012.641200. https://pubmed.ncbi.nlm.nih.gov/22251265/

Hvidtfeldt UA, Erdmann F, Urhøj SK, Brandt J, Geels C, Ketzel M, Frohn LM, Christensen JH, Sørensen M, Raaschou-Nielsen O (2020) Air pollution exposure at the residence and risk of childhood cancers in Denmark: a nationwide register-based case-control study. EClinicalMedicine, 28: 100569. https://doi.org/10.1016/j.eclinm.2020.100569. https://www.thelancet.com/journals/eclinm/article/PIIS2589-5370(20)30313-8/fulltext

Hwang J, Bae H, Choi S, Yi H, Ko B, Kim N (2020) Impact of air pollution on breast cancer incidence and mortality: a nationwide analysis in South Korea. Sci Rep 10:5392. https://doi.org/10.1038/s41598-020-62200-x

Imhoff J (2019) Study explores why prostate cancer mortality is higher in black men. Michigan Medicine, University of Michigan, May 23, 2019. https://labblog.uofmhealth.org/lab-report/study-explores-why-prostate-cancer-mortality-higher-black-men. Accessed 12 Aug 2022

IS Global (2017) Air pollution is associated with cancer mortality beyond lung cancer: a large scale epidemiological study associates some air pollutants with kidney, bladder and colorectal cancer death. Barcelona Institute for Global Health, Barcelona, Spain. https://www.isglobal.org/en_GB/-/la-contaminacion-del-aire-tambien-se-asocia-con-mortalidad-por-cancer-de-rinon-vejiga-y-colorrectal#:~:text=PM2%2C5%20was%20associated%20with,per%20each%206.5%20ppb%20increment. Accessed 12 Aug 2022

Jackson N, Menon BS, Zarina W, Zawawi N, Naing NN (1999). Why is acute leukemia more common in males? A possible sex-determined risk linked to the ABO blood group genes. Ann Hematol, 78(5):233–236. https://doi.org/10.1007/s002770050507 https://pubmed.ncbi.nlm.nih.gov/10391104/

Jamal S, Jones C, Walker J, Mazereeuw M, Sheppard AJ, Henry D, Marrett LD (2021) Cancer in First Nations people in Ontario, Canada: Incidence and mortality, 1991 to 2010. Health Reports, Statistics Canada, June 16, 2021. https://doi.org/10.25318/82-003-x202100600002-eng https://www150.statcan.gc.ca/n1/pub/82-003-x/2021006/article/00002-eng.htm

Jeggo PA, Löbrich M (2007) DNA double-strand breaks: their cellular and clinical impact? Oncogene, 26:7717–7719. https://doi.org/10.1038/sj.onc.1210868 https://www.nature.com/articles/1210868

Jenwitheesuk K, Peansukwech U, Jenwitheesuk K (2020) Accumulated ambient air pollution and colon cancer incidence in Thailand. Scient Rep 10,17765. https://doi.org/10.1038/s41598-020-74669-7 https://www.nature.com/articles/s41598-020-74669-7#citeas

Kain D (2007) Why liver cancer is more prevalent in males than in females. UCSD News Center, July 5, 2007. https://ucsdnews.ucsd.edu/archive/newsrel/health/07-07LiverCancerDK-.asp. Accessed 12 Aug 2022

Karzai S, Zhang Z, Sutton W, Prescott J, Segev DL, McAdams-DeMarco M, Biswal SS, Ramanathan M Jr, Mathur A (2022) Ambient particulate matter air pollution is associated with increased risk of papillary thyroid cancer. Surgery, 171(1):212–219. https://doi.org/10.1016/j.surg.2021.05.002. https://pubmed.ncbi.nlm.nih.gov/34210530/

Knell Y (2022) The Palestinian cancer centre that can't take patients. British Broadcasting Corporation (BBC News), March 27, 2022. https://www.bbc.com/news/world-middle-east-60829319. Accessed 12 Aug 2022

Kocarnik JM (2022) Cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life years for 29 Cancer Groups From 2010 to 2019 – A Systematic Analysis for the Global Burden of Disease Study 2019. Global Burden of Disease 2019 Cancer Collaboration. JAMA Oncol 8(3):420–444. https://doi.org/10.1001/jamaoncol.2021.6987. https://jamanetwork.com/journals/jamaoncology/fullarticle/2787350

Krishnamurthy R (2022) India's cancer burden: Cases & deaths increased last decade, COVID-19 widens screening gap. Globally, cancer cases increased 21% and deaths 26% from 2010–2019. Down to Earth, January 5, 2022. https://www.downtoearth.org.in/news/health/india-s-cancer-burden-cases-deaths-increased-last-decade-covid-19-widens-screening-gap-80984. Accessed 12 Aug 2022

Lee JS, Bracci PM, Holly EA. (2008) Non-Hodgkin lymphoma in women: reproductive factors and exogenous hormone use. Am J Epidemiol 168(3):278–288. https://doi.org/10.1093/aje/kwn119. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2727261/

Leon-Kabamba N, Ngatu NR, Kakoma, SJ, Nyembo C, Mbelambela EP, Moribe RJ, Wembonyama S, Danuser B, Oscar-Luboya N (2018) Respiratory health of dust-exposed Congolese coltan miners. Int Archiv Occupat Environ Health, 91:859–864. https://doi.org/10.1007/s00420-018-1329-0. https://pubmed.ncbi.nlm.nih.gov/29951778/

Li Q, Chang ET, Bassig BA, Dai M, Qin Q, Gao Y, Zhang Y, Zheng T (2013) Body size and risk of Hodgkin's lymphoma by age and gender: a population-based case-control study in Connecticut and Massachusetts. Cancer Causes Control, 24(2):287–295. https://doi.org/10.1007/s10552-012-0100-1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3557669/

Little MP, Weiss HA, Boice JD Jr, Darby SC, Day NE, Muirhead CR (1999) Risks of leukemia in Japanese atomic bomb survivors, in women treated for cervical cancer, and in patients treated for ankylosing spondylitis. Radiat Res 152(3):280–292. https://pubmed.ncbi.nlm.nih.gov/10453089/

Maggioncalda A, Malik N, Shenoy P, Smith M, Sinha R, Flowers CR (2010) Clinical, molecular, and environmental risk factors for Hodgkin lymphoma. Adv Hematol 736261. https://doi.org/10.1155/2011/736261 and https://www.hindawi.com/journals/ah/2011/736261/

Majek O, Gondos A, Jansen L, Emrich K, Holleczek B, Katalinic A, Nennecke A, Eberle A, Brenner H (2013) Cancer survival working group. Sex differences in colorectal cancer survival: population-based analysis of 164,996 colorectal cancer patients in Germany. PLoS One, 5, 8(7):e68077. https://doi.org/10.1371/journal.pone.0068077. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3702575/

Makowski E (2019) Air pollution tied to brain cancer: study. Inhaling combustion-produced particles may lead to the development of brain tumors. The Scientist, 13 November 2019. https://www.the-scientist.com/news-opinion/air-pollution-tied-to-brain-cancer--study-66717#:~:text=Nov%2013%2C%202019&text=They%20found%20that%20an%20air,one%2C%20according%20to%20The%20Guardian. Accessed 12 Aug 2022

Mayo Clinic (2022) Prostate cancer. https://www.mayoclinic.org/diseases-conditions/prostate-cancer/symptoms-causes/syc-20353087. Accessed 12 Aug 2022

Mazereeuw MV, Withrow DR, Diane Nishri E, Tjepkema M, Marrett LD (2018) Cancer incidence among First Nations adults in Canada: follow-up of the 1991 Census Mortality Cohort (1992–2009). Canadian J Public Health, 109(5–6):700–709. https://doi.org/10.17269/s41997-018-0091-0. https://pubmed.ncbi.nlm.nih.gov/29981110/

MCC (Moffitt Cancer Center) (2018a) What are the causes of leukemia? https://moffitt.org/cancers/leukemia/diagnosis/causes/. Accessed 12 Aug 2022

MCC (Moffitt Cancer Center) (2018b) Bladder cancer symptoms in women vs. men. https://moffitt.org/cancers/bladder-cancer/faqs/bladder-cancer-symptoms-in-women-vs-men/#:~:text=Bladder%20cancer%20is%20the%20fourth,this%20malignancy%20as%20non%2Dsmokers.. Accessed 12 Aug 2022

Melman Y (2021) What Israel is digging up under Dimona's Nuclear Reactor. Israeli construction work at the nuke site began in late 2018 or early 2019. It may be for burying radioactive waste or simply be an anti-aging effort. Haaretz, March 3, 2021. https://www.haaretz.com/israel-news/2021-03-03/ty-article/.premium/whats-israel-digging-up-under-dimonas-nuclear-reactor/0000017f-e179-d568-ad7f-f37b4b9b0000. Accessed 12 Aug 2022

Mills D, Abushanab S, Elhaloul A, El Nuweiry H, Shbair M, Qaddoumi I, Salman Z (2022) Barriers to care and outcomes of pediatric acute lymphoblastic leukemia treatment in the Gaza Strip. J Pediat Hematol Oncol, 44(1):e123–e126. https://doi.org/10.1097/MPH.0000000000002338. https://pubmed.ncbi.nlm.nih.gov/34705357/

MNT (Medical News Today) (2021) What to know about breast cancer. https://www.medicalnewstoday.com/articles/37136#Outlook. Accessed 12 Aug 2022

Morgan KK (2022) How many people die of cancer a year? WebMD Cancer Center. June 19, 2022. https://www.webmd.com/cancer/how-many-cancer-deaths-per-year. Accessed 12 Aug 2022

Multigner L, Ndong JR, Oliva A, Blanchet P (2008) Polluants environnementaux et cancer de la prostate: données épidémiologiques [Environmental pollutants and prostate cancer: epidemiological data]. Gynecol Obstet Fertil, 36(9):848–856. French. https://doi.org/10.1016/j.gyobfe.2008.07.005. https://pubmed.ncbi.nlm.nih.gov/18693059/

Nakata K, Hiyama E, Katanoda K, Matsuda T, Tada Y, Inoue M, Kawa K, Maru M, Shimizu C, Horibe K, Miyashiro I (2022) Cancer in adolescents and young adults in Japan: epidemiology and cancer strategy. Int J Clin Oncol 27(1):7–15. https://doi.org/10.1007/s10147-021-02064-x. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8732807/

NCI (National Cancer Institute) (2022) DNA. National Cancer Institute at the National Institutes of Health, U.S. Department of Health and Human Services. https://www.cancer.gov/publications/dictionaries/genetics-dictionary/def/dna. Accessed 12 Aug 2022

NHGRI (National Human Genome Research Institute) (2022) Deoxyribonucleic Acid (DNA). https://www.genome.gov/genetics-glossary/Deoxyribonucleic-Acid. Accessed 12 Aug 2022

NHS (2019) Overview: Thyroid Cancer. August 28, 2019. https://www.nhs.uk/conditions/thyroid-cancer/. Accessed 12 Aug 2022

O'Donnell E (2017) Why is cancer more common in men? Harvard Mag. March–April 2017. https://www.harvardmagazine.com/2017/03/why-is-cancer-more-common-in-men#:~:text=Their%20results%20were%20startlingly%20clear,escape%20X%2Dinactivation%20in%20women.. Accessed 12 Aug 2022

Offord C (2019) Air pollution may damage people's brains. Contaminants in the atmosphere appear to have harmful effects on neurodevelopment and cognitive function. The Scientist, October 1, 2019. https://www.the-scientist.com/features/air-pollution-may-damage-peoples-brains-66473. Accessed 12 Aug 2022

Parent M-É, Goldberg MS, Crouse DL, Ross NA, Chen H, Valois M-F, Liautaud A (2013) Traffic-related air pollution and prostate cancer risk: A case-control study in Montreal, Canada. Occupat Environ Med 70(7):511–8. https://doi.org/10.1136/oemed-2012-101211. https://hal.archives-ouvertes.fr/pasteur-01132023/

PCBS (Palestinian Central Bureau of Statistics) (2022a) Palestinian Central Bureau of Statistics (PCBS) presents the conditions of Palestinian populations on the occasion of the International Population Day, 11/07/2022 – A world of 8 billion: "Towards a resilient future: Harnessing opportunities and ensuring rights and choices for all." About 14.3 Million Palestinians in Historical Palestine and Diaspora. Ramallah, Palestine. July 11, 2022 https://pcbs.gov.ps/post.aspx?lang=en&ItemID=4279. Accessed 12 Aug 2022

PCBS (Palestinian Central Bureau of Statistics) (2022b) The Palestinian Central Bureau of Statistics (PCBS) announces the preliminary results of the "Smoking and Tobacco Consumption Survey, 2021" on the World No Tobacco Day (31 May 2022). https://www.pcbs.gov.ps/site/512/default.aspx?lang=en&ItemID=4246. Accessed 12 Aug 2022

Peters A (2018) Scrap struggle in the Holy Land. E.Scrap News, August 1, 2018. https://resource-recycling.com/e-scrap/2017/08/09/scrap-struggle-holy-land/. Accessed 12 Aug 2022

POICA (2008) Report about nuclear radiation in south Hebron. October 3, 2022. http://poica.org/2008/10/report-about-nuclear-radiation-in-south-hebron/. Accessed 12 Aug 2022

Pontin B, De Lucia V, Rus JG (2015) Environmental Injustice in Occupied Palestinian Territory. A-Haq. Ramallah, West Bank, Palestine. 87p. https://www.alhaq.org/cached_uploads/download/alhaq_files/publications/Environmental.Injustice.Report.En.pdf

RAC (Randall Anthony Communications) (2020) Working towards a world where no Canadian fears cancer. The Globe and Mail, February 4, 2020. https://www.theglobeandmail.com/life/adv/article-working-towards-a-world-where-no-canadian-fears-cancer/. Accessed 12 Aug 2022

Rahbari R, Zhang L, Kebebew E (2010). Thyroid cancer gender disparity. Future Oncol 6(11):1771–1779. https://doi.org/10.2217/fon.10.127. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3077966/#:~:text=Some%20investigators%20have%20suggested%20that,to%20higher%20rates%20in%20women.

Rhyno D (2018) High cancer rates on the East Coast – Unhealthy habits decades ago and an older population are factors. Canadian Cancer Society's Special Report for 2018. https://www.saltscapes.com/living-healthy/2805-high-cancer-rates-on-the-east-coast.html https://cdn.cancer.ca/-/media/files/research/cancer-statistics/2018-statistics/canadian-cancer-statistics-2018-en.pdf. Accessed 12 Aug 2022

Robles-Díaz L, Goldfrank DJ, Kauff ND, Robson M, Offit K (2004) Hereditary ovarian cancer in Ashkenazi Jews. Familial Cancer, 3(3–4):259–64. https://doi.org/10.1007/s10689-004-9552-0. https://pubmed.ncbi.nlm.nih.gov/15516850/

Rubin J (2019) When it comes to brain tumors, a patient's sex matters. The Conversation. 8 January 2019. https://theconversation.com/when-it-comes-to-brain-tumors-a-patients-sex-matters-109176. Accessed 12 Aug 2022

Saint-Jacques N, Dewar R, Nauta L, MacIntyre M. (2018) Nova Scotia Cancer Incidence and Survival. Statistics Update: Focusing on 2011–15. Registry & Analytics, Nova Scotia Cancer Care Program, Nova Scotia Health Authority, Halifax, N.S., Canada. https://www.nshealth.ca/sites/nshealth.ca/files/nsccpcancerstatisticsreport2018_revised13112018.pdf

Sakhvidi MJZ, Lequy E., Goldberg M, Jacquemin B (2020) Air pollution exposure and bladder, kidney and urinary tract cancer risk: a systematic review, Environmental Pollution, 267:115328. https://doi.org/10.1016/j.envpol.2020.115328 and https://www.sciencedirect.com/science/article/pii/S0269749120360164

Saladi RN, Persaud AN (2005) The causes of skin cancer: a comprehensive review. Drugs Today (Barc), 41:37–53. https://doi.org/10.1358/dot.2005.41.1.875777. https://pubmed.ncbi.nlm.nih.gov/15753968/

Salem HS (2015) Health aspects of air quality in Palestine (Occupied). The First Africa/Middle East Expert Consultation/Workshop on the Impact of Airborne Dust on Health. WHO-CEHA, UNEP, WMO, EUMSTAT, and AEMET, Amman, Jordan, November

2–5, 2015.https://www.researchgate.net/publication/305459180_Health_Aspects_of_Air_Quality_in_Palestine_Occupied

Salem HS (2017) Indoor air pollution sources (particularly Skunk) and their impacts on health and the environment in the Occupied Palestinian Territories. (pp: 204–221). In Yassin MF (ed): Proceeding of Workshop on Air Quality in Hot Arid Climate (IAQHAC). Kuwait Institute for Scientific Research (KISR), Shuwaikh, Kuwait City, Kuwait, April 3–4, 2017.https://www.researchgate.net/publication/337890801_Indoor_air_pollution_sources_particularly_Skunk_and_their_impacts_on_health_and_the_environment_in_the_Occupied_Palestinian_Territories_PP_204-221_In_Conference_Proceedings_Full_Book

Salem HS (2019a) Sources of indoor air pollutants in the Occupied Palestinian Territories, including skunk liquid, household cleaning products, and others. J Environ Pollut Control, 2(1):106.http://www.annexpublishers.com/articles/JEPC/2106-Sources-of-Indoor-Air-Pollutants-in-the-Occupied-Palestinian-Territories-Including-Skunk-Liquid-Household-Cleaning-Products-and-Others.pdf https://www.researchgate.net/publication/336812632_Sources_of_Indoor_Air_Pollutants_in_the_Occupied_Palestinian_Territories_Including_Skunk_Liquid_Household_Cleaning_Products_and_Others_-_Journal_of_Environmental_Pollution_and_Control

Salem HS (2019b) No sustainable development in the lack of environmental justice. Environ Justice, 12(3):140–157. https://www.liebertpub.com https://doi.org/10.1089/env.2018.0040 https://www.researchgate.net/publication/330847246_No_Sustainable_Development_in_the_Lack_of_Environmental_Justice

Salem HS (2020) Air pollution caused by stone and marble industry in Palestine and its impacts on health. A Paper presented at the First International Conference on Applications of Air Quality in Science and Engineering Purposes, 10–12 February 2020, Kuwait Institute for Scientific Research (KISR), Shuwaikh, Kuwait City, Kuwait. https://tsi.com/discover-tsi/events/conferences/1st-international-conference-on-applications-of-air-quality-in-science-and-engineering-icaaqse-2020/

Salem HS (2021) Evaluation of the Stone and Marble Industry in Palestine: environmental, geological, health, socioeconomic, cultural, and legal perspectives, in view of sustainable development. Environ Sci Pollut Res 28,28058–28080. https://doi.org/10.1007/s11356-021-12526-4 https://doi.org/10.1007/s11356-021-12526-4#citeas https://www.researchgate.net/publication/340846344_Evaluation_of_the_Stone_and_Marble_Industry_in_Palestine_Environmental_Geological_Health_Socio-Economic_Cultural_and_Legal_Perspectives_in_View_of_Sustainable_Development

Salman Z, Shbair M, Zeineddin M, Balousha T, Qaddoumi I, Rodriguez-Galindo C (2021) Cancer care for children in the Gaza Strip. Lancet Oncol 22(12):1667–1668. https://doi.org/10.1016/S1470-2045(21)00655-0 https://www.thelancet.com/journals/lanonc/article/PIIS1470-2045%2821%2900655-0/fulltext?rss=yes

Schroeder R (2021) Environmental exposures may drive prostate cancer risk. School of Public Health, University of Illinois Chicago. Posted: 12 July 2021. https://publichealth.uic.edu/news-stories/environmental-exposures-may-drive-prostate-cancer-risk/. Accessed 12 Aug 2022

Sharma R, Aashima, Nanda M, Fronterre C, Sewagudde P, Ssentongo AE, Yenney K, Arhin ND, Oh J, Amponsah-Manu F and Ssentongo P (2022) Mapping cancer in Africa: A comprehensive and comparable characterization of 34 cancer types using estimates from GLOBOCAN 2020. Front Public Health 10:839835. https://doi.org/10.3389/fpubh.2022.839835 https://doi.org/10.3389/fpubh.2022.839835/full#:~:text=We%20examined%20the%20burden%20of,29)%20to%20711%2C000%20in%202020.

Shawahna R, Mosleh S, Odeh Y, Halawa R, Al-Ghoul M (2021) Clinical characteristics and outcomes of patients with pediatric acute lymphoblastic leukemia after induction of chemotherapy: a pilot descriptive correlational study from Palestine. BMC Res Notes 14(1):259. https://doi.org/10.1186/s13104-021-05678-6. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8256561/#:~:text=Cancer%20is%20the%20second%20most,children%20%5B1%2C%202%5D.

Siegel RL, Miller KD, Fuchs HE, Jemal A (2022) Cancer statistics, 2022. CA 72. https://doi.org/10.3322/caac.21708 https://acsjournals.onlinelibrary.wiley.com/doi/full/ https://doi.org/10.3322/caac.21708

Sivacoumar R, Jayabalou R, Subrahmanyam YV, Jothikumar N, Swarnalatha S (2001) Air pollution in stone crushing industry, and associated health effects. Indian J Environ Health 43(4):169–173. https://pubmed.ncbi.nlm.nih.gov/12395522/

So R, Chen J, Mehta AJ, Liu S, Strak M, Wolf K, Hvidtfeldt UA, Rodopoulou S, Stafoggia M, Klompmaker JO, Samoli E, Raaschou-Nielsen O, Atkinson R, Bauwelinck M, Bellander T, Boutron-Ruault MC, Brandt J, Brunekreef B, Cesaroni G, Concin H, Forastiere F, van Gils CH, Gulliver J, Hertel O, Hoffmann B, de Hoogh K, Janssen N, Lim Y-h, Westendorp R, Jørgensen JT, Katsouyanni K, Ketzel M, Lager A, Lang A, Ljungman PL, Magnusson PKE, Nagel G, Simonsen MK, Pershagen G, Peter RS, Peters A, Renzi M, Rizzuto D, Sigsgaard T, Vienneau D, Weinmayr G, Severi G, Fecht D, Tjønneland A, Leander K, Hoek G, Andersen ZJ (2021) Long-term exposure to air pollution and liver cancer incidence in six European cohorts. Int J Cancer, 149(11):1887–1897. https://doi.org/10.1002/ijc.33743 https://onlinelibrary.wiley.com/doi/10.1002/ijc.33743

St. LH (St. Luke's Health) (2020) Why men have a higher risk of melanoma. https://www.stlukeshealth.org/resources/why-men-have-higher-risk-melanoma. Accessed 12 Aug 2022

Stapelfeld C, Dammann C, Maser E (2019) Sex-specificity in lung cancer risk. Int J Cancer, 146(9):2376–2382. https://doi.org/10.1002/ijc.32716 https://onlinelibrary.wiley.com/doi/full/10.1002/ijc.32716

Stöppler MC (2017) Why is breast cancer more common in females than males? Medicine Net. https://www.medicinenet.com/breast_cancer_in_males_and_females/ask.htm. Accessed 12 Aug 2022

Su S-Y, Liaw Y-P, Jhuang JR, Hsu S-Y, Chiang C-J, Yang Y-W, Lee W-C (2019) Associations between ambient air pollution and cancer incidence in Taiwan: An ecological study of geographical variations. BMC Public Health 19:1496. https://doi.org/10.1186/s12889-019-7849-z https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-019-7849-z

Taha M (2022) Causing an outbreak of cancer: This is how 'Israel' turned the West Bank into a dumping ground for its nuclear waste. Al-Estiklal Newspaper, February 14, 2022. https://www.alestiklal.net/en/view/12275/causing-an-outbreak-of-cancer-this-is-how-israel-turned-the-west-bank-into-a-dumping-ground-for-its-nuclear-waste. Accessed 12 Aug 2022

Taj T, Poulsen AH, Ketzel M, Geels C, Brandt J, Christensen JH, Puett R, Hvidtfeldt UA, Sørensen M, Raaschou-Nielsen O (2020) Long-term exposure to air pollution and risk of non-Hodgkin lymphoma in Denmark: a population-based case-control study. Int J Cancer 147(7):1874–1880. https://doi.org/10.1002/ijc.32978. https://pubmed.ncbi.nlm.nih.gov/32175588/

Tucktuck M, Ghandour R, Abu-Rmeileh NME (2018) Waterpipe and cigarette tobacco smoking among Palestinian university students: a cross-sectional study. BMC Public Health 18:1. https://doi.org/10.1186/s12889-017-4524-0

Turner MC, Krewski D, Diver WR, Pope CA 3rd, Burnett RT, Jerrett M, Marshall JD, Gapstur SM (2017) Ambient air pollution and cancer mortality in the cancer prevention study II. Environ Health Perspect 125(8):087013. https://doi.org/10.1289/EHP1249. https://pubmed.ncbi.nlm.nih.gov/28886601

Turner MC, Gracia-Lavedan E, Cirac M, Castaño-Vinyals G, Malats N, Tardon A, Garcia-Closas R, Serra C, Carrato A, Jones RR, Rothman N, Silverman DT, Kogevinas M (2019) Ambient air pollution and incident bladder cancer risk: updated analysis of the Spanish Bladder Cancer Study. Int J Cancer, 145(4):894–900. https://doi.org/10.1002/ijc.32136. https://pubmed.ncbi.nlm.nih.gov/30653254/

Turner M, Andersen ZJ, Baccarelli A, Diver WR, Gapstur SM, Pope III CA, Diddier P, Samet J, Thurston G, Cohen A (2020) Outdoor air pollution and cancer: an overview of the current evidence and public health recommendations. CA, 76(6): 460–479. https://doi.org/10.3322/caac.21632. https://acsjournals.onlinelibrary.wiley.com/doi/full/10.3322/caac.21632

UCF (Urology Care Foundation) (2016) Bladder cancer in women. Fall 2016. https://www.urologyhealth.org/healthy-living/urologyhealth-extra/magazine-archives/fall-2016/bladder-cancer-in-women#:~:text=Bladder%20cancer%20can%20affect%20women,far%20the%20greatest%20risk%20factor. Accessed 12 Aug 2022

UNICEF (United Nations International Children's Emergency Fund) (2021) State of Palestine: Key Demographic Indicators. https://data.unicef.org/country/pse/#/. Accessed 12 Aug 2022

van Middendorp JJ, Sanchez GM, Burridge AL (2010) The Edwin Smith papyrus: a clinical reappraisal of the oldest known document on spinal injuries. Eur Spine J 19:1815–23. https://doi.org/10.1007/s00586-010-1523-6. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2989268/

Villanueva C, Chang J, Ziogas A, Bristow RE, Vieira VM (2021) Ambient air pollution and ovarian cancer survival in California. Gynecol Oncol 163(1):155–161. https://doi.org/10.1016/j.ygyno.2021.07.036

Vona R, Pallotta L, Cappelletti M, Severi C, Matarrese P (2021) The impact of oxidative stress in human pathology: Focus on gastrointestinal disorders. Antioxidants (A Special Issue Oxidative Stress and Inflammation in Health and Diseases), 10(2):201 https://doi.org/10.3390/antiox10020201 https://www.mdpi.com/2076-3921/10/2/201/htm#

Wang X, Xu Z, Su H, Ho HC, Song Y, Zheng H, Hossain MZ, Khan MA, Bogale D, Zhang H, Wei J, Cheng J (2021) Ambient particulate matter (PM_1, $PM_{2.5}$, PM_{10}) and childhood pneumonia: The smaller particle, the greater short-term impact? Sci Total Environ 772:145509. https://doi.org/10.1016/j.scitotenv.2021.145509 https://www.sciencedirect.com/science/article/abs/pii/S0048969721005775?via%3Dihub

Wang Z, Zhai Z, Chen C, Tian X, Xing Z, Xing P, Yang Y, Zhang J, Wang C, Dong L (2022) Air pollution particles hijack peroxidasin to disrupt immunosurveillance and promote lung cancer. eLife, 11:e75345. https://doi.org/10.7554/eLife.75345 https://elifesciences.org/articles/75345

Weichenthal S, Olaniyan T, Christidis T, Lavigne E, Hatzopoulou M, Van Ryswyk K, Tjepkema M, Burnett R (2020) Within-city spatial variations in ambient ultrafine particle concentrations and incident brain tumors in adults. Epidemiology, 31(2):177–183. https://doi.org/10.1097/EDE.0000000000001137. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7004474/

White A, Ironmonger L, Steele RJC, Ormiston-Smith N, Crawford C, Seims A (2018) A review of sex-related differences in colorectal cancer incidence, screening uptake, routes to diagnosis, cancer stage and survival in the UK. BMC Cancer 18(1):906. https://doi.org/10.1186/s12885-018-4786-7. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6149054/

WHO (World Health Organization) (2005a) Air Quality Guidelines. Global Update 2005. Particulate matter, ozone, nitrogen dioxide and sulfur dioxide. WHO, Geneva, Switzerland. WHO, Geneva, Switzerland. 484p. ISBN 92 890 2192 6. http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/pre2009/air-quality-guidelines.-global-update-2005a-particulate-matter,-ozone,-nitrogen-dioxide-and-sulfur-dioxide

WHO (World Health Organization) (2005b) WHO air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide. Global update 2005–Summary of risk assessment. WHO, Geneva, Switzerland.https://apps.who.int/iris/bitstream/handle/10665/69477/WHO_SDE_PHE_OEH_06.02_eng.pdf;jsessionid=74FD2752542B71058C7DBDA44BCE7454?sequence=1

WHO (World Health Organization) (2016a) Ionizing radiation, health effects and protective measures. April 29, 2016. WHO, Geneva, Switzerland. https://www.who.int/news-room/fact-sheets/detail/ionizing-radiation-health-effects-and-protective-measures. Accessed 12 Aug 2022

WHO (World Health Organization) (2016b) Health conditions in the occupied Palestinian territory, including east Jerusalem, and in the occupied Syrian Golan. Sixty Ninth World Health Assembly, Provisional Agenda Item 19. A69/INF.6/ May 20, 2016. WHO, Geneva, Switzerland. https://apps.who.int/gb/ebwha/pdf_files/WHA69/A69_INF6-en.pdf

WHO (World Health Organization) (2020a) Gaza Strip and West Bank Source: Globocan 2020. International Agency for Research on Cancer. WHO, Geneva, Switzerland.https://gco.iarc.fr/today/data/factsheets/populations/275-gaza-strip-and-west-bank-fact-sheets.pdf

WHO (World Health Organization) (2020b) Tobacco Tax: Palestine. WHO-EM/TFI/219/E. WHO, Geneva, Switzerland. https://applications.emro.who.int/docs/WHOEMTFI219E-eng.pdf?ua=1

WHO (World Health Organization) (2021) Ambient (outdoor) air pollution. WHO, Geneva, Switzerland. Updated: September 22, 2021. WHO, Geneva, Switzerland. https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health. Accessed 12 Aug 2022

WHO (World Health Organization) (2022a) Report - WHO Air Quality Database (Update 2022). WHO, Geneva, Switzerland. https://www.who.int/data/gho/data/themes/air-pollution/who-air-quality-database. Accessed 12 Aug 2022

WHO (World Health Organization) (2022b) Air Pollution. WHO, Geneva, Switzerland. https://www.who.int/health-topics/air-pollution#tab=tab_1. Accessed 12 Aug 2022

WHO (World Health Organization) (2022c) Billions of people still breathe unhealthy air: new WHO data. Over 6000 cities now monitor air quality. WHO, WHO, Geneva, Switzerland.https://www.who.int/news/item/04-04-2022c-billions-of-people-still-breathe-unhealthy-air-new-who-data. Accessed 12 Aug 2022

WNA (Wafa News Agency) (2018) Cancer the second cause of death in Palestine in 2016. February 4, 2016. https://english.wafa.ps/page.aspx?id=LLiNEea96346907943aLLiNEe. Accessed 12 Aug 2022

Wong CM, Tsang H, Lai HK, Thomas GN, Lam KB, Chan KP, Zheng Q, Ayres JG, Lee SY, Lam TH, Thach TQ (2016) Cancer mortality risks from long-term exposure to ambient fine particle. Cancer Epidemiol Biomark Prevent 25(5):839–845. https://doi.org/10.1158/1055-9965.EPI-15-0626. https://cebp.aacrjournals.org/content/25/5/839

Worldometer (2022) State of Palestine Population Live: 5,350,466. https://www.worldometers.info/world-population/state-of-palestine-population/#:~:text=The%20current%20population%20of%20the,the%20latest%20United%20Nations%20data. Accessed 12 Aug 2022

Wu S, Powers S, Zhu W, Hannun YA (2016) Substantial contribution of extrinsic risk factors to cancer development. Nature 529(7584):43–47. https://doi.org/10.1038/nature16166. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4836858/

Xia C, Dong X, Li H, Cao M, Sun D, He S, Yang F, Yan X, Zhang S, Li N, Chen W (2022) Cancer statistics in China and United

States, 2022: profiles, trends, and determinants. Chinese Med J (English), 135:584–590. https://doi.org/10.1097/CM9.0000000000002108. https://pubmed.ncbi.nlm.nih.gov/35143424/

Yaghi HR (2017) Cancer incidence in the Gaza strip facts & figures 2015–2016. Cancer Registry Center PHIC, Gaza, Palestine. https://www.moh.gov.ps/portal/wp-content/uploads/2018/07/CANCER-IN-GAZA-2015-2016.pdf

Zaid A, Abualia K, Khatib AAS, Qumsiyeh MB (2018) Cytogenetic abnormalities in acute leukemia patients from Occupied Palestine. Jordan Med J 52(3):137–145. https://journals.ju.edu.jo/JMJ

Zhang Y (2013) Understanding the gender disparity in bladder cancer risk: The impact of sex hormones and liver on bladder susceptibility to carcinogens. J Environ Sci Health Part C Environ Carcinogen Ecotoxicol Rev 31(4): 287–304. https://doi.org/10.1080/10590501.2013.844755. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3852434/