

Эпидемиология наиболее распространенных видов рака в Найнаве в 2017–2021 гг.

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Резюме

Актуальность. Во всем мире рак является одним из самых опасных для жизни людей заболеваний, которое развивается независимо от пола, этнической принадлежности или национальности. **Цель.** Представить эпидемиологическую характеристику случаев злокачественных заболеваний в мухафазе Найнава¹ (включая проценты, показатели заболеваемости, смертности и др.), зарегистрированных в 2017–2021 гг. **Материалы и методы.** В исследовании использовался ретроспективный аналитический эпидемиологический метод. Для сбора данных о различных типах рака, распространенных в Найнаве в 2017–2021 гг., использовали информационную базу Иракского реестра рака. Мы сосредоточились на 10 самых распространенных злокачественных заболеваний среди населения Найнавы. **Результаты.** Наше исследование показало, что количество новых случаев рака и смертность ежегодно увеличивались в рассматриваемый период. Среди женщин наблюдалась более высокая заболеваемость раком, чем среди мужчин. Наиболее распространенными видами рака в Найнаве были рак груди у женщин и рак легких у мужчин. В структуре злокачественных заболеваний у детей лейкоз занимала первое место. Кроме того, это исследование показало, что рак легких имел самый высокий уровень смертности в Найнаве, за ним следует рак груди. **Заключение.** Наше исследование позволяет оценить ситуацию с онкологической заболеваемостью в мухафазе Найнава, и его результаты будут полезны врачам, преподавателям медицинских образовательных организаций и специалистам в области медицины.

Ключевые слова: эпидемиология, рак, заболеваемость, Найнава, смертность

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Epidemiology of the most Prevalent Cancers in Ninewa between 2017–2021

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Abstract

Purpose. Cancer is characterized by abnormal cell growth resulting from uncontrolled cell division. These cells spread and form metastatic lesions in normal tissues, leading to loss of tissue and organ function. Cancer is one of the most life-threatening diseases worldwide that develops in humans, regardless of sex, ethnicity, or nationality. **Material and methods.** Here, we conducted a retrospective study to collect data on the various types of cancers prevalent in Ninewa, Iraq, between 2017–2021, using hospital records pooled in the Iraq Cancer Registry. We focused on the top 10 most notable cancers prevalent in humans. **Results.** Our study revealed that number of novel cancer cases and mortality rates have been increasing annually between 2017–2021. Females had higher rates of cancer occurrence than males. The most prevalent cancers in Ninewa were breast cancer in women and lung cancer in men. Leukemia was the most common pediatric cancer. Furthermore, this study reported that lung cancer had the highest mortality rate in Ninewa, followed by breast cancer.

Conclusion Our study provides a statistical overview on cancer cases in the Ninewa governorate, and will be useful to clinicians, faculty members and other professionals in the medical field.

Keywords: epidemiology, cancer, incidence, Ninewa, mortality, childhood cancer

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Introduction

Cancer is the first or second most prevalent cause of mortality worldwide, accounting for approximately 10 million deaths in 2020, which is roughly every one in six deaths (Ferlay et al., 2015; Sung et al., 2021). In men, the most common types of cancer are lung, prostate, colorectal, liver, stomach, and bladder cancers; whereas the most prevalent cancers in women are breast, lung, colorectal, cervical, thyroid, and uterine corpus cancers (Sung et al., 2021). In terms of mortality, lung, colorectal, and stomach cancers most frequently causing deaths in males, whereas breast, lung, and colorectal cancers were the most common causes of deaths in females. About 70% of cancer cases in developing countries result in mortality (Akinyemiju, 2018; Akinde et al., 2015). The global incidence of different types of cancers is predicted to increase from 14.1 million novel cases in 2012 to 20 million in 2025 (Ferlay et al., 2015).

The epidemiology of cancers is essential for knowledge understanding and investigating the distribution and frequency of different types of cancers and for possible disease control in specific regions. Cancer epidemiology provides recent information on its incidence rates, estimates the burden of cancer worldwide, and provides insights into cancer mortality rates (Mattiuzzi & Lippi, 2019). These data are valuable resources for the government to identify risk factors and develop effective therapeutic strategies to prevent increased cancer incidence in certain areas (Akinyemiju, 2018; Oliveria et al., 1997; M-Amen et al., 2022). Epidemiological research plays a vital role in identifying the risk factors that contribute to the development of cancer. These factors include tobacco use, unhealthy diet, alcohol consumption, urban air pollution, obesity, physical inactivity, and bacterial and viral infections (Ervik et al., 2016). Epidemiological studies have evaluated that more than 75% of cancer cases might be controlled through lifestyle modifications (Oliveria et al., 1997). Iraq has suffered continuously from wars and economic sanctions for the last 40 years, which has led to notable deterioration of health infrastructure and lifestyle of people in all Iraqi cities, including Ninewa (WHO IARC, 2018; Hussain & Lafta, 2021). The systematic collection of cancer data in Iraq is conducted by the Iraqi Cancer Registry (ICR), which provides reliable data on the incidence rate, pattern, and mortality of cancer distributed by age and sex in all governorates of Iraq (Iraqi Cancer Registry, 2021).

Ninewa is the second-largest governorate in Iraq after the capital Baghdad, in terms of area and popula-

tion. Mousl is the capital city of Ninewa. It lies in north-western Iraq and has an area of 37,323 square kilometers with a population of 3,729,99 million people in 2022, according to the Central Organization for Statistics. Ninewa borders Syria to the west and Turkey to the north (World Bank in Iraq., 2023). Ninewa Governorate consists of nine districts: Mosul, Tel Kayf, Sheikhan, Akre, Tal Afar, Sinjar, Ba'aj, Al-Hatra, and Hamdaniya (International Organization for Migration, 2019). Cancer is one of the leading causes of death in Ninewa (Ala'din, 2004). The Ninewa Health Department has reported a dramatic increase in the number of cancer cases and mortality rates in Ninewa, particularly during the years following the war against ISIS (Al-Hashimi & Wang, 2013; Alkhayatt et al., 2021). Therefore, the present study aimed to provide epidemiological estimates of cancer incidence rates and patterns of different types of cancers in Ninewa, Iraq, arranged by sex and age for the years 2017_2021 using incidence and mortality data. This study also aimed to provide an update on cancer mortality and mortality rates in Ninewa during the study period (2017_2021).

Materials and Methods

This retrospective epidemiological study collected data from different hospitals in Ninewa Governorate, Iraq, between 2017_2021. These data are registered in by the Iraqi Cancer Registry (ICR) of the Ministry of Health, Iraq. The ICR was established in 1974 through collaboration between the Health Ministry and the Iraqi Society Center of the Iraqi Health Ministry. The ICR provides an annual report to calculate and estimate cancer cases in all Iraq governorates yearly. These reports include the number of novel cancer cases in adults and children and provide information about the cases of mortality resulting from cancer. Data in ICR are collected from the medical records of all (private and public) hospitals, laboratories, radiotherapy and pathology departments, and cancer oncology centers from all directorates of health in Ninewa. The registration includes personal information of patients who participated in this study (name, sex, age, residence, and nationality) and details of the tumor (diagnosis date, primary site, grade, and histology). All data on cancer cases from Ninewa governorate were analyzed using the CanReg-3 program (International Association of Cancer Registries, Lyon, France). The program removed duplicate entries of the same cancer case and only the verified cases were analyzed. The current study listed the top ten most prevalent cancers in Ninewa, along

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with their total percentages and affected sex (male and female) each year between 2017_2021. In addition, data on the incidence of cancer (IR) per 100 individuals were calculated for both sexes (adult males and females) for different types of cancer by dividing the number of cancer cases by the total population. Furthermore, this study elaborated the top ten cancers and their percentages in children aged 0_14 years. In this epidemiological study, we opted not to include the stage, grade, survival rate, or molecular status of genes involved in the initiation and development of cancer.

Statistical Analysis

GraphPad Prism version 6 (GraphPad Software Inc, USA) was used for all statistical analyses and preparation of graphs in the study.

Results

1. Estimated total number of patients, percentages, and incidence rates of cancer in Ninewa

A total of 11,053 cases of the top ten cancers were reported in adults of both sexes (male and female) of the Ninewa Governorate over five years (2017_2021) (Table 1). The results show the distribution of the top

ten Cancers. Regardless of the sex of the patients, the number of patients with malignant tumors increased with time in Ninewa. According to the Iraqi Cancer Registry, breast cancer was the most prevalent type of cancer in the total population between 2017_2021, followed by lung malignancy in both sexes in all years, except for leukemia, which was the second most common cancer in 2017. The third most common type of cancer was colorectal cancer. The number of patients and percentage with breast cancer were higher in 2017 than in other years, reaching 538 and a rate of 31.44%, whereas the number of patients with breast cancer was the lowest in 2020 (478) at 19.04%. Ovarian cancer was the least common type of cancer recorded at 2.92 in 2017; data were not available on ovarian cancer for any other period.

In contrast, the other top ten prevalent tumors in Ninewa between 2017 and 2021 were non-Hodgkin lymphoma, prostate, Hodgkin lymphoma, brain and central nervous system, stomach, skin, thyroid gland, and urinary bladder tumors. In the data showed that the crude incidence rates of the top ten cancers increased between 2017 and 2021 (Figure. 1). In the stretched time for these five years, breast cancer had the highest incidence rate in the total population. Although breast

Table 1. Total number of patients and incidence percentages of the percent of top ten most prevalent cancers in Ninewa during the 5-year study period (2017–2021). Breast cancer and lung cancer were predominant among all cancers in Ninewa between (2018–2021), while breast cancer and leukemia were the most prevalent in Ninewa in 2017

Таблица 1. Общее количество пациентов и заболеваемость в процентах десяти наиболее распространенных видов рака в Найнаве в течение 5-летнего периода исследования (2017–2021). Рак груди и рак легких преобладали среди всех видов рака в Найнаве в период (2018–2021), в то время как рак груди и лейкемия были наиболее распространенными в Найнаве в 2017 г.

Years														
2017			2018			2019			2020			2021		
Tumor Site	No.	%	Tumor site	No.	%	Tumor site	No.	%	Tumor site	No.	%	Tumor Site	No.	%
Breast	538	31.44	Breast	502	22.77	Breast	513	20.72	Breast	478	19.0	Breast	503	29.68
Leukemia	130	7.6	Lung	208	9.43	Lung	228	9.21	Lung	199	7.93	Lung	217	12.80
Colorectal	103	6.02	Colorectal	164	7.44	Colorectal	170	6.87	Colorectal	177	7.05	Colorectal	182	10.74
Lung	99	5.79	Leukemia	123	5.58	Leukemia	152	6.14	Brain & CNS	176	7.01	Brain & CNS	155	9.14
Non-Hodgkin lymphoma	99	5.79	Brain & CNS	101	4.58	Brain & CNS	136	5.49	Leukemia	133	5.30	Leukemia	148	8.73
Prostate	54	3.16	Non-Hodgkin lymphoma	88	3.99	Thyroid gland	105	4.24	Stomach	122	4.86	Urinary bladder	109	6.43
Hodgkin lymphoma	53	3.10	Stomach	86	3.90	Prostate	94	3.80	Thyroid gland	115	4.58	Stomach	107	6.31
Brain & CNS	51	2.98	Urinary bladder	78	3.54	Stomach	91	3.68	Non-Hodgkin lymphoma	100	3.98	Thyroid gland	94	5.55
Stomach	51	2.98	Skin	71	3.22	Kidney	89	3.59	Unknown primary site	99	3.94	Non-Hodgkin lymphoma	91	5.37
Ovary	50	2.92	Prostate	69	3.13	Non-Hodgkin lymphoma	86	3.47	Skin	88	3.50	Prostate	89	5.25

Figure 1. Incidence rate per 100,000 people for the ten most prevalent types of cancer in Ninewa governorate, Iraq, during the study period (2017–2021). Among the top ten cancers, breast and lung cancers had the highest incidence rates of the total population of both genders (including both male and female) of Ninewa governorate

Рисунок 1. Уровень заболеваемости на 100 тыс. человек для десяти наиболее распространенных видов рака в Найнаве в течение периода исследования (2017–2021). Среди десяти основных видов рака, рак груди и легких имел самые высокие показатели заболеваемости среди всего населения обоих полов

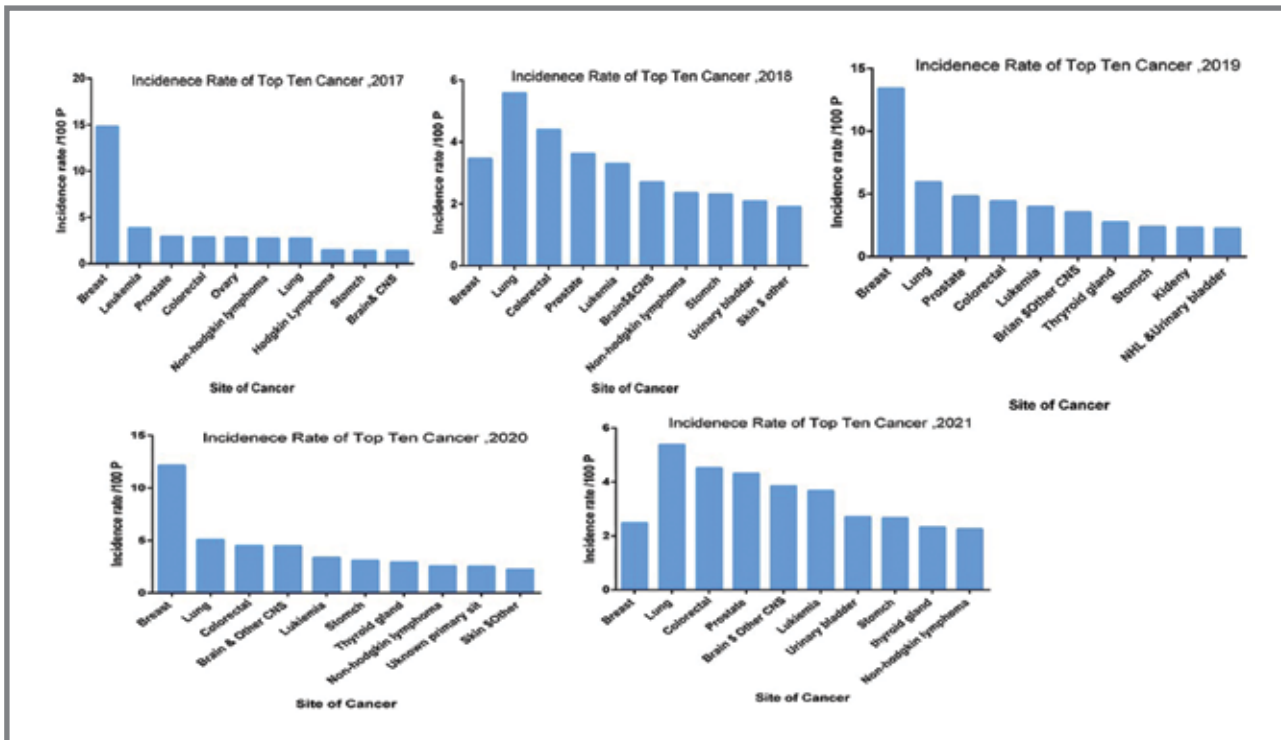
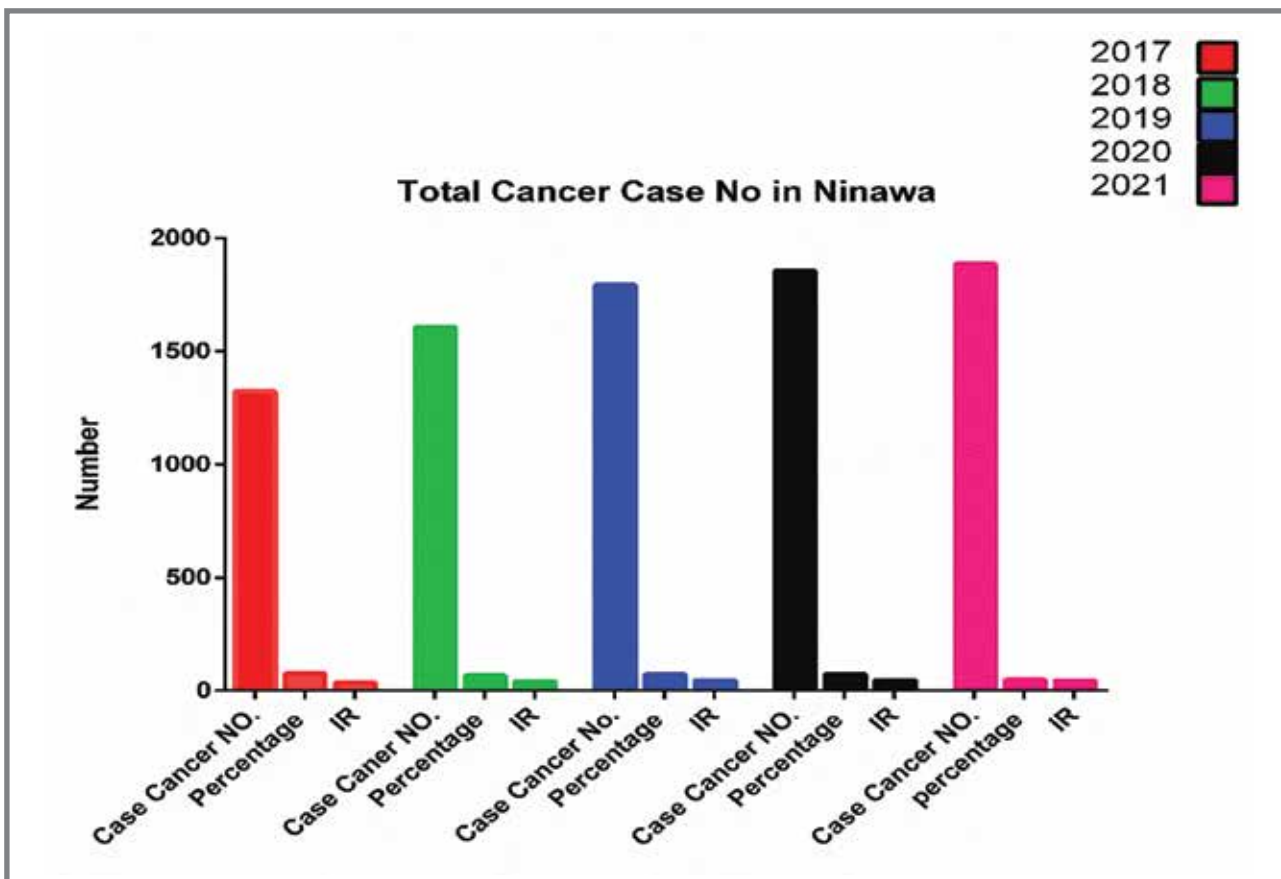


Figure 2. Total number of cancer cases, pattern, and incidence rate in Ninewa during the study period (2017–2021)

Рисунок 2. Общее количество случаев рака, динамика и уровень заболеваемости в Найнаве за исследуемый период (2017–2021)



cancer has a higher incidence rate for all cancer types in the entire population, the incidence rate of breast cancer decreased slightly between (2017 and 2021). The incidence rates of breast cancer as recorded at 14.81/100.000 in 2017, and 12.48/100.000 in 2021. Lung cancer was the second most common cancer after breast cancer, except in 2017, and leukemia was the most common type of cancer after breast cancer.

The number of patients and the percentage of the top ten cancers have increased recently in Ninewa. The annual trend in the incidence of various types of cancers from 2017 to 2021 in Ninewa was recorded, and the incidence rate increased between 2017 and 2021. The total of patients with cancer in 2021 was the highest compared with last year, reaching 1695 with at a rate of 100% (Figure 2). The incidence rate was 44.17, while the total of patients and percentage were lower than in other years, which reached 1325 and 100%, respectively. The incidence rate was 36.64 in 2017.

2. Number percentage, and incident rate of the top ten cancers in males, Ninewa.

The results estimated the number of cancer cases, percentages, and incidence rates in males in Ninewa from 2017 to 2021 (Table 2). The Data recorded the

most common cancers in males in Ninewa during (2017_2021). The most prevalent type of cancer was lung cancer, the incidence of which has drastically increased in recent years. Overall, 3126 cancer cases occurred in the period 2017 to 2021 in males, with 654 cases of lung cancer accounting for approximately 20% of all novel cancer cases. The number of patients with lung cancer reached 171 in 2021, with a percentage (of 21.4 %), while the number of cancer cases in males was 77, with a rate of 12.03% in 2017. As the second leading cause of cancer, it has fluctuated over time. In 2018, 2020, and 2021, colorectal cancer was recorded as the second most common type of cancer. In 2017, Leukemia was the second most common type of cancer, whereas urinary bladder was the second most common type of cancer in 2019. The remaining top ten cancers most prevalent in Ninewa were prostate, non-Hodgkin lymphoma, urinary bladder, stomach, Brain CNS, Hodgkin lymphoma, larynx, liver, and kidney cancer.

In addition, lung cancer is associated with a high crude incidence rate (Figure.3). The incidence rate of lung cancer elevated over the years, with highest rate of 8.59% in 2019, while it was 4.15% in 2017.

Table 2. The number of patients and incidence percentages of the top ten most prevalent cancers in males in Ninewa. Lung cancer was the most common cancer in Ninewa during the study period (2017–2021)

Таблица 2. Количество пациентов и процент заболеваемости десятью наиболее распространенными видами рака у мужчин в Найнаве. Рак легких был наиболее распространенным видом рака в Найнаве в течение периода исследования (2017–2021)

Years														
2017			2018			2019			2020			2021		
Tumor Site	No.	%	Tumor site	No.	%	Tumor site	No.	%	Tumor site	No.	%	Tumor Site	No.	%
Breast	538	31.44	Breast	502	22.77	Breast	513	20.72	Breast	478	19.0	Breast	503	29.68
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Colorectal	103	6.02	Colorectal	164	7.44	Colorectal	170	6.87	Colorectal	177	7.05	Colorectal	182	10.74
Lung	99	5.79	Leukemia	123	5.58	Leukemia	152	6.14	Brain & CNS	176	7.01	Brain & CNS	155	9.14
Non-Hodgkin lymphoma	99	5.79	Brain & CNS	101	4.58	Brain & CNS	136	5.49	Leukemia	133	5.30	Leukemia	148	8.73
Prostate	54	3.16	Non-Hodgkin lymphoma	88	3.99	Thyroid gland	105	4.24	Stomach	122	4.86	Urinary bladder	109	6.43
Hodgkin lymphoma	53	3.10	Stomach	86	3.90	Prostate	94	3.80	Thyroid gland	115	4.58	Stomach	107	6.31
Brain & CNS	51	2.98	Urinary bladder	78	3.54	Stomach	91	3.68	Non-Hodgkin lymphoma	100	3.98	Thyroid gland	94	5.55
Stomach	51	2.98	Skin	71	3.22	Kidney	89	3.59	Unknown primary site	99	3.94	Non-Hodgkin lymphoma	91	5.37
Ovary	50	2.92	Prostate	69	3.13	Non-Hodgkin lymphoma	86	3.47	Skin	88	3.50	Prostate	89	5.25

Figure 3. Incidence rate (males) of the top ten most prevalent cancers per 100,000 males in Ninewa governorate, Iraq (2017–2021) shows that lung cancer was the most common type of cancer in males

Рисунок 3. Уровень заболеваемости (среди мужчин) десятью наиболее распространенными видами рака на 100 тыс. мужчин в мухафазе Найнава, (2017–2021 гг.) показывает, что рак легких является наиболее распространенным типом рака у мужчин

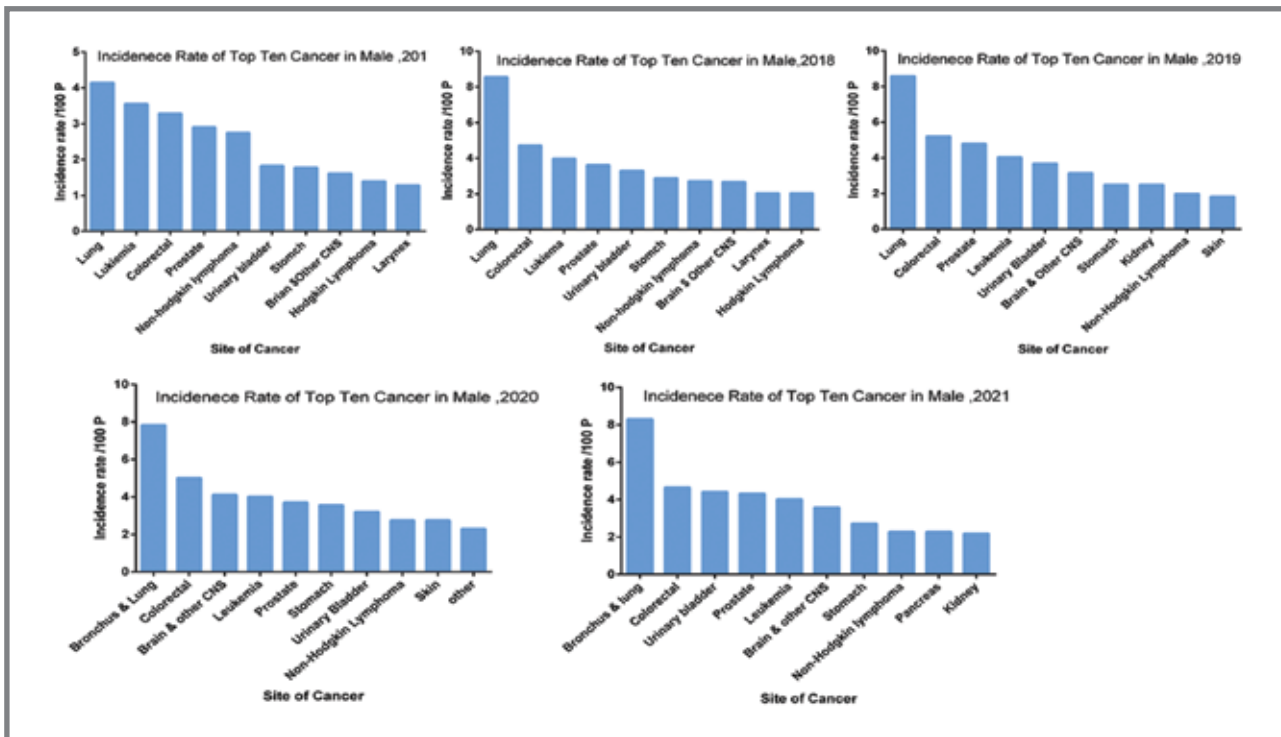
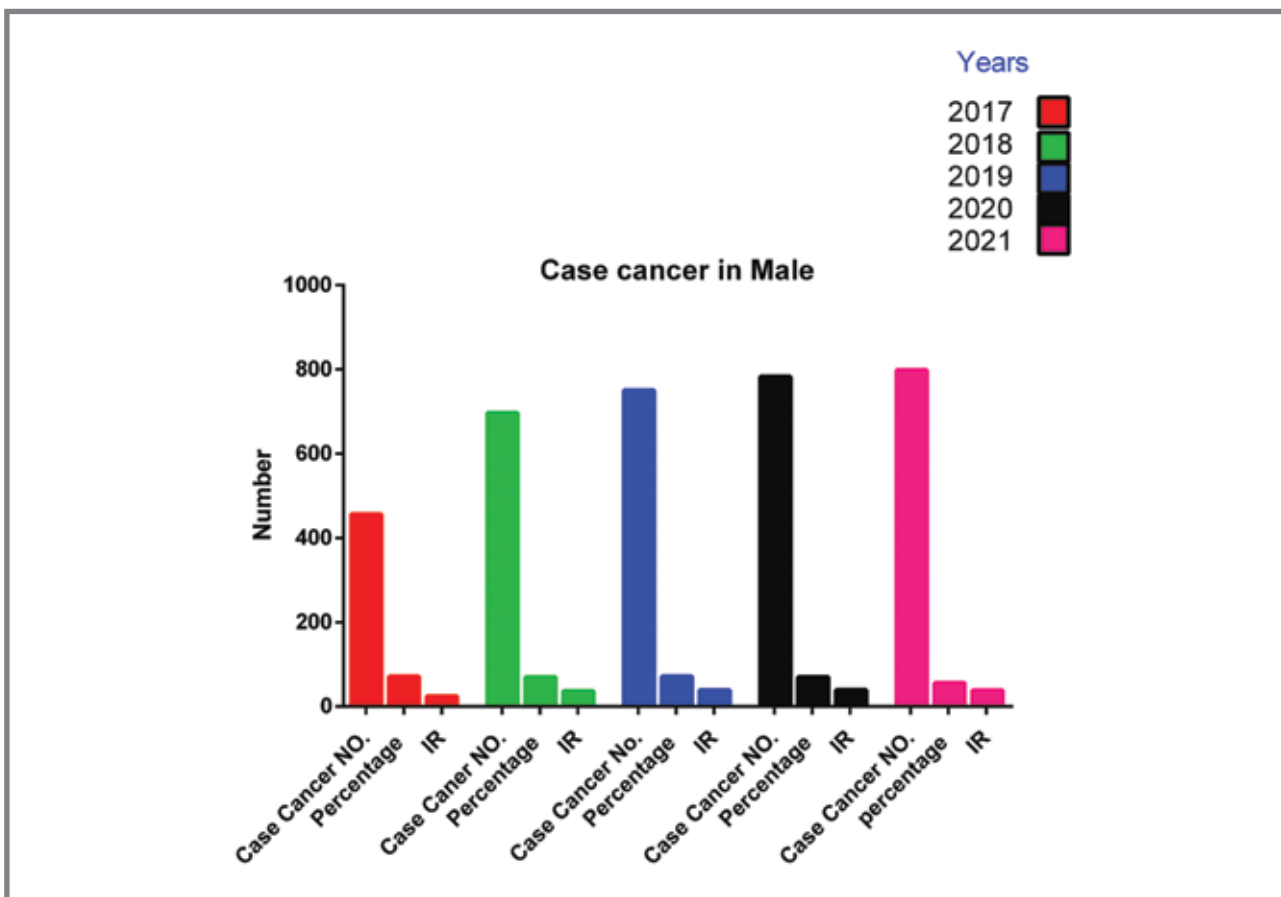


Figure 4. Total number of cancer cases, pattern, and incidence rate in males in Ninewa during the study period (2017–2021)

Рисунок 4. Общее количество случаев рака, динамика и уровень заболеваемости среди мужчин в Найнаве за исследуемый период (2017–2021 гг.)



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The total number of patients and percentages increased over the years (Figure.4). The higher cancer cases, the percentage was 799 cases, with a percentage of 56.19% in 2021 compared with the year 2017, which had witnessed the lowest number of patients and percentage (456, 71.25), respectively. However, the incidence rate also increased in 2021 compared with that in 2017. This increased from 24.58 in 2017 to 38.80 in 2021.

3. Number, percentage, and the crude incidence in female rate, Ninewa

In females, various types of cancer have been diagnosed in the population of the Ninewa Governorate during the last five years (2017_2021) (Table 3). The data recorded the most common cancers in women during 2017_2021. The top ten cancers were in females: breast cancer, leukemia, ovarian, non-Hodgkin lymphoma, colorectal, thyroid gland, Hodgkin lymphoma, uterine cancer, unknown primary site, and lung cancers. Breast cancer cases in women are mostly diagnosed between 2017

and 2021. Of the 4983 cases of cancer in women the number of breast cancer cases was 2,491. Although breast cancer was the most common cancer in women, data have shown a marked decreased in the number of breast cancer patients during these years. There were 529(49.39%) cases of breast cancer which decreased to 496 cases 45.59%. In addition, the results showed that the most common secondary cancer in Ninewa varied according to the year; leukemia was the second highest cancer case and percentage in 2017; Colorectal Cancer occupied the second grade in 2018 and 2021; and thyroid gland cancer in 2019 and 2020.

Regarding the crude incidence in women, the data showed that breast cancer had the highest incidence rate among females in Ninewa. The highest incidence rate in females in Ninewa was for breast cancer, and the lowest was for lung, stomach, and Hodgkin lymphoma (2017_2018). The incidence rate of breast cancer was 29.67 women per 100,000 women in 2017 and it decreased to 25.16 women per 100,000 women in 2021 (Figure 5).

Table 3. Number of patients and incidence percentages of the top ten most prevalent cancers in females in Ninewa during the 5-year-study period (2017–2021). Breast and lung cancers were the most common types of cancers in Ninawa during 2017–2021

Таблица 3. Количество пациентов и процент заболеваемости десятью наиболее распространенными видами рака у женщин в Найнаве в течение 5-летнего периода исследования (2017–2021). Рак груди и легких были наиболее распространенными типами рака в Найнаве в 2017–2021 гг.

Years														
2017			2018			2019			2020			2021		
Tumor Site	No.	%	Tumor site	No.	%	Tumor Site	No.	%	Tumor site	No.	%	Tumor Site	No.	%
Breast	529	49.39	Breast	492	40.73	Breast	503	35.42	Breast	471	33.96	Breast	496	45.59
Leukemia	64	5.98	Colorectal	74	6.13	Thyroid Gland	86	6.06	Thyroid Gland	97	6.99	Colorectal	86	7.90
Ovary	50	4.67	Thyroid Gland	54	4.47	Brian & CNS	74	5.21	Brian & CNS	94	6.78	Brian & CNS	81	7.44
Non-Hodgkin lymphoma	48	4.48	Brian & CNS	50	4.14	Leukemia	73	5.14	Uterus	81	5.84	Thyroid Gland	77	7.08
Colorectal	42	3.92	Ovary	47	3.89	Colorectal	68	4.79	Colorectal	77	5.55	Uterus	77	7.08
Thyroid gland	38	3.55	Leukemia	47	3.89	Bronchus & lung	60	4.23	Leukemia	53	3.82	Leukemia	65	5.97
Hodgkin lymphoma	27	2.52	lung	45	3.73	Non-Hodgkin lymphoma	47	3.31	Unknown primary site	53	3.82	Ovary	62	5.70
Uterus unspecified	26	2.43	Non-Hodgkin lymphoma	36	2.98	Ovary	46	3.24	Ovary	51	3.68	Stomach	51	4.69
Unknown primary site	23	2.15	Skin, other	34	2.81	Uterus unspecified	44	3.10	Stomach	51	3.68	Unknown primary site	47	4.32
Lung	22	2.05	Stomach	31	2.57	Stomach	42	2.96	Non-Hodgkin lymphoma	45	3.24	Lung	46	4.23

Figure 5. Incidence rate (females) of the top ten most prevalent cancers per 100,000 females in Ninewa Governorate, Iraq (2017–2021) shows that breast cancer was the most common type of cancer in females

Рисунок 5. Уровень заболеваемости (среди женщин) десятью наиболее распространенными видами рака на 100 тыс. женщин в мухафазе Найнава (2017–2021 гг.) показывает, что рак молочной железы является наиболее распространенным типом рака у женщин

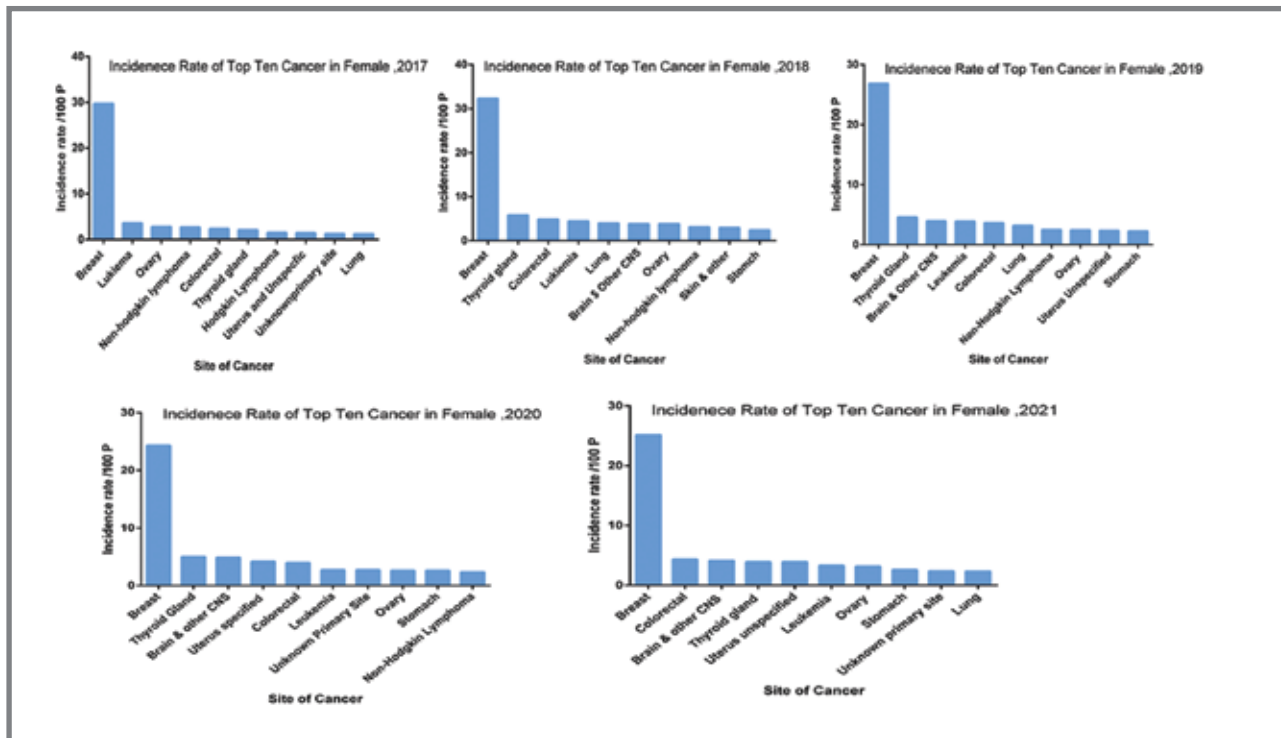
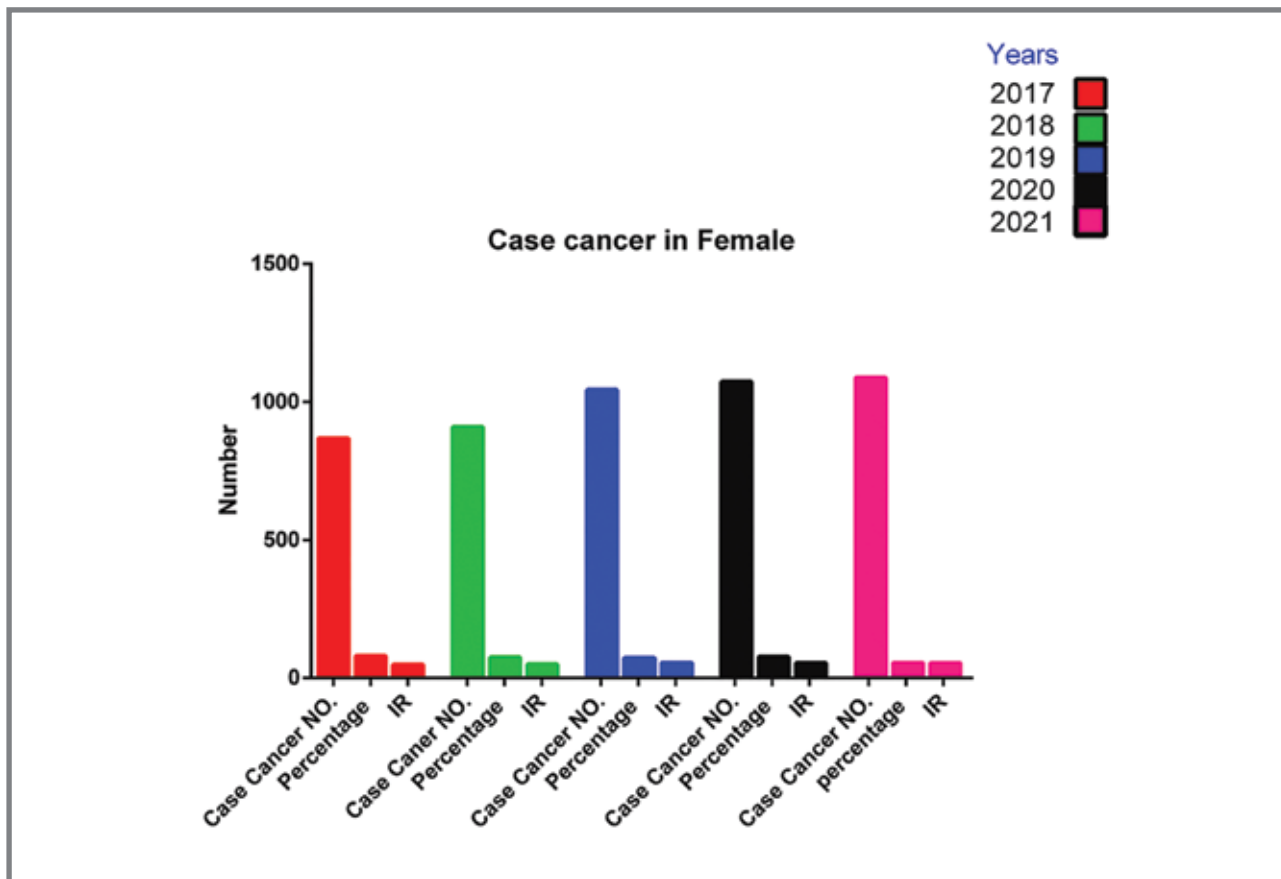


Figure 6. Total number of cancer cases, pattern, and incidence rate in females in Ninewa during the study period (2017–2021)

Рисунок 6. Общее количество случаев рака, динамика и уровень заболеваемости среди женщин в Найнаве за исследуемый период (2017–2021 гг.)



The results showed a dramatic increase in the total number of patients and the percentage of females with the top ten cancers in Ninewa during (2017_2018) (Figure 6). The total number of cancer cases and percentage in women elevated from 869 cases with a percentage of 81.14% in 2017 to 1088 cases and a percentage of 100% in 2021. The crude incidence rate per 100,000 people increased from 2017 to 2021. The highest crude incidence rate of all cancers was 67.53 in females in 2018; and the lowest crude incidence rate was 47.64 in 2017. There was a slight decrease in the crude incident rate compared with 2018, reaching 55.67, 55.47, 55.2 in 2019, 2020, 2021, respectively.

4. Number and percentage of the top ten cancers in children in Ninewa

In children younger 15 years of age, the results showed the distribution of the top ten Cancers in Ninewa during 2017_2021 (Table 4). The number of cancer cases and their rates elevated from 2017 to 2021. The most significant increase in the number of cancer cases was 154, with a rate of 99.93 in 2019. The data found that leukemia is the most common childhood cancer in Ninewa, Iraq. The total number of children with leukemia reached 228 out of 663 overall cancers in childhood over five years (2017_2021). The most significant number of patients was 49 in 2019 and 2021, with rates of 31.81 and 32.66, respectively.

In comparison, the second most prominent type of cancer in children is brain and Central nervous system (CNS) tumors, which reached a rate of 19.67 and 17.33 in 2020 and 2021, respectively. The third most common type of lymphoma was Non-Hodgkin Lymphoma. Less than 5% of the cancers was unspecified sites where cancer cells have spread in the body, but the place where the primary cancer began is unknown.

5. Number, percentage, and the crude mortality rate in the population of the top ten cancers in Ninewa

The results showed the top ten most common cancers that led to death in Ninewa, Iraq, during 2017_2021 (Table 5). The data found that bronchial and lung cancer were the most common types of cancer that caused death in patients of both sex males and females; lung cancer deaths accounted for approximately 18.44% (503,700) out of 2505 for all cancer deaths. The death and mortality rates of lung cancer in 2019 reached 141 (22.1%), with a mortality rate of 3.6 per 100,000.

The second leading death during 2017_2021 was breast cancer, with a higher rate of 106% and mortality rate of 2.6 in 2021, while the lowest was non-Hodgkin's lymphoma, which has witnessed an increase in cancer cases and mortality rate with time and the most frequent number of deaths thirty-one with rate 4.5% and mortality rate 0.8% in 2021. The total mortality for the top ten cancers in Ninewa was 2505 cases across all ages and gender during 2017_2021. The results showed that the number, percentage,

Table 4. Patient numbers and percentages of the top ten cancers in children (0–14 years) in Ninewa Governorate during the 5-year study period (2017–2021). Leukemia was the most prevalent

Таблица 4. Количество пациентов и процентное соотношение десяти основных видов рака у детей (0–14 лет) в мухафазе Найнава за 5-летний период исследования (2017–2021). Наиболее распространенной была лейкемия

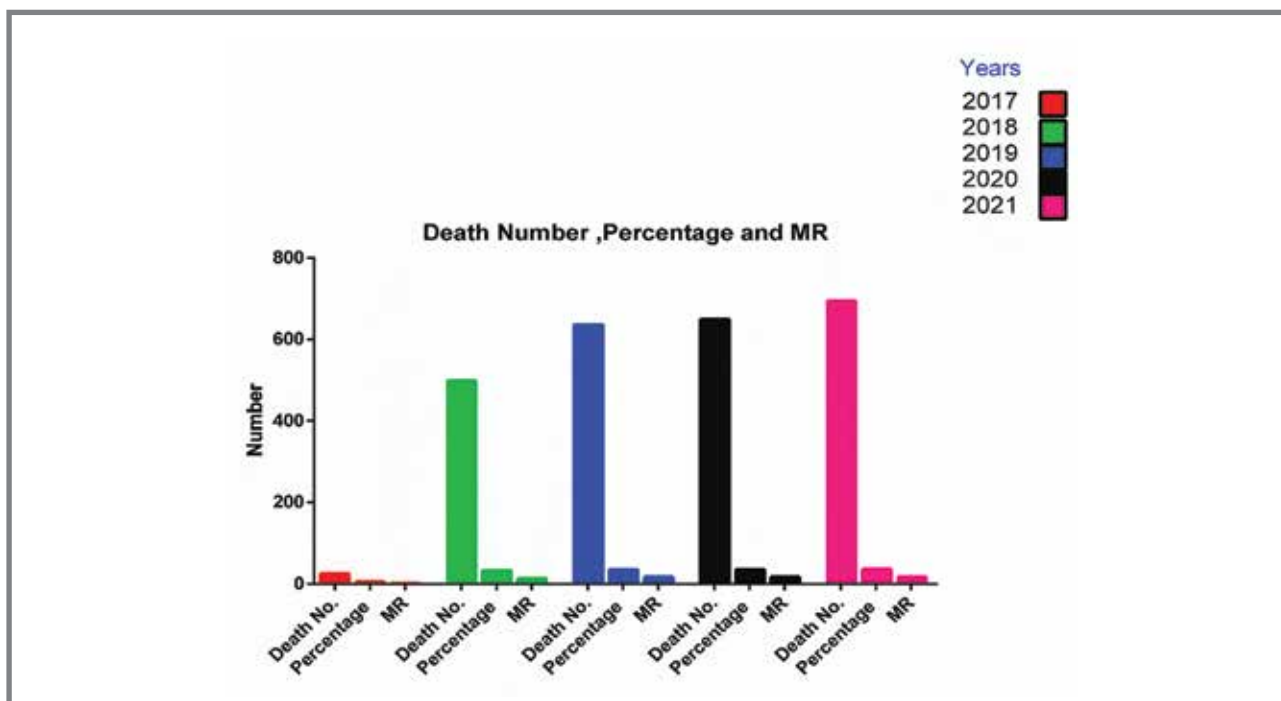
Types of cancer	2017		2018		2019		2020		2021	
	Patients Number	%	Patients Number	%	Patients Number	%	Patients Number	%	Patients Number	%
Leukemia	43.0	43.4	46.0	38.65	49.0	31.81	41.0	33.60	49.0	32.66
Brain & other CNS	11.0	11.11	15.0	12.60	26.0	16.88	24.0	19.67	26.0	17.33
Non-Hodgkin Lymphoma	11.0	11.11	15.0	12.60	17.0	11.03	14.0	11.47	17.0	11.33
Hodgkin Lymphoma	9.0	9.09	13.0	10.92	16.0	10.38	4.0	3.27	13.0	8.66
Kidney	6.0	6.06	5.0	4.20	18.0	11.68	7.0	5.73	8.0	5.33
Bones, Cartilage & limbs	7.0	7.07	14.0	11.76	5.0	3.25	8.0	6.55	10.0	6.66
Eye & Adnexa	1.0	1.01	3.0	2.52	5.0	3.25	2.0	1.63	6.0	4.00
Other Connective \ Soft tissues	3.0	3.03	4.0	3.36	9.0	5.84	7.0	5.73	7.0	4.66
Adrenal Gland	8.0	8.08	4.0	3.36	8.0	5.19	11.0	9.01	10.0	6.66
Unspecified Site	0.0	0.0	0.0	0.0	1.0	0.65	4.0	3.27	4.0	2.66

Table 5. The number and percentages of deaths, and mortality rates (in both genders) of the top ten cancers in Ninewa Governorate during the 5-year-study period 2017–2021. Bronchial and lung cancers were the leading cancers
Таблица 5. Количество и процент смертей, а также показатели смертности (среди обоих полов) десяти основных видов рака в мухафазе Найнава за 5-летний период исследования (2017–2021 гг.). Рак бронхов и легких были ведущими видами рака

Tumor site	2017			2018			2019			2020			2021		
	Death No.	%	MR	Death No.	%	MR	Death No.	%	MR	Death No.	%	MR	Death No.	%	MR
Bronchus & Lung	3.0	11.5	0.4	101	20.2	2.7	141	22.1	3.6	131	20.1	3.3	127	18.3	3.2
Breast	4.0	15.3	0.1	73	14.6	1.9	95	14.9	2.4	99	15.2	2.5	106	15.3	2.6
Leukemia	9.0	34.6	0.2	58	11.6	1.5	67	10.5	1.7	72	11.0	1.8	69	10.0	1.7
Brain	4.0	15.3	0.1	60	12.0	1.6	69	10.8	1.8	87	13.4	2.2	90	13.0	2.2
Colorectal	0.0	0.0	0.0	53	10.6	1.4	61	9.5	1.5	46	9.8	1.6	77	11.0	2.0
Liver	0.0	0.0	0.0	50	10.0	1.3	56	8.8	1.4	56	8.6	1.4	47	6.8	1.2
Stomach	0.0	0.0	0.0	49	9.8	1.3	64	10.1	1.6	44	6.7	1.1	70	10.1	1.5
Pancreas	3.0	11.5	0.4	25	5.6	0.6	39	6.13	1.0	53	8.1	1.3	60	8.6	1.7
Urinary Bladder	1.0	3.8	0.0	23	4.6	0.6	15	2.3	0.3	14	2.1	0.3	17	2.4	0.4
Non- Hodgkin Lymphoma	2.0	7.6	0.0	8	1.6	0.2	29	4.6	0.7	29	4.4	0.7	31	4.5	0.8

Figure 7. Distribution of the total mortalities, percentage, and crude mortality rate of the top ten cancers in the Ninewa Governorate from 2017 to 2021. In addition, it illustrates that the highest number of deaths, percentage of deaths, and mortality rate for the top ten cancers were occurred in 2021 compared with other years

Рисунок 7. Распределение общего числа смертей, процентного соотношения и общего коэффициента смертности от десяти основных видов рака в мухафазе Найнава с 2017 по 2021 год. Кроме того, он иллюстрирует, что наибольшее число смертей, процентное соотношение смертей и коэффициент смертности от десяти основных видов рака были зарегистрированы в 2021 году по сравнению с другими годами



and mortality rate of the major cancer types in both sexes (male and female) in Ninewa, Iraq, gradually increased during 2017–2021 (Figure 7). The data showed that the highest number of patients, percentage, and crude mortality rate in 2021 were 694 and a rate of 36.77 with a crude incidence of 17.22. In

contrast, the lowest cancer cases and mortality rate were 26, 1.72, respectively, in 2017.

6. Total number of populations, cancer number, and death

Table -6- demonstrates that the population increased in Ninewa Governorate, Iraq, from 2017 to

Table 6. Total population, number of cancer cases and mortality for the top ten cancers in Mosul during (2017 –2021). The number of cancer cases and cancer-related deaths has increased with progressing year

Таблица 6. Общая численность населения, количество случаев рака и смертность от десяти основных видов рака в Мосуле в 2017–2021 гг.. Количество случаев рака и смертей, связанных с раком, увеличивалось с каждым годом

Total number			
Years	Population	Case cancer	Death
2017	3,633,648	1325	26.0
2018	3,729,998	2205	500
2019	3,828,197	2476	636
2020	3,926,931	2511	649
2021	4,030,006	2536	694

2021. This increase was significantly associated with an increased number of cancer cases in Ninewa. The highest population and number of cancer cases were in 2021, reaching 4,030,006 and number 2536, while the lowest population was 3,633,648 in 2017 with number of patients 1325. In addition, the total number of deaths was estimated, and there was a significant increase in mortality with an increase in population in Ninewa between 2017 and 2021 reaching 694 deaths in 2021.

Discussion

Cancer is one of the most life-threatening diseases affecting numerous people worldwide, including those in Iraq (Fuliful et al., 2021). The mortality rate of cancer has surpassed that of individuals infected with tuberculosis, malaria, and HIV/AIDS together (Prager et al., 2018). Cancer deaths in low- and middle-income countries are nearly 75% higher compared to those in high-income countries (Pramesh et al., 2022). The main reason for the increasing incidence of cancer in these countries is the rapidly changing environment and increased exposure to diverse carcinogenic factors (Farmer et al., 2010). Additionally, especially in Iraq, other factors could be attributed to the spike in cancer cases related mainly to wars and political instability since 1980, which has destroyed the healthcare infrastructure and the health sector (Fathi et al., 2013). A critical component of cancer epidemiology is the sex distribution of cancer incidence. The incidence of cancer in men is higher in Western and developed nations (Siegel et al., 2012; Wang et al., 2014). In contrast, cancer cases are higher in females in the Middle Eastern countries. This study agrees with previous investigations that focused on various regions of Iraq and the majority of the Arab Gulf regions, including The United Arab Emirates and Kuwait (Alwan and Kerr D, 2018). Sex hormones, estrogen and androgen, may positively affect the initiation and development of different types of cancers. These hormones are present in females and promote the expression of B-cell lymphoma-extra-large (Bcl-XL), an oncogenic protein (Kim et al., 2018). Additionally, estrogen and progesterone receptors in

breast cancer play vital roles in stimulating cancer cell growth (Yue et al., 2019).

In this study, our results showed that breast cancer was the most frequent cancer type among cancers affecting both males and females, as well as in adult females. Our findings are comparable with those of Iraq's population-based cancer registries managed by the National Cancer Registry, which identified breast cancer as the most prevalent type of cancer among the top 10 cancers. Iraqi governorates by a percentage of 20% in the period between 2017 and 2021 (Iraqi Cancer Registry, 2017_2021). Other similar reports from different parts of Iraq have observed that breast cancer has the highest prevalence in Iraq (Al-Alwan, 2022). Also, the incidence of breast cancer is reported to be the highest among females in Arab countries (Al-Shamsi et al., 2022). Growing industrialization, changing lifestyles, and postponement and lowering of birth rates have all contributed to the rapid rise in the incidence of breast cancer in females (Habib et al., 2016). Many other factors may contribute to the increase in breast cancer in Arabic countries, including, but not limited to, DM, obesity, hormonal therapy, early menarche, late menopause, socioeconomic status, and decreased breastfeeding (Hamadeh et al., 2017; Safiri et al., 2022). Two studies conducted in 2018 by Mir et al. and Al Balawi et al. found that mutations in BRCA1-3 and vascular epithelial growth factor (VEGF) are strongly associated with breast cancer. In the same year, Alhuquail and colleagues reported that BRCA1 and BRCA2 were significantly associated with the development of breast and ovarian cancers (Alhuquail et al., 2018). Oral contraceptives, familial history of breast cancer, and low vitamin D levels are found in cases with breast cancer (Abulkhair et al., 2015; Ifediora et al., 2019).

On the other hand, the current study found that the top ten cancer were in the bronchi & lungs in males during 2017 -2021. This finding consistent with another study that found that lung cancer was the most prevalent tumor in men in Ninewa, Iraq, but in different periods between 2000_2010 (Al-Hashimi et al., 2014). Another study was performed In 2021, Husain and Lafta who also observed that lung cancer is

the most common cancer diagnosed worldwide. The same study also reported that lung cancer incidence rates increased significantly in Iraq governorates from 4.08/100,000 in 2000 to 5.60/100,000 ($p = 0.038$) in 2016, affecting males more than females (Hussain & Lafta, 2013). Other studies reported that Cancer of the lung is the most common cancer diagnosed in males in India, wherein it accounts for 10% of all cancers (Noronha et al., 2016). Tobacco smoking is a major risk factor for the development of most lung cancers, including squamous cell carcinoma, small-cell carcinoma, adenocarcinoma, and large-cell carcinoma (Ignatius et al., 2012). Iraq is one of a country that consumes large amounts of tobacco. Thus, the incidence of lung cancer in Iraq is high (Ibrahim et al., 2018). In addition, indoor pollution, dust, petroleum exposure, alcohol consumption, hormone use, HIV infection, religion, geography, race, and waste from wars, such as uranium in Iraq might be other essential risk factors implicated in the increasing incidence of lung cancer among the Iraqi population (Fuliful et al., 2018; Manjunath et al., 2022). However, non-smokers can have lung cancer; there are several genetic mutations in genes such as (EGFR, BRAF, MET, and ERBB2 [HER2]) and four fusions or rearrangements (ALK, ROS1, RET, and NTRK), which are associated with lung cancer patients (Singh et al., 2021).

Our results showed that the top ten childhood cancers in Ninewa were leukemia, brain tumor, non-Hodgkin leukemia, Hodgkin's disease, kidney, bone and cartilages, adrenal gland, eye and adnexa, other connective and soft tissues. Leukemia was the most frequent pediatric cancer and represented 47% of pediatric cancers in Mosul. This percentage is almost the same as a study conducted in Basra City in the south of Iraq by Abood and his colleagues in 2020, which reported that leukemia was 39%, while Karbala City was 41%, a city in the southwest of Iraq (Mjali et al., 2019). The leukemia incidence rate in Baghdad, Iraq's capital city, was significantly elevated, approximately 72.5% (Mohammed et al., 2009). The Leukemia incidence rate in this study was higher than that in developed countries, including though not limited to the USA, 20%, and France, 30% (Alkhayatt et

al., 2021; Saeed, 2009). The remarkable increase in leukemia cases among children in Ninewa remains unclear. However, this may be due to several environmental risk factors, including radiation, chemical exposure, air pollution, explosion sounds, and anxiety during war. All these factors may have produced acquired mutations in fetuses that may play a crucial role in the increase in cancer cells (Alkhayatt et al., 2021). Other studies have suggested that the lifestyle of women, smoking tobacco, and consuming large amounts of liquor during gestation, might cause leukemia in their children. Some of these acquired mutations may have occurred in early stages before birth. Additionally, Hereditary mutations inherited from the parents increase the offspring's risk of cancer (American Cancer Society, 2020). In both low-income and middle-income countries, lung cancer is the leading cause of mortality in males. The major reason for the higher mortality rate in lung cancer is its intrinsic resistance to chemotherapy. The highest rate of mortality in lung cancer in Ninewa was 141 people, with 22.1% in 2019 compared with that in other years, as lung cancer patients had a higher mortality rate during COVID-19 infection compared with non-lung Cancer COVID-19 patients (Mojsak et al., 2023). The COVID-19 pandemic had a negative impact on lung cancer patients, according to the study, which indicated that 38% fewer novel cases of lung cancer were diagnosed during COVID-19 (Mojsak et al., 2023; Reyes et al., 2021). COVID-19 may have caused severe immunosuppression, changing the tumor microenvironment, promoting cancer cell proliferation, and awakening dormant cancer cells from quiescence (Aramini et al., 2022).

Conclusion

Overall, the incidence of cancer continues to increase in Ninewa, Iraq. Using reliable data sources, this study demonstrated that breast cancer was the most common type of cancer in females, while lung cancer had the highest number of male patients over five years (2017–2021). These novel estimates will help in planning cancer prevention and control activities through early detection, risk reduction, and management interventions.

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