Cancer Statistics in Kurdistan Region of Iraq: A Tale of Two Cities

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Abstract

There is limited published data on recent cancer incidence trends in Iraqi Kurdistan. Therefore, this study assesses epidemiological estimates of cancer incidence as well as the projection of future cancer trends in the upcoming decade by analysing the population-based cancer registry from 2013 to 2019 in both Erbil and Duhok governorates. A retrospective study was conducted on data retrieved from the Medical Statistics Department at the Ministry of Health, KRG. The total number of female cancer patients was higher in both governorates, and the total number of patients more than doubled from 2013 to 2019 in Erbil and Duhok, from 73 to 174 patients/100,000 population for women, and 36 to 85 patients/100,000 population for men. Data analysis indicates that the percentage of cancer patients is projected to increase in the decade from 2020-2030 from 107.4% to 234.3% in 2030 in Erbil governorate; and from 106% to 163% in Duhok governorate. Female breast cancer and lung cancer are the most prominent types of cancers since 2013 in Erbil and Duhok governorates. The striking pattern of trends for both present and future cancer incidence rates require the urgent solutions and comprehensive efforts to control risk factors that promote the continuity of cancer diseases in these two KRG governorates.

Introduction

Cancer is considered one of the leading causes of death worldwide, accounting for 9.6 million lives in 2018. Particularly unfavourable outcomes are expected in developing countries where access to healthcare is limited, and there is an increase in risk factors, such as political and economic instability and transitioning lifestyles ¹. Despite the implementation of national cancer registries and control programs since 1974 in Iraq, the rise of cancer incidence and death are alarming ². According to the recent estimates of the International Agency for Research on Cancer (IARC), more than 25,000 new cancer cases and 14,000 deaths in Iraq were reported in 2018, with breast, lung, leukaemia, bladder, and colorectal cancer being the top five most common cancer types ³. To address these burdens, over the last two decades, the Iraqi Government as well as the Kurdistan Regional Government (KRG) have exerted significant efforts to rebuild supporting infrastructures, seeking to increase health system capacities through creating cancer centre and improving the cancer registry system. However, there is very limited published data on recent cancer incidence trend in the KRG.

The early reported cancer incidence rates for Erbil and Duhok were 50.0 and 61.5 per 100,000 populations, respectively. In contrast, in Sulaymaniyah the incidence rate showed an increasing trend from 38.5 in 2006 to 61.7 by 2013 ⁴. Hence, due to these limitations, significant gaps and challenges mainly remain in carrying out cancer-related scientific research and moving toward reliable numbers through a meta-analysis of available data ⁵. This study presents comprehensive demographic, comparative, and epidemiological estimates of cancer incidence as well as the projection of future cancer trend in the current decade (2020–2030) by analysing the population-based cancer registry from 2013 to 2019 in both Erbil and Duhok governorates of the KRG. This will provide an essential resource for decision-makers in planning and re-evaluating the effectiveness of implanted cancer control policies. Additionally, it opens new avenues for basic and clinical research to determine the possible and preventable risk factors that might be associated with the increased cancer incidences in certain areas.

Results

Erbil and Duhok governorates' cancer incidence stratified by gender (2013 to 2019)

Total number and incidence (cases per 100,000 population) for all cancer types in both Erbil and Duhok governorates was classified based on gender (Table 1). In Erbil, the number of female cancer patients from 2013 to 2019 was higher than the number of their male counterparts. The result shows a similar pattern in Duhok governorate, as the number of female cancer patients was higher than the male cancer patients from 2013 to 2019, with the exception of 2014, where males were predominant.

Regardless of the gender of the cancer patients, the number of total cancer patients was increased in both governorates. For instance, in 2013 in Erbil, 73 patients per 100,000 population had cancer, and this figure has more than doubled (174 patients/100,000 population) by 2019. Similarly, in Duhok, the total number of patients more than doubled from 2013 to 2019. For example, the number increased from 486 (36 per 100,000 population) in 2013 to 1365 (85 per 100,000 population) in 2019.

Based on the current analysis, the cancer cases are expected to be more than double in the next decade, with the line steeply increasing from 107.4% in 2020 to 234.3% in 2030 in the Erbil governorate. In Duhok governorate, the number of cancer cases is predicted to be 163% in 2030 compared to approximately 106% in 2020 (Figure 1).

Breast and lung cancer are the most prominent since 2013 in Erbil and Duhok governorates

All the registered cancer types for both genders for seven consecutive years (2013-2019) are presented in Table 2, Table 3, and Figure 2. In Erbil governorate, starting from 2013, the most prominent cancer type in females was breast cancer, accounting for 263 cases, while for males lung cancer was the leading type, with 114 patients. The second top cancer type in females and males was blood cancer, accounting for 84 and 95 patients, respectively. Regarding the Duhok governorate, the leading cancer types were breast (110 patients) and blood (26 patients) in females, and lung (57 patients) and blood (34 patients) in males. In Erbil, in total, 2.24% of cancers were from unknown primary sites while only 0.62% were from the unknown primary site in Duhok.

Concerning 2014, in the Erbil governorate, for females, breast cancer was again the top cancer type with 506 cases, followed by blood cancer with 94 patients. However, for males, the most diagnosed cancer types were blood cancer followed by lung, with 136 and 124 patients, respectively. In Duhok governorate, a

comparable pattern is observed concerning the top cancer types among females, since breast and blood cancers were the first and second most diagnosed cancer types. Lung cancer, followed by blood, were the top types of cancers among males.

However, in the Erbil governorate in 2015, the common types of cancer among female patients were breast, followed by blood cancer, while male patients were more commonly diagnosed with lung and blood cancers. In Duhok, breast and skin cancers were the most common types of cancer among females; while lung, blood and skin cancers were the most common types of cancers among male patients. Moreover, in Erbil governorate the most common types of cancers among females for the years 2016-2019 were breast followed by colorectal in 2016; breast followed by blood in 2017; breast followed by skin in 2018; and breast followed by colorectal in 2019. Likewise, in Duhok, the highest number of female patients were diagnosed with breast cancer from 2016 to 2019. The second most common type of cancer was blood in 2016, and skin from 2017-2019. Regarding male patients in both Erbil and Duhok governorates, the most common types of cancer were lung cancer, while the second common type of cancer was blood and kidney in 2016-2019, and colorectal in 2019.

To sum up, the most common cancer types during 2013-2019 were breast cancer for females, and lung cancer for males.

Age-standardized incidence of cancer types in Erbil and Duhok governorates

Over the seven-year period 2013-2019, Erbil diagnosed 15,739 cases (8,492 females, 7247 males); and Duhok diagnosed 7,330 cases (3,798 females, 3532 males). The overall incidence for both genders combined per 100,000 population was: 123.3 (131.5 for females, 109.38 for males) in Erbil; and 71.3 (74.86 for females, 67.86 for males) in Duhok.

Although the overall female-to-male cancer ratio was 1.2 and 1.1 for Erbil and Duhok (respectively), there were differences in the average age-standardized incidence rate (ASIR) between sexes according to age groups. For example, the ASIR for males were slightly higher than for females in children (aged 0-14 years) in both Erbil and Duhok (Figure 3), while it was similar in both sexes for the two studied populations in the adolescent age group (aged 15-19 years). For cancer patients aged 20-59 years, ASIRs were higher for females than males in both governorates. The gap was highest in the age groups 30-39 and 40-49, when the rate of females was more than two times higher than that of males in both Erbil and Duhok. For cancer patients aged 60 and over, ASIRs were higher in males than in females, and were more than double in the age groups 70-79 and 80-89 years in both governorates. To sum up, in the early ages of life (< 20 years), male cancer incidence was higher, while the female cancer incidence started to rise afterwards until the age of 60, after which male cancer incidence increased markedly.

Except for a minor decrease in ASIR from the age group of 15-19 (27.46) to the age group of 20-29 (26.65) in Duhok governorate, overall average ASIR increased with age. Average ASIRs per 100,000 population by age groups in Erbil and Duhok were as follows (respectively): 0-14 (11.08 vs 8.17), 15-19 (38.62 vs 27.46), 20-29 (43.08 vs 26.65), and 30-39 (105.67 vs 56.88). The peak ASIR was recorded in the age group 80-90 years, which was 2010.99 in Erbil and 1074.32 in Duhok. In contrast, a marked decrease was recorded in patients aged 90 and over for both governorates (Table 4, Table 5).

In this study, the median age of cancer incidence was 55 years for both governorates. More than half of the cancer cases were registered in patients aged 50 years and over, which was 58.1% in Erbil and 57.4% in Duhok. The highest percentage of cases was recorded for patients aged 60-70 years, which was 22.8% and 22.3% for Erbil and Duhok, respectively. However, the percentages of registered cases in children (0-14) were 3.9% in Erbil and 4.8% in Duhok, and in patients aged 15-19 years they were 6% in Erbil and 6.2% in Duhok. Overall, for cancer patients under 20 years old, the percentage of recorded cases accounted for 7.2% in Erbil and 8.8% in Duhok governorate.

Common cancer types differed between age groups (Table 6). For example, blood cancers scored the highest incidence rate among children (0-14 years) and adolescents (15-19 years) in Erbil (4.59 vs 11.55 per 100,000 population) and Duhok (3.52 vs 9.25 per 100,000 population). Combining these two age groups, blood cancers were followed as the most common cancer in Erbil by lymph nodes cancer (7.45) and brain tumours (4.13); and in Duhok by lymph nodes cancer (4.35) and soft tissue cancer (3.86). In young adults aged 20-29 years, both blood cancer (6.18) and breast cancers (6.18) were the most commonly registered cancers for Erbil, while in Duhok, breast cancer was the most common type, followed by lymph nodes and kidney cancer. In Duhok the greatest prevalence was for blood (3.1), colorectal (2.4), and lymph nodes cancer (2.23). The top cancer type in the age groups 30-39, 40-49, and 50-59 was breast cancer for both provinces, while for the age groups 70-79 and 80-89 years it was lung. Stomach cancer (50.11) and skin cancer (28.52) were the top cancer types among the most elderly patients (≥ 90 years) in Erbil and Duhok, respectively.

Percentage of graded cancer patients at the time of cancer detection

The number of registered patients in each year and the percentage of graded cancer patients relative to the total number of patients in each year are summarized in Table 7. In the Erbil governorate, the majority of patients from 2013-2019 had their cancer detected with their cancer grades unknown except for 2016, where the highest percentage (33%) of cases had grade II cancer at the time of detection. However, in Duhok governorate, the majority of patients had unknown grades of cancer from 2013 to 2019.

Table 8 and Figure 4 demonstrate the stratification of cancer patients based on governorate zones. Erbil governorate had the most cancer patients, and their number had increased from 64 cases per 100,000 population in 2013 to 160 patients per 100,000 population in 2019. Meirgehsor had the lowest patients per 100,000 population compared to other zones in Erbil governorate from 2013 to 2019, except for 2014 where Khabat registered the lowest number (19/100,000 population). On the other hand, Duhok centre had a maximum number of patients compared to different zones of the Duhok governorate. For instance, in 2019, 128 cancer patients per 100,000 population was recorded in Duhok centre compared to only 16 patients per 100,000 in Berdehresh (Table 9, Figure 4).

Discussion

The current study has reported the cancer incidence trends from 2013 to 2019 and predicted new cases over the next decade. The overall cancer incidence rate increased sharply during 2013–2014 in both Erbil and Duhok governorates. A plausible explanation for this increase could be due to the demographical changes in the Erbil population as the result of the ISIS invasion of Mosul governorate in 2014, which caused thousands of internally displaced persons to migrate to Khazer refugee camp in Erbil, which led to the detection of a further increase in cancer cases. Thus far, previous studies focused on risk factors such that directly influence the incidence rate of cancer diseases in Iraq, such as the consequence of various wars, changes in the lifestyle⁶, the economic disease burden⁷, economic crisis⁸, social status⁹, environmental pollution, and exposure to carcinogenic agents. Moreover, some behavioural factors like smoking, alcohol consumption, drug abuse, and fast food consumption have recently been shown to significantly increase the risk of certain cancers in KRG^{9–11}.

According to the prediction of the current study for the next decade, there will be a significant increase in cancer burden in Erbil and Duhok governorates. This is in agreement with previous national studies on different types of cancer diseases^{2,12–14}, as well as international trends that estimated an increase of 28% globally between 2006 and 2016¹. Correspondingly, cancer incidence trends in less developed countries have been expected to increase from 56% in 2008 to more than 60% in 2020. In contrast, in the US and many Western countries, the trends are generally expected to be dropping¹¹.

The cancer incidence rates in the KRG, particularly in Erbil and Duhok governorates, spiked dramatically between 2013 and 2019; this is partly a structural factor due to the increasing Kurdish population. However cancer incidence rates for all cancer types in the KRG during these periods are lower compared to neighbouring countries or Europe, East Asia, and the US¹⁵, which is likely associated with the lack of implementing evidence-based cancer control programs and planning, which are fundamental for high-quality cancer data registry, but which are almost totally unavailable¹⁶ in most low- and middle-income countries, including KRG. The incidence and burden among both sexes between 2013 and 2019 saw a two-fold increase in Erbil and Duhok governorates for all cancer types. The reason for this drastic increase is likely due to various risk factors, including population growth, ageing, unhealthy lifestyle behaviours, insufficient physical activity, infectious agents, genetic mutations and environmental risk factors^{17–19}.

Nevertheless, the ratio of cancer rates in females was slightly higher among females compared to males in Erbil and Duhok governorates. A higher percentage in cancer rates in females is most likely due to a great extent, reflect contrasts in endogenous hormones and natural exposures to indoor and outdoor pollution, as well as sophisticated intuitive between these impacts²⁰.

In Erbil and Duhok governorates, the most frequently documented cancer among females was breast cancer between 2013 and 2019, followed by blood cancer, then colorectal and lung cancer in Erbil and Duhok governorates. The most frequently documented cancer among women in both governorates was breast cancer between 2013 and 2019, followed by blood cancer, colorectal and lung cancer. The most common cancer aligns with cancer incidence trends worldwide. However, the second, third, and fourth most common cancers in the world are colorectal, lung, and cervix uteri, respectively³. The most prominent risk factor for getting breast cancer is the female gender²¹, followed by age, reproductive factors, long history of menstruations, age of the females giving birth to their first child, and elevated use of oral contraceptives, especially in Middle East countries, including Iraq²². The highest prevalence of female breast cancer in Western countries is between the ages of 75 and 79 years, while in KRG it is between the ages of 51 to 60 years; this indicates that breast cancer occurs in women in this population at a younger age, as in the neighbouring country of Iran, and unlike women in Western countries^{22,23}.

The most commonly diagnosed cancer in men is lung cancer in Erbil and Duhok, which this aligns with the most diagnosed cancer type in the world. Globally, smoking is the leading cause of death among lung cancer patients, accounting for about 80% of cancer deaths among men^{22,23}. The reason behind the higher prevalence of lung cancer in Duhok compared to the Erbil governorate could partially be caused by unventilated gasoline-fuelled stoves, indoor kerosene heaters, and fumes from cooking²⁴; another notable risk factor is an increase of tobacco smoking among women in this governorate. In Erbil, lung cancer ranks fifth place for overall cancer rates in this area, which might indicate that women are smoking less than men and are less exposed to outdoor industrial pollution. However, lung cancer among women is comparable to global lung cancer incidence for 2018¹⁵.

The second most diagnosed cancer during seven years of cancer registry in the KRG is leukaemia, which was slightly higher in males than in females. Leukaemia is a relatively less common diagnosed cancer worldwide²⁵, and the first leading cause of death in the Sulaymaniyah governorate of KRG between 2006 and 2013, as reported by Khoshnaw et al.¹³. It is likely that three major destructive wars in Iraq since 1980 have resulted in the presence of significant volumes of military pollution throughout Iraq, including depleted uranium (DU), which are widely suspected of causing a significant increase in congenital disabilities and cases of cancer, particularly childhood leukaemia^{26,27}.

The third most commonly diagnosed cancer among men in both governorates is kidney cancer, for which incidence rates among men were nearly three to four times higher than among women in the Erbil governorate, and more than twice as high among men compared to women in the Duhok governorate. Higher exposure of the men to the contaminants of military warfare during the last three decades of the conflict in Iraq might play an essential role in the elevated kidney cancer cases. The kidney is considered to be the most susceptible target organ to DU toxicity, relative to other organs²⁶. Studies have shown that renal cells damaged by DU toxicity can cause kidney cancer²⁸. Cancer of the kidney is on top six of the most common cancer type worldwide in 2018, with incidence rates about 2.2% of all cancer sites, and the leading cause of death in around 1.8% of cancer cases. Consequently, mortality and incidence rates of kidney cancer among men were approximately double the rates among women³.

Colorectal cancer was the third most common cancer among women and the fifth among men in Erbil governorate between 2013 and 2019. It represented the fifth most prevalent cancer in the Duhok governorate for both sexes. The reasons for the burden of colorectal cancer in the KRG are believed to reflect the changes in lifestyle and dietary factors, including smoking and obesity, which are associated with Westernized lifestyle factors²⁹. In 2018, colorectal cancer was the second most prevalent cancer among women worldwide, and the third among men; overall, colorectal cancer ranked third in prevalence, but second worldwide in mortality³. Likewise, in neighbouring countries such as in Iran, colorectal cancer ranked the third most frequent cancer in 2015³⁰.

In the Duhok governorate, skin cancer was the fourth most commonly diagnosed cancer among both sexes from 2013 to 2019. In Erbil governorate it was among the top four most commonly diagnosed, and the sixth most frequent cancer among men. Relative to other areas of Iraq, skin cancer cases in the KRG are significantly higher, which can be linked to a geographical location and other lifestyle variables, such as the use of sun blockers, excessive ultraviolet (UV) exposure, sun exposure times, and occupancy³¹. In 2015, the Iraqi Cancer Registry (IRC) declared skin cancer as the ninth most frequent cancer in Iraq, and incidence rates among males and females were 3.9% and 2.6%, respectively². Globally, in 2018, melanoma skin cancer was the 8th and 9th most common skin cancer in women and men, respectively, in High Development Index (HDI) countries³.

Prostate cancer ranked as the fourth most common cancer among men between 2013 and 2019 in Erbil governorate, accounting for almost 10% of male cases, whereas in Duhok governorate it was the seventh most frequently diagnosed cancer, accounting for 5% of male cases. Prostate cancer is the second most widely diagnosed cancer in men, with 13.5% among all cancer types worldwide; and the world's fifth-largest cause of cancer death³. The prostate cancer incidence rate in 2018 was 6.6% in Iraq, which is lower than in most neighbouring countries including Iran (16.6%), Jordan (14.7%), Kuwait (21.6%), Syria (20.1%), and Turkey (41.7%); Saudi Arabia also has 6.6% incidence³². The variations in incidence rates could be due to differences in the testing method for prostate-specific antigens (PSA)³³.

The overall cancer incidence was higher in Erbil than in Duhok. One of the most important risk factors for cancer incidence is age³⁴. In this study, the median age (55 years) of cancer patients was similar to the results of other studies conducted in Middle Eastern countries, such as Jordan (55 years³⁵ and 56 years³⁶) and Palestine (55 years³⁷), while cancer patients in the present study were generally about ten years younger than in Western developed countries. The median age of cancer patients in Norway is 69 years³⁸, and in the US it is 66 years³⁹. This could be attributable to the Kurdish population and other nations in the Middle East having younger populations than Western countries.

The highest percentages of diagnosed cases reported in this study were in Erbil (23.3%) and Duhok (22.8%) for patients aged between 60–69 years. This result was in line with previous reports finding 23.1%² and 19.7%⁶, but inconsistent with reports in neighbouring countries, where the age structure of the population is approximately similar, such as in Jordan (23%)⁴⁰. However, the highest incidence was found in patients aged 70–79 years in some European countries, like the UK with 28.34% and Norway 27.7%³⁸.

Paediatric cancers among children (aged 0–14 years) and adolescents (aged 15–19 years) are relatively rare and have a distinct profile, but account for a higher percentage of cancer in developing countries than in developed countries, which is partly due to the younger age structure of developing countries, including Iraq. To the best of our knowledge, this is the first population-based study to estimate ASIR and tumour profile in paediatrics. The average ASIR of cancer in children per 100,000 populations in this study was 11.08 and 8.17 in Erbil and Duhok, respectively. This result is lower than that observed in a previous study during 2012–2016 in Basra⁴¹, and relatively similar to the incidence of some neighbouring countries, such as Iran (11.9)⁴², Jordan (11.38)⁴³, and Saudi Arabia (9.8)⁴⁴.

In childhood, the cancer rate accounted for 3.9% and 4.8% of all registered cases in Erbil and Duhok, respectively, with a child proportion of 36%, and the rate was less than the 7.75% reported in the first cancer report in Iraq, with a child proportion of 49% out of the Iraqi population⁴⁵. However, the cancer rate is in agreement with the results of the Jordanian child cancer rate of 7.75%⁴⁰. However, the rate is much higher than that of some developed countries, where the frequency is less than 1%, such as in Norway and the UK, where frequency was 0.4 and 0.5, respectively³⁸.

The overall average of ASIR per 100,000 population in adolescents in this study was 38.62 and 27.46 in Erbil and Duhok, respectively, which is higher than rates reported in some developed countries, for example: 19.83 in Portugal, 21.1 in the US, 26.1, in Austria, and 28.2 in Piedmont (Italy), respectively^{46–48}. The frequency of all new cases in Erbil and Duhok was approximately comparable to the frequency of the Iraqi Cancer Registry from 2018, and was much higher than in Western countries.

Blood cancers were the most common cancer among children and adolescents, and were more prominent among male than female children. This data is in agreement with previous local studies^{2,13,41,45} and most other parts of the world^{49,50}. Currently, the second most common cancer type in Erbil is kidney cancer, followed by lymphoma; in Duhok, it is soft tissues followed by brain cancer. However, this data is not in line with data reported by the Iraqi Cancer Registry (2018), which found cancer of the central nervous system (CNS) to be the second most common type of cancer, followed by lymphoma⁴⁹. Among adolescents in the present study, lymphomas and CNS tumours vs lymphomas and soft tissue cancers were the second and third most common cancers in Erbil and Duhok, respectively. In Iraq as a whole, CNS cancers and lymphomas were the second and third most common cancers².

Finally, breast cancer is rare under the age of 20 years in women⁵¹, and the current study affirmed this, but the small incidence of breast cancer reported among this age group was more aggressive than in older patients⁵². Young age is an independent poor prognostic factor in breast cancer⁵³. Hence, it is important to take breast cancer screening programs at an earlier age into consideration.

The stages of cancer disease are classified according to the TNM system, which is expressed as 0, I, II, III, and IV⁵⁴. Results of previous studies concluded that two-thirds of global cancer deaths occurred in less developed countries as a result of late-stage diagnosis and lack of adequate treatments^{55,56}. It has been documented that many influencing factors can determine the late-stage diagnosis of cancer, such as inadequate screening tests, education, and cultural awareness⁵⁷. Cancer type is another important factor that determines the differences in cancer stages among patients. For example, lung, stomach, colorectal, pancreas, and liver cancer were recorded to be among the highest frequency of late-stage diagnosis compared to other types of cancers in the skin, prostate, uterus, and breast^{58,59}. However, the results of many Iraqi studies exhibited that the majority of breast cancer cases are detected at very advanced stages^{8,57,60,61}. Therefore, to minimize the consequence of late diagnosis, persistent monitoring of cancer incidence by stage should be prioritized⁶².

In terms of frequency distribution in the KRG between 2013 and 2019, the highest rates were recorded in the centre of Erbil, and the lowest in Mergasor, regarding the cancer risk distribution. In Duhok, the highest and lowest rates were reported respectively in Duhok centre and Berdehresh district. To our knowledge this is mostly due to early detection through mammography screening programs in urban centres. By increasing the social role of women in urban areas, the social effects of exposure to cancer risk factors can be useful in cancer development, so in major cities like Erbil and Duhok it is more prevalent compared to rural and small towns with lower population densities and differing lifestyles ²³.

Many limitations may influence the interpretations of cancer incidence trends discussed here. First, the lack of knowledge on cancer mortality burden and death certificates in our study is more likely due to administrative bureaucracy, which affects the accuracy of cancer rates in this area. Second, we define local variations in cancer rates mainly based on only two selected cancer registries (Erbil and Duhok), and missing differences for specific cancer sites in the Sulaymaniyah governorate. Third, the restriction of screening and imaging approaches in cancer detection centres may partly explain the low incidence rates for certain cancers, masking the real disease prevalence.

Conclusions

The top three cancers dominant in KRG are lung, female breast, and blood cancers, which explain about half of the region's top ten cancer incidence rates. It is more consistent with the latest studies indicating that lung, female breast, and colorectal cancers are the top three prevalent cancers in terms of incidence worldwide. The incredible trends of all prominent cancer types in the KRG region illustrate the urgent need to prioritize early diagnosis. In our data, we observed a high proportion of unknown primary cancer, which could be due to limited diagnostic facilities in KRG. The urgent priorities to be addressed to minimize cancer incidence and mortality in KRG include developing and improving services concerned with cancer screening and early detection, aetiology of cancer, cancer registration, and surveillance. Despite the challenges of accurate and comprehensive data collection, better estimation and use of local data is strongly recommended in KRG for cancer registry development, to evaluate and support the national control efforts. Early cancer detection through various techniques and improved therapies is highly recommended to decrease the incidence of cancer over the next decades.

Methodology

This study was a retrospective investigation to inquire about the prevalence and cancer incidences. All cancer cases included in the current study were diagnosed and registered in Erbil and Duhok governorates of the KRG from 2013 to 2019. The analyses were based on data collected from the Medical Statistics Department at the Ministry of Health, which is retrieved from all the main cancer registry centres in both governorates.

Relevant variables including the number of hospitals and patients that participated in this study; patient names, places of residence, and demographic data (e.g. gender and age intervals); and tumour details (primary site, date of diagnosis, histology, grade, stage, and basis of diagnosis) were obtained for this study. Data on the incidences were analysed per 100,000 population for each type of cancer.

The abstracted data for tumour sites was coded according to the International Classification of Disease (ICD) using the 9th or -10th morbidity and mortality coding system. The topography (primary site) and morphology (histology) of the malignancies were identified and coded by the ICD-Oncology system, as specified by the International Classification of Diseases for Oncology 3rd Edition (ICD-O3), published by the World Health Organization (WHO) in 2000. The indexes of the registered cases used serial numbers, names, and site codes. Furthermore, to avoid duplicate registrations, the incoming notifications were double-checked against the registered data.

The data was recorded using the WHO CANREG (cancer registration) system following the standards of WHO's International Agency for Research on Cancer (IARC). Graphpad Prism 8 and Microsoft Excel were used for data analysis and presentations. Codes given by ICD for the data were maintained and presented in the current study.

Declarations

Conflict of Interest

The authors declare that they have no conflict of interest.

Authors' contributions

KMA, AMSA, HHN, DM, HEO, FMR, TSM and KM co-wrote the paper. BH, ZAM, BTB, AMS, FMS, SASK, GOO, MHA and GQ collected data. LRS, MS, OAS, DKM, ZH, BMH, FAA, FAQ and DMT revised the manuscript. AS, collected data, analyzed data and co-wrote the manuscript.

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Tables

Table 1. Cancer incidence in Erbil and Duhok cities stratified based on gender

	Erbil			Duhok		
	Female	Male	Total	Female	Male	Total
2013	675 (80)	574 (66)	1250 (73)	252 (38)	234 (35)	486 (36)
2014	995 (114)	761 (86)	1756 (100)	547 (79)	558 (81)	1105 (80)
2015	962 (108)	776 (85)	1738 (96)	529 (75)	520 (73)	1049 (74)
2016	936 (102)	773 (83)	1709 (92)	555 (76)	527 (72)	1082 (74)
2017	1481 (158)	1305 (136)	2786 (147)	576 (76)	520 (69)	1096 (72)
2018	1623 (169)	1420 (145)	3043 (157)	592 (76)	555 (71)	1147 (74)
2019	1884 (192)	1573 (157)	3457 (174)	747 (93)	618 (77)	1365 (85)
Total	8492	7247	15739	3798	3532	7330
Increasing ratio (2013 to 2019)	2.4fold	2.37 fold	2.38 fold	2.44fold	2.2fold	2.36 fold
Female to Male ratio	1.17			<u>1.07</u>		

Table 2. Types of cancer 2013-2019 in Erbil governorate

	2013				2014				2015				2016				2017		
	F	M	T	%	F	M	T	%	F	M	T	%	F	M	T	%	F	M	
Breast	263	5	268	21.4	506	11	517	29.4	422	10	432	24.86	358	11	369	21.6	559	23	
Lung	26	114	140	11.2	36	124	160	9.11	41	156	197	11.33	40	149	189	11.1	63	216	
Blood	84	95	179	14.3	94	136	230	13.1	66	116	182	10.47	45	55	100	5.85	109	137	
Colorectal	40	37	77	6.16	58	63	121	6.89	49	71	120	6.9	64	76	140	8.19	90	132	
Kidney	14	46	60	4.8	13	36	49	2.79	25	43	68	3.91	38	106	144	8.43	48	182	
Skin	7	8	15	1.2	13	18	31	1.77	8	13	21	1.21	39	46	85	4.97	92	75	
Prostate		41	41	3.28		63	63	3.59		82	82	4.72		70	70	4.1		122	
Lymph Nodes	38	62	100	8	37	69	106	6.04	39	42	81	4.66	33	38	71	4.15	42	55	
Stomach	18	23	41	3.28	22	30	52	2.96	31	31	62	3.57	28	34	62	3.63	39	78	
Brain	8	15	23	1.84	27	39	66	3.76	28	27	55	3.16	23	32	55	3.22	37	40	
Thyroid	4	1	5	0.4	13	5	18	1.03	21	8	29	1.67	29	7	36	2.11	52	18	
Ovary	38		38	3.04	31		31	1.77	44		44	2.53	38		38	2.22	62		
Uterus	32		32	2.56	30		30	1.71	35		35	2.01	36		36	2.11	61		
Bone	19	25	44	3.52	15	29	44	2.51	17	12	29	1.67	12	16	28	1.64	20	21	
Liver	7	3	10	0.8	6	10	16	0.91	16	23	39	2.24	14	18	32	1.87	25	27	
Pancreas	8	19	27	2.16	9	16	25	1.42	17	16	33	1.9	14	8	22	1.29	15	20	
Mouth	6	8	14	1.12	13	20	33	1.88	5	19	24	1.38	13	17	30	1.76	18	22	
Soft Tissues	8	11	19	1.52	11	15	26	1.48	9	9	18	1.04	13	6	19	1.11	15	18	
Esophagus	4	1	5	0.4	9	3	12	0.68	10	9	19	1.09	9	8	17	0.99	16	15	
Cervix and vagina	7		7	0.56	12		12	0.68	19		19	1.09	19		19	1.11	18		
Testis		10	10	0.8		15	15	0.85		18	18	1.04		13	13	0.76		24	
Pharynx	6	6	12	0.96	4	8	12	0.68	3	7	10	0.58	4	8	12	0.7	4	14	
Adrenal Gland	6	6	12	0.96	3	5	8	0.46	1	5	6	0.35	2	2	4	0.23	6	3	
Small Intestine		1	1	0.08		2	2	0.11	2	6	8	0.46	3	4	7	0.41	6	8	
Placenta									7		7	0.4	10		10	0.59	11		
Eye					1	2	3	0.17	3	4	7	0.4	6	3	9	0.53	4	5	
GIT-other	2	4	6	0.48	1	5	6	0.34	7	5	12	0.69		1	1	0.06	3		
Heart					1	2	3	0.17		4	4	0.23				0	2	4	
Peritoneum	6		6	0.48	2	1	3	0.17	3	4	7	0.4	2	2	4	0.23		2	
Glands - Other	1		1	0.08	2	2	4	0.23	2	1	3	0.17	1	1	2	0.12	1	1	
Nerves					2		2	0.11	5	1	6	0.35	1		1	0.06	1		
Ear/Nose		1	1	0.08	2	1	3	0.17		1	1	0.06		2	2	0.12		3	
Thymus		1	1	0.08	2	3	5	0.28						1	1	0.06	2		
NOS	11	16	27	2.16	1	3	4	0.23	4	8	12	0.69	1	9	10	0.59	7	7	
UPS	13	15	28	2.24	19	25	44	2.51	21	27	48	2.76	41	30	71	4.15	53	33	
Grand Total	676	574	1250		995	761	1756		960	778	1738		936	773	1709		1481	1305	

NOS: Not Otherwise Specified; UPS: Unknown primary site

Table 3. Types of cancer 2013-2019 in Duhok governorate

	2013				2014				2015				2016				2017	
	F	M	T	%	F	M	T	%	F	M	T	%	F	M	T	%	F	M
Breast	110	3	113	23.25	154	2	156	14.12	150	1	151	14.39	149	3	152	14.05	187	
Lung	8	57	65	13.37	15	105	120	10.86	9	87	96	9.15	12	92	104	9.61	12	97
Blood	26	34	60	12.35	72	68	140	12.67	40	62	102	9.72	58	53	111	10.26	55	54
Colorectal	23	13	36	7.41	33	48	81	7.33	34	43	77	7.34	33	50	83	7.67	38	48
Kidney	7	21	28	5.76	11	65	76	6.88	20	45	65	6.2	13	58	71	6.56	19	59
Skin	2	7	9	1.85	42	48	90	8.14	45	62	107	10.2	55	48	103	9.52	56	49
Prostate		14	14	2.88		24	24	2.17		21	21	2		18	18	1.66		22
Lymph nodes	14	20	34	7	10	4	14	1.27	16	31	47	4.48	25	28	53	4.9	21	27
Stomach	8	11	19	3.91	18	32	50	4.52	13	24	37	3.53	18	26	44	4.07	12	17
Brain	10	15	25	5.14	22	29	51	4.62	25	32	57	5.43	27	21	48	4.44	21	24
Thyroid	3		3	0.62	10		10	0.9	23	2	25	2.38	17	2	19	1.76	13	2
Ovary	14		14	2.88	28		28	2.53	23		23	2.19	30		30	2.77	20	
Uterus	5		5	1.03	14		14	1.27	22		22	2.1	13		13	1.2	14	
Bone	4	4	8	1.65	5	12	17	1.54	7	9	16	1.53	11	11	22	2.03	11	10
Liver	3	3	6	1.23	11	7	18	1.63	14	17	31	2.96	7	20	27	2.5	10	23
Pancreas	7	9	16	3.29	7	7	14	1.27	9	6	15	1.43	7	5	12	1.11	7	9
Mouth	2	1	3	0.62	3	5	8	0.72	4	1	5	0.48	3	7	10	0.92	2	3
Soft Tissues	3	9	12	2.47	41	51	92	8.33	22	32	54	5.15	32	27	59	5.45	30	27
Esophagus		2	2	0.41	7	5	12	1.09	3	7	10	0.95		6	6	0.55	4	5
Cervix and vagina	1		1	0.21	7		7	0.63	8		8	0.76	11		11	1.02	4	
Testis		6	6	1.23		12	12	1.09		6	6	0.57		10	10	0.92		9
Pharynx	1	2	3	0.62	3		3	0.27	1	3	4	0.38		2	2	0.18	1	3
Adrenal Gland					1		1	0.09	2		2	0.19	1	2	3	0.28		
Small Intestine						2	2	0.18	1	1	2	0.19						1
Placenta												0						
Eye					2	1	3	0.27	1	2	3	0.29	2	2	4	0.37		2
GIT-other					6	6	12	1.09	8	7	15	1.43	10	15	25	2.31	13	3
Heart								0	6	1	7	0.67	1	4	5	0.46	2	8
Peritoneum					1		1	0.09				0	3		3	0.28		
Glands - Other		1	1	0.21	1	1	2	0.18				0	1		1	0.09		
Nerves					2		2	0.18	1		1	0.1		1	1	0.09	1	1
Ear/Nose					7	9	16	1.45	19	15	34	3.24	8	6	14	1.29	6	7
Thymus														1	1	0.09		
NOS					1	1	2	0.18				0				0		1
UPS	1	2	3	0.62	13	14	27	2.44	3	3	6	0.57	8	9	17	1.57	17	9
Grand Total	252	234	486		547	558	1105		529	520	1049		555	527	1082		576	520

NOS: Not Otherwise Specified; UPS: Unknown primary site

Table 4. Age-standardized cancer rate based on gender in Erbil governorate

	0-14			15-19			20-29			30-39			40-49		
	F	M	T	F	M	T	F	M	T	F	M	T	F	M	T
2013	9.88	9.65	9.76	30.37	40.42	35.50	38.02	31.33	34.62	92.58	56.92	74.55	190.99	109.49	115.52
2014	9.06	14.08	11.64	43.17	45.67	44.45	61.25	39.27	50.08	144.95	59.80	101.84	330.99	121.28	205.47
2015	7.75	10.15	8.98	30.89	34.70	32.84	42.39	30.58	36.39	107.66	50.17	78.52	303.60	141.11	205.47
2016	5.98	9.14	7.60	20.35	18.30	19.30	41.45	29.25	35.25	114.52	47.04	80.28	247.04	126.12	115.52
2017	10.89	15.63	13.32	49.93	55.17	52.62	54.67	42.84	48.65	139.80	82.29	110.60	389.14	198.13	205.47
2018	12.09	15.71	13.95	44.49	31.56	37.85	52.16	46.03	49.04	187.84	103.42	144.94	391.53	166.14	205.47
2019	10.83	13.72	12.31	53.12	42.78	47.81	52.79	42.51	47.55	197.43	102.11	148.96	473.91	205.47	305.47
Total	66.48	88.08	77.56	272.33	268.61	270.36	342.73	261.82	301.58	984.80	501.74	739.68	2327.20	1067.74	1155.52
Average	9.50	12.58	11.08	38.90	38.37	38.62	48.96	37.40	43.08	140.69	71.68	105.67	332.46	152.53	205.47

50-59			60-69			70-79			80-89			>=90		
F	M	T	F	M	T	F	M	T	F	M	T	F	M	T
368.37	225.63	299.74	414.97	575.16	490.41	294.89	865.50	556.50	370.06	587.58	465.87	0.00		0
414.76	319.81	369.08	529.35	791.13	652.32	457.99	1019.74	715.67	889.64	1605.14	1204.88	280.94		8
417.40	285.94	354.09	609.16	856.98	725.32	609.40	1074.06	822.51	1036.22	2329.75	1606.49	70.64		6
342.44	322.22	332.69	702.56	802.83	749.48	724.85	1133.40	912.03	753.30	2801.62	1657.20	70.64		0
630.22	440.22	538.43	956.37	1316.38	1124.61	1156.03	2034.77	1557.89	1263.16	3957.71	2454.05	140.38		8
555.51	420.41	490.08	1122.05	1469.29	1284.21	1238.71	2295.72	1720.83	1617.67	5241.09	3220.99	554.52		8
716.30	514.46	618.30	1212.01	1513.09	1352.57	1132.91	2416.21	1716.44	2453.99	4741.50	3467.48	340.83		6
3444.99	2528.70	3002.40	5546.47	7324.86	6378.91	5614.79	10839.39	8001.87	8384.04	21264.38	14076.96	1457.94		2
492.14	361.24	428.91	792.35	1046.41	911.27	802.11	1548.48	1143.12	1197.72	3037.77	2010.99	208.28		3

Table 5. Age-standardized cancer rate based on gender in Duhok governorate

	0-14			15-19			20-29			30-39			40-49		
	F	M	T	F	M	T	F	M	T	F	M	T	F	M	T
2013	6.14	6.51	6.33	5.97	20.08	13.16	20.73	20.05	20.39	35.54	10.79	23.03	119.42	53.60	86
2014	8.06	10.31	9.21	39.06	24.93	31.84	26.35	22.94	24.62	77.32	37.13	56.98	218.35	143.89	18
2015	5.78	12.60	9.28	28.02	30.71	29.40	35.11	29.81	32.42	75.08	33.72	54.12	204.12	93.72	14
2016	8.92	10.36	9.66	38.01	28.35	33.05	34.26	19.38	26.69	89.78	46.86	68.01	179.87	93.29	13
2017	6.75	8.54	7.67	43.42	28.66	35.84	35.05	15.74	25.22	77.42	35.94	56.36	203.02	108.14	15
2018	6.25	8.02	7.16	26.81	22.94	24.82	29.41	15.32	22.24	86.86	52.30	69.30	175.91	86.69	13
2019	7.61	8.10	7.86	19.84	28.14	24.11	45.75	24.60	34.97	93.67	47.77	70.34	229.37	119.27	17
Total	49.51	64.45	57.17	201.14	183.81	192.23	226.66	147.85	186.54	535.68	264.52	398.13	1330.05	698.60	10
Average	7.07	9.21	8.17	28.73	26.26	27.46	32.38	21.12	26.65	76.53	37.79	56.88	190.01	99.80	14

50-59			60-69			70-79			80-89			>=90	
F	M	T	F	M	T	F	M	T	F	M	T	F	M
152.83	120.38	137.25	175.17	338.54	251.96	207.62	382.22	287.58	178.55	831.77	466.25	0.00	0.00
344.13	334.70	339.60	494.23	836.98	654.94	367.07	947.23	632.87	360.84	1528.46	875.03	180.42	458
294.68	343.00	317.91	450.87	695.98	565.55	407.36	761.07	569.37	482.45	1379.08	877.36	181.04	0.00
253.72	297.00	274.56	529.58	710.03	613.86	319.95	905.56	587.88	662.96	1297.79	943.03	0.00	229
281.90	215.96	250.08	414.86	755.26	573.65	486.35	862.33	658.02	418.42	2040.72	1134.84	179.32	340
250.62	226.20	238.81	491.12	739.13	606.73	590.87	1128.42	835.65	1002.64	2081.74	1479.99	265.40	0.00
388.21	235.22	314.01	541.23	843.20	681.96	484.77	858.22	654.29	1390.46	2188.58	1743.74	260.55	328
1966.07	1772.46	1872.22	3097.06	4919.12	3948.65	2863.99	5845.05	4225.67	4496.31	11348.14	7520.24	1066.73	135
280.87	253.21	267.46	442.44	702.73	564.09	409.14	835.01	603.67	642.33	1621.16	1074.32	152.39	193

Table 6. Age-standardized rate of cancer types in Erbil and Duhok

	Erbil										
	0-14	15-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	>=90	Average
Breast	0.00	0.30	6.18	37.08	99.23	122.39	147.54	111.14	141.04	22.27	68.72
Lung	0.00	0.22	0.55	2.60	11.21	45.81	171.00	215.46	348.90	22.27	81.80
Blood	4.59	11.55	6.18	7.80	15.10	27.51	59.43	72.65	126.20	11.14	34.21
Colorectal	0.05	0.82	3.92	8.48	19.25	36.73	73.25	100.59	122.49	11.14	37.67
Kidney	1.14	0.60	1.24	4.40	13.24	36.02	74.29	114.87	193.01	27.84	46.66
Skin	0.04	0.22	0.60	3.84	8.83	21.13	59.17	95.00	270.95	33.41	49.32
Prostate	0.00	0.00	0.09	0.12	0.97	12.91	72.21	153.99	300.65	50.11	59.10
Lymph nodes	0.89	6.56	5.76	6.81	6.62	11.91	22.42	23.59	48.25	5.57	13.84
Stomach	0.05	0.30	0.92	2.91	9.00	13.05	41.45	52.78	107.64	16.70	24.48
Brain	0.85	3.28	2.40	4.77	7.68	10.07	13.56	11.18	11.14	0.00	6.49
	Duhok										
	0-14	15-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	>=90	Average
Breast		0.19	3.63	18.86	43.67	53.10	57.89	43.83	47.53	14.26	28.30
Blood	3.52	9.25	3.1	5.05	9.82	20.73	37.48	45.42	76.05	7.13	21.75
Lung		0.09	0.35	1.26	8.13	30.91	105.41	105.99	156.84	7.13	41.61
Skin	0.09	1.13	1.87	3.94	10.27	25.64	62.58	78.89	128.33	28.52	34.13
Colorectal		0.76	2.4	4.26	14.11	21.82	52.54	47.81	76.05	7.13	22.69
Kidney	0.57	0.66	0.76	1.97	8.35	20.18	48.86	49.41	104.56	7.13	24.25
Soft tissues	0.83	2.93	1.99	3.08	6.66	10.36	25.77	23.11	61.79		13.65
Brain	1.61	1.89	1.87	2.52	5.19	9.09	17.4	15.14	4.75	7.13	6.66
Lymph nodes	0.57	3.78	2.23	2.45	3.84	8	11.04	11.95	33.27		7.71
Stomach		0.09	0.59	1.66	3.84	10	24.09	27.89	52.28		12.04

Table 7. Cancer grades of patients at the first time of detection (percentage of the grade comparing to total no. of patients of that year)

Erbil									
	B-cell	Grade I	Grade II	Grade III	Grade IV	NK cell	Null cell	T-cell	Unknown
2013	49 (3.92)	26 (2.08)	204 (16.32)	189 (15.12)	35 (2.8)		2 (0.16)	6 (0.48)	739 (59.12)
2014	42 (2.39)	48 (2.73)	393 (22.38)	330 (18.79)	57 (3.25)	2 (0.11)		6 (0.34)	878 (50)
2015	53 (3.05)	67 (3.86)	367 (21.12)	280 (16.11)	105 (6.04)		1 (0.06)	9 (0.52)	856 (49.25)
2016	31 (1.81)	113 (6.61)	564 (33)	405 (23.7)	135 (7.9)		1 (0.06)	11 (0.64)	449 (26.27)
2017	47 (1.69)	194 (6.96)	867 (31.12)	565 (20.28)	206 (7.39)	2 (0.07)		8 (0.29)	897 (32.2)
2018	51 (1.68)	253(8.31)	904(29.71)	539 (17.71)	241 (7.92)	1 (0.03)		9 (0.3)	1045 (34.34)
2019	47 (1.36)	271 (7.84)	1009 (29.19)	649 (18.77)	242 (7.00)	1 (0.03)		3 (0.09)	1235 (35.72)
Total	320 (2.03)	972 (6.18)	4308 (27.37)	2957 (18.79)	1021 (6.49)	6 (0.04)	4 (0.03)	52 (0.33)	6099 (38.75)
Duhok									
	B-cell	Grade I	Grade II	Grade III	Grade IV	NK cell	Null cell	T-cell	Unknown
2013	6 (1.23)			1 (0.21)			49 (10.08)		430 (88.48)
2014	2 (0.18)			1 (0.09)		30 (2.71)	147 (13.3)		925 (83.71)
2015	4 (0.38)					30 (2.86)	93 (8.87)		922 (87.89)
2016	6 (0.55)			5 (0.46)	2 (0.18)	53 (4.9)	76 (7.02)	1 (0.09)	939 (86.78)
2017	4 (0.36)		1 (0.09)	7 (0.64)		52 (4.74)	104 (9.49)		928 (84.67)
2018	13 (1.13)	2 (0.17)	13 (1.13)	82 (7.15)	4 (0.35)	62 (5.41)	83 (7.24)		888 (77.42)
2019	17 (1.25)	8 (0.59)	26 (1.9)	61 (4.47)	8 (0.59)	41 (3)	110 (8.06)	1 (0.07)	1093 (80.07)
Total	52 (0.71)	10 (0.14)	40 (0.55)	157 (2.14)	14 (0.19)	268 (3.66)	662 (9.03)	2 (0.03)	6125 (83.56)

Red numbers are (%)

Table 8. Stratification of cancer incidence in Erbil city based on zones

	2013	2014	2015	2016	2017	2018	2019	Total	%
Erbil Center	561	678	726	821	1300	1522	1636	7244	46
	64	75	78	86	133	152	160		
Deshti Erbil	76	129	94	101	168	194	185	947	6
	37	61	43	45	73	83	77		
Sooran, Rawandooz, Choman	61	76	85	87	127	140	170	746	5
	27	33	36	36	51	55	65		
Shaqlaw, Hareer, Salahaddin	31	45	64	73	91	108	94	506	3
	22	31	43	48	59	68	58		
Kweisengek	25	38	43	46	46	59	63	320	2
	24	35	39	41	40	50	52		
Khabat	22	20	34	33	56	68	59	292	2
	21	19	31	30	49	58	49		
Meirgehsor	7	13	14	14	23	22	28	121	1
	14	26	27	26	42	39	49		
Other cities	467	757	678	534	975	930	1222	5563	35

Table 9. Stratification of cancer incidence in Duhok city based on zones

	2013	2014	2015	2016	2017	2018	2019	Total	%
Duhok Center	239	571	580	542	495	536	542	3505	48
	68	157	155	140	124	131	128		
Zakho	63	137	114	139	110	137	149	849	12
	24	51	41	49	38	45	48		
Sumail	10	31	38	48	36	39	73	275	4
	9	28	33	40	29	31	56		
Ammadyia	2	13	7	10	53	52	56	193	3
	2	12	6	8	43	41	43		
Aqreh				1	40	65	59	165	2
				1	21	33	29		
Shaikhan				5	50	39	59	153	2
				3	32	24	35		
Berdehresh				8	21	15	26	70	1
				5	14	10	16		
Other cities	172	353	310	329	291	264	401	2120	29

Figures

Figure 1

Projection of new cases in Erbil and Duhok governorates.

Erbil

Duhok

Figure 2

Top ten prevalent cancer types based on sex in Erbil and Duhok governorates shows the most common types of cancer in both sexes and in both governorates. In male patients, lung cancer accounted for 1264 cases followed by blood (815) and kidney (814) in Erbil governorate. Comparably, in Duhok governorate, the most common type of cancer was lung cancer corresponding to 649 cases followed by blood cancer (405) and kidney cancer (369). However, concerning female patients, breast and blood cancers were the top cancers in both governorates.

Figure 3

Cancer incidence based on sex and age groups in Erbil and Duhok governorates, illustrates the number of cancer patients according to their age groups in both governorates throughout 2013 to 2019. The maximum number of cancer patients in Erbil governorate was in the age group of 61-70. In Duhok governorate, the maximum number of cancer patients were also in the age group of 61-70 from 2014-2019 except for 2015 where the maximum number of cancer patients were aged between 51-60 years.

Figure 4

Kurdistan Region map of cancer incidence displaying geographic distribution of cancer in Erbil and Duhok governorates. Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.