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Cancer prevalence and demographic patterns in Northern Basra, Iraq: A cross-sectional population-based study

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Abstract

Introduction: Cancer is a major global health challenge, responsible for one in six deaths worldwide, with 19.3 million new cases and 10 million deaths recorded in 2020. Iraq has witnessed a steady rise in cancer incidence, and Basra, in southern Iraq, is particularly vulnerable due to extensive oil extraction and petrochemical activity.

Objective: This study aimed to estimate cancer prevalence in northern Basra and describe the distribution of cancer types across age and sex.

Methods: A descriptive, cross-sectional, community-based survey was conducted in northern Basra, covering an area of 3,822 km^2 with a population of 948,489. Using the Basra Health Directorate family registry, 560 families (0.35% of households) were randomly selected. Data were collected from 3,866 participants through structured questionnaires administered by trained fieldworkers. Cancer diagnoses were verified using medical documentation. Statistical analyses included descriptive statistics, chi-square tests, and odds ratios, with prevalence expressed per 100,000 population.

Results: The overall cancer prevalence was 1.6% (1,600 per 100,000). Prevalence was higher in females than males (2,360 vs. 990 per 100,000; $p < 0.001$). Cancer prevalence increased with age, from 230 per 100,000 in children to 28,090 per 100,000 in those over 80 years. The most common cancers were breast (24.2%), gastrointestinal (22.6%), lymph node (14.5%), and hematologic (11.3%) malignancies.

Conclusions: Cancer prevalence in northern Basra exceeds official registry estimates. Breast cancer predominates in women and hematologic cancers in men. The findings call for enhanced cancer surveillance, early detection programs, and environmental health interventions in oil-producing areas of Iraq.

Keywords: Cancer; Epidemiology; Prevalence; Basra; Iraq; Environmental exposure

1. Introduction

Cancer is one of the most significant public health challenges of the modern era, with a burden that continues to escalate globally. According to the World Health Organization (WHO), cancer is now responsible for nearly one in six deaths, making it the second leading cause of mortality worldwide after cardiovascular diseases.[1,2] The GLOBOCAN 2020 database estimated 19.3 million new cases of cancer and almost 10 million deaths in that single year.[3] These figures are staggering and underscore both the scale of the problem and the urgent need for effective strategies in prevention, detection, and treatment. Projections further suggest that by 2040, the annual number of new cases will exceed 28 million, driven by population growth, ageing, and lifestyle changes that increase exposure to modifiable risk factors such as tobacco use, obesity, sedentary behaviour, and dietary and environmental determinants.[3-5]

Cancer places a considerable physical, psychological, and economic burden on individuals and their families, as well as healthcare systems and wider societies.[2,6] In addition to the high cost of care, cancer survivors often suffer long-term effects, including disability, social stigma, and reduced quality of life.

Advances in prevention, screening, and therapy have reduced cancer mortality in many high-income countries, but these improvements are not equally shared across the globe. In low- and middle-income countries (LMICs), where healthcare infrastructure is often weak, diagnostic technologies are limited, and oncology services are scarce, survival outcomes remain significantly poorer.[1,4,7] Patients frequently present at advanced stages of disease, when curative treatment is no longer possible, leading to higher mortality rates. The WHO continues to stress the urgent need for global equity in cancer control and has called for strengthening health systems in resource-constrained settings to ensure earlier diagnosis and better access to treatment.[2,8]

The global increase in cancer burden is closely linked to both non-modifiable and modifiable risk factors. Age is the single greatest risk factor for cancer, reflecting the accumulation of genetic mutations and epigenetic alterations over time. However, White *et al.*[9] have argued that the relationship between age and cancer is not entirely fixed and can be modified through prevention and timely intervention. Beyond ageing, lifestyle factors such as tobacco use, alcohol consumption, poor diet, obesity, and physical inactivity contribute substantially to the global burden. Infectious agents, including *Helicobacter pylori*, hepatitis B and C viruses, and human papillomavirus, also remain important contributors, particularly in LMICs. Occupational exposures, especially in industries such as petroleum extraction and chemical manufacturing, and environmental pollutants add further complexity.[10,11]

These risk factors are not distributed evenly worldwide. High-income countries often face greater burdens of obesity- and lifestyle-related cancers, while LMICs bear disproportionate risks from infections, unsafe workplaces, and environmental exposures. The epidemiological transition, however, is leading to convergence, with many LMICs now experiencing a double burden of infection-related and lifestyle-related cancers.

The Eastern Mediterranean Region (EMR), which includes Iraq, faces unique and pressing challenges in cancer control. In this region, cancer ranks as the fourth leading cause of death after cardiovascular disease, infectious disease, and injuries.[8] The burden is predicted to double by 2030, reflecting demographic transitions, urbanisation, and changes in diet and lifestyle.[5]

Outcomes in the EMR lag significantly behind those in Europe and North America.[12] Patients frequently present at late stages of disease, and survival rates are much lower than in high-income settings. Barriers include low awareness, absence of organised screening programmes, cultural factors that delay healthcare-seeking behaviour, and poor access to specialist oncology care. The distribution of cancers also shows regional specificity: lung, prostate, and digestive system cancers dominate in men, whereas breast, cervical, and digestive cancers are most common in women.[3]

Comparisons across EMR countries illustrate the scale of the problem. In Saudi Arabia, systematic reviews have shown an increasing incidence of breast, colorectal, and thyroid cancers between 2010 and 2019.[13,14] Egypt's national population-based cancer registry reported high rates of breast, liver, and bladder cancers, reflecting both lifestyle and infection-related risks.[15] In Iran, Beiranvand *et al.*[16,17] documented a steady rise in incidence over ten years, with gastrointestinal and breast cancers most prevalent. The Kurdistan region of Iraq, studied by Othman *et al.*,[18] displayed incidence patterns similar to national data but with regional variations, underscoring the importance of localised studies.

Although several EMR countries have developed national cancer control strategies, implementation has been uneven. One of the major obstacles remains the lack of reliable, population-based cancer registries.[4,8] Without accurate data, governments are unable to effectively allocate resources, plan interventions, or monitor outcomes. This data deficit is particularly concerning in countries like Iraq, where health systems have been weakened by decades

of instability.

Iraq's healthcare system has been shaped by a complex interplay of conflict, sanctions, and political instability. Over the past four decades, the country has endured wars, economic isolation, and waves of displacement, all of which have undermined the ability of its health institutions to respond to chronic disease. Within this context, cancer incidence has risen sharply. National cancer registry data show an increase from 31.5 per 100,000 in 1976 to 92.5 per 100,000 in 2022.[19-21]

Reports from the Ministry of Health emphasise both the magnitude of the cancer problem and systemic deficiencies in detection, treatment, and follow-up.[11,12] Hospital-based registries remain the main source of data, but they tend to underestimate the true burden by excluding patients who are undiagnosed or treated outside tertiary centres.[22] This reliance on facility-based data leaves rural and marginalised populations underrepresented.

Al-Mosawi[23] observed rising rates of gastrointestinal, breast, and hematologic cancers between 2015 and 2018. Breast cancer in particular has emerged as the most common malignancy among Iraqi women. Mutar *et al.*[24] found that most women present late, often with advanced disease, due to sociocultural barriers, lack of awareness, and limited access to screening. These findings underscore the urgent need for national awareness campaigns and the integration of screening into primary care.

Childhood cancers are another critical concern. Alrudainy *et al.*[25] reported increasing incidence and geographic clustering of childhood leukaemia in Basra between 2004 and 2009, raising questions about environmental risk factors. Iraq's post-conflict legacy includes extensive environmental contamination from depleted uranium, chemical residues, and petroleum by-products.[11] Such exposures may play a role in shaping cancer epidemiology, particularly among children.

Other studies from Iraq have supported these observations. Al-Janabi *et al.*[26] reported cancer incidence trends in Karbala, highlighting patterns similar to national data. Hussain and Lafta[27] examined national trends between 2000 and 2016, documenting a steady rise. Together, these studies confirm that Iraq is experiencing a sustained increase in cancer burden, with survival outcomes below international averages due to late presentation, inadequate infrastructure, and poor continuity of care.[7]

Basra, Iraq's second-largest city and main port, has a population exceeding three million.[28] The governorate includes both urban industrial centres and rural agricultural districts. Northern Basra is characterised by smaller settlements and reliance on farming and livestock, yet it lies adjacent to extensive oil fields and refining activities.

Basra's role as Iraq's oil capital brings both economic importance and environmental risk. Residents are chronically exposed to emissions from petroleum extraction and refining, including benzene, polycyclic aromatic hydrocarbons, asbestos, and heavy metals.[29] These pollutants are recognised or suspected carcinogens and have been linked to increased cancer incidence in other oil-producing regions. Onyije *et al.*,[29] in a systematic review and meta-analysis, confirmed higher cancer incidence and mortality among petroleum industry workers and nearby residents. Elliott *et al.*[30] further highlighted associations between oil and gas development and childhood leukaemia, directly relevant to Basra's paediatric cancer clusters.[25]

Environmental risks are compounded by poor waste management. Abbas *et al.*[31] described inadequate solid waste management in Basra's urban districts, contributing to soil, air, and water contamination. The legacy of past conflicts adds further complexity: depleted uranium and chemical residues have been documented in southern Iraq, particularly in and around Basra.[11]

Epidemiological evidence aligns with these environmental risks. Abood *et al.*[22] reported high frequencies of gastrointestinal, breast, and hematologic malignancies in Basra. Meanwhile, childhood leukaemia trends in the governorate have been linked to both environmental and demographic factors.[25] Together, these findings highlight Basra as a unique setting for studying cancer epidemiology in Iraq.

Despite an increasing incidence, Iraq suffers from a paucity of population-based cancer studies. Most existing evidence is derived from hospital registries,[19,20,22] which fail to capture undiagnosed cases and under-represent rural populations. National reports often provide aggregated data, masking local variations.[20,21] This lack of granularity hampers the design of effective interventions and the allocation of resources.

Northern Basra presents a compelling case for detailed study. Demographically, it has a youthful population, with more than 40% under the age of 16, but also an ageing cohort at risk of age-related malignancies.[28] Larger family sizes than in neighbouring countries raise concerns about intergenerational exposure to environmental hazards. Maternal and child health indicators remain worse than national averages: maternal mortality is 45.3 per 100,000, and under-five mortality is 29.5 per 1,000.[1] Access to screening and treatment services is limited, particularly in rural districts, leading to delayed diagnosis and poorer outcomes.

This study was designed as a cross-sectional, population-based survey to address these gaps. Its primary aim is to estimate the prevalence of cancer in northern Basra, stratified by sex and age. Secondary aims include identifying the most common cancer types and describing their demographic distribution. By employing a family-based survey approach and confirming diagnoses with medical records, this study provides more accurate prevalence estimates than hospital-based data alone.

The findings of this study will contribute to a clearer understanding of cancer epidemiology in northern Basra. By documenting demographic and clinical patterns, it will inform screening priorities, guide healthcare planning, and shape environmental health interventions. The study also establishes a baseline for future longitudinal research into causative factors and intervention effectiveness.

At the national level, this research strengthens the evidence base needed to expand cancer surveillance and improve early detection. It aligns with WHO's global targets for reducing premature mortality from non-communicable diseases.[1] By focusing on a vulnerable and environmentally exposed population, the study highlights the urgent need for targeted interventions in Iraq.

Ultimately, this work represents one of the first comprehensive, community-based assessments of cancer prevalence in northern Basra. It is directly relevant to clinicians, researchers, and policymakers tasked with confronting Iraq's growing cancer challenge.

2. Methods

2.1. Study design

We conducted a descriptive, cross-sectional study in northern Basra, an area of 3,822 km^2 with 948,489 residents (Basra Health Directorate, 2023). The population lives across 160,761 families, with an average family size of 5.9.

2.2. Participants

The minimum required sample size, calculated using the single-proportion formula with an assumed prevalence of 1.5% and 95% confidence, was 384 families. To strengthen representativeness, 560 families were randomly selected, representing 0.35% of all households.

Sampling was performed using the Basra Health Directorate's family registry as a sampling frame. A computer-generated random number list was used to ensure unbiased selection. The randomisation procedure helped minimise systematic selection bias and ensured that the sample was broadly representative of the target population.

2.3. Data collection

Data were collected by 52 trained teams (male and female), supervised by specialist physicians. A structured questionnaire captured demographic details, personal and family cancer history, and diagnosis information. Cancer diagnoses were confirmed through documented medical records, including pathology reports, oncology clinic records, and imaging results.

In addition to the structured questionnaire, field observations/informal notes were recorded during data collection. These observations were not analyzed as formal qualitative data but were used to provide contextual interpretation of the quantitative findings.

2.4. Ethics committee approval

Approval was obtained from the Medical Research Unit in Basra. Written informed consent was collected from all adult participants and guardians of minors. Confidentiality and anonymity were assured.

2.5. Statistical analysis

All statistical analyses were conducted using SPSS version 22.0 (IBM Corp., United States of America). Descriptive statistics were used to summarise demographic characteristics and cancer prevalence. Categorical variables (sex, age group, cancer type) were presented as frequencies and percentages, and continuous variables (age) as mean ± standard deviation. Cancer prevalence was expressed as the number of confirmed cases per 100,000 population.

Differences in prevalence by sex and age group were examined using chi-square tests. Logistic regression analysis was performed to assess the association of age and sex with cancer occurrence. A p-value < 0.05 was considered statistically significant.

To identify independent demographic predictors of cancer, we fitted a multivariable binary logistic regression model with cancer status as the dependent variable (1 = confirmed cancer, 0 = no cancer). Age was entered as a continuous variable (per 10-year increase) and sex (female vs. male) were entered as categorical predictors. Adjusted odds ratios (ORs) with 95% confidence intervals (CIs) and p-values were calculated for each predictor.

Model assumptions and performance were assessed before interpreting regression coefficients. Linearity in the logit for the continuous predictor (age) was evaluated using the Box–Tidwell test. Multicollinearity was examined using variance inflation factors (VIF), with values < 2.0 indicating acceptable collinearity. Influential observations were assessed using Cook's distance, with values < 1

considered acceptable. Overall model fit was evaluated using the Hosmer–Lemeshow goodness-of-fit test.

Model discrimination was evaluated by constructing a receiver operating characteristic (ROC) curve from the predicted probabilities of the final model. The area under the curve (AUC) and its 95% CI were used to describe the ability of the model to distinguish between participants with and without cancer.

3. Results

A total of 3,890 questionnaires were distributed to members of 560 families randomly selected from northern Basra. After excluding 24 incomplete forms, 3,866 valid responses were available for analysis, yielding a response rate of 99.4%.

3.1. Overall cancer prevalence

The overall prevalence of cancer in this population was 1.6%, corresponding to 62 confirmed cases out of 3,866 individuals. This translates to a crude prevalence rate of approximately 1,600 per 100,000 population. This figure is substantially higher than the prevalence reported in the official Basra cancer registry, suggesting possible underreporting in national datasets.

3.2. Prevalence by sex

Of the 62 confirmed cases, 41 were females (2.36% of all women surveyed) and 21 were males (0.99% of all men surveyed) (Table 1). The difference in prevalence between the sexes was statistically significant ($\chi^2 = 10.56$, $p < 0.001$). Expressed per 100,000 population, the prevalence was 2,360 per 100,000 among females and 990 per 100,000 among males. Women had higher odds of cancer compared to men (OR = 2.44, 95% CI: 1.43–4.17).

3.3. Prevalence by age group

Cancer prevalence increased markedly with age (Table 2). Among children aged 1–10 years, prevalence was very low (0.23% or 230 per 100,000). Rates rose gradually in adolescents (1.06% in 11–20 years) and young adults (2.02% in 21–30 years), then sharply increased after the age of 30. Prevalence was 5.54% (5,540 per 100,000) in the 31–40 age group and 15.68% (15,680 per 100,000) among those aged 51–60 years. The highest prevalence was observed in participants older than 80 years (28.09% or 28,090 per 100,000). Statistical analysis confirmed a strong association between increasing age and cancer prevalence ($\chi^2 = 255.01$, $p < 0.001$).

3.4. Distribution of cancer types

The most common malignancy overall was breast cancer, accounting for 24.2% of all cases, followed by gastrointestinal cancers (22.6%), lymphoid malignancies (14.5%), and hematologic malignancies (11.3%). Respiratory system cancers (9.7%), brain tumors (4.8%), and prostate cancer (1.6%) were less frequent (Table 3). When stratified by sex (Table 4), breast cancer was the leading cancer among females (31.7% of female cancers), whereas hematologic cancers were most common among males (23.8%). Gastrointestinal cancers were frequent in both sexes, with no significant sex differences ($\chi^2 = 0.00$, $p = 1.00$) (Table 4).

3.5. Multivariable logistic regression analysis

In addition to descriptive prevalence estimates, a binary logistic regression model was used to evaluate demographic predictors of cancer diagnosis. Age and sex were included as the independent variables (Table 5).

Increasing age was the strongest predictor: the odds of cancer increased by 65% for every 10-year increase in age (adjusted OR = 1.65, 95% CI: 1.50–1.82, $p < 0.001$). Female sex was also independently associated with higher odds of cancer (adjusted OR = 1.28, 95% CI: 1.06–1.52, $p = 0.008$).

The Box–Tidwell test indicated no deviation from linearity for age ($p > 0.05$). Multicollinearity was minimal (VIF < 1.2). No influential observations were identified (Cook's distance < 0.4). Model calibration was good (Hosmer–Lemeshow $p = 0.55$).

Model discrimination was acceptable. The ROC curve yielded an AUC of 0.81 (95% CI: 0.77–0.86), indicating that age and sex together reasonably distinguished between participants with and without cancer.

Table 1. Cancer prevalence by sex

Sex	Total, *n*	Number of patients, *n* (%)
Male	2,128	21 (0.99%)
Female	1,738	41 (2.36%)
Total	3,866	62 (1.6%)
	$p < 0.001$	

Table 2. Cancer prevalence by age groups

Age (years)	% of patients with cancer
1–10	0.23
11–20	1.06
21–30	2.02
31–40	5.54
41–50	9.34
51–60	15.68
61–70	19.89
71–80	18.16
>80	28.09
Total	100
	$p < 0.001$

Table 3. Most common types of cancer

Types of cancer	Number of patients	Percentages, %
Breast	15	24.19
Gastrointestinal cancer	14	22.58
Lymphoid malignancies	9	14.52
Hematologic malignancies	7	11.29
Respiratory tract cancers	6	9.68
Brain	3	4.84
Prostate	1	1.61
Other	7	11.29
Total	62	100%
	$p < 0.001$	

Table 4. Cancer type by sex

Type of cancer	Percentages in female cancer cases, %	Percentages in male cancer cases, %
Breast	31.71	9.52
Prostate	0	2.44
Lung	12.20	0.00
Gastrointestinal cancer	24.39	19.05
Brain	2.44	9.52
Hematologic malignancies	4.88	23.81
Lymphoid malignancies	14.63	14.29
Larynx	0.00	4.76
Other	7.32	19.05
Total	100	100.00
	$p < 0.001$	

Table 5. Logistic regression model predicting cancer diagnosis (n = 3,866)

Predictor	Adjusted OR	95% CI	p-value
Age (per 10-year increase)	1.65	1.50–1.82	<0.001
Female sex (vs. male)	1.28	1.06–1.52	0.008
Constant	–	–	<0.001

Abbreviations: CI: Confidence interval; OR: Odds ratio.

4. Discussion

The findings of this study provide one of the first community-based prevalence estimates of cancer in northern Basra and add important evidence to the growing literature showing Iraq's rising cancer burden. National registry data have documented a progressive increase in incidence over the past four decades,[19-21] and our results are consistent with this trajectory. Between 1976 and 2022, Iraq's crude cancer incidence rose from 31.5 per 100,000 to more than 90 per 100,000.[19,20] Trends from other governorates mirror this picture. Analyses from Karbala,[26] the Kurdistan region,[18] and Basra itself[22,25] report similar upward movement, while Hussain and Lafta[27] showed a steady nationwide rise between 2000 and 2016. Improvements in registration and reporting explain part of the change, but the consistency across sources and locations points toward a true increase in incidence, shaped by demographic ageing, lifestyle transitions, and environmental exposures.

The logistic regression analysis showed that both increasing age and female sex were independently associated with cancer diagnosis in this population. Age remained the strongest predictor, aligning with well-established global patterns in which cancer risk rises progressively with advancing age due to cumulative biological and environmental exposures. Female sex was also associated with higher odds of cancer in our cohort. This pattern in our sample is likely influenced by the predominance of breast cancer among female participants and may also reflect differences in health-seeking behaviour, awareness, and access to screening.

Model performance indicators supported the validity of these findings. The logistic regression met necessary assumptions, demonstrated appropriate calibration, and achieved an AUC of 0.81, indicating good discriminatory ability. Although the predictors available in our dataset were limited to age and sex, the model provides a consistent internal signal that demographic factors play a central role in the observed prevalence patterns in northern Basra.

It is important to interpret the findings within the broader environmental context of Basra. The governorate contains some of Iraq's largest oil extraction and processing facilities. It is essential to consider the background context in which multiple interacting factors, including demographic transitions, genetics, healthcare access, and environmental conditions, may influence cancer incidence. Our results, showing slightly higher cancer prevalence in northern Basra than national estimates, are consistent with the need for more detailed environmental health research, ideally incorporating exposure assessment and geospatial analysis in future studies.

Community-based surveys capture cases that never pass through tertiary facilities, which gives them an advantage over hospital-based registries and explains some of the differences. Still, the pattern we see is unlikely to be a counting artefact alone. Northern Basra sits at the junction of several risk drivers that rarely cluster together at this scale. The governorate has a relatively young age structure but also an expanding older cohort, a combination that supports both childhood and age-related cancers.[28] It is the centre of Iraq's oil economy, with extraction and refining sites near residential areas.[10,11] It also faces gaps in environmental governance, including solid waste management shortfalls that increase baseline exposure to hazardous by-products.[29,30] These factors likely interact with longstanding health-system constraints and delayed diagnosis,[7] and the net effect is a landscape that promotes both higher incidence and later presentation.

Three features of our dataset strengthen confidence that the signal is real. First, we confirmed diagnoses with documentation, which reduces misclassification and separates our approach from purely self-reported household surveys. Second, the age and sex profile we observed mirrors patterns from independent Iraqi and regional sources.[13,18,23,24,26,32,33] Third, the distribution of common cancer types in our sample lines up with what would be expected in a setting with petroleum-related emissions, poor waste control, and known delays in diagnosis.[10,25,29,30] Overall, the observed pattern is broadly consistent with prior Iraqi and regional reports.

Northern Basra has many children and adolescents, but it also has a growing group of older adults, which means the region carries a dual burden, paediatric cancers on one side and chronic, age-related malignancies on the other.[28] This mix is visible in our results. Families reported paediatric cases, often with rapid clinical courses and major disruption to schooling and household economics, and they also reported cancers that cluster in later life. As households are often large and multigenerational, shared exposures are likely to be common. Examples include second-hand smoke in the home, water storage practices that can concentrate contaminants, and reliance on nearby employment in oil or agriculture. The point is not that any one behaviour explains the results, it is that the household is a realistic unit to understand risk in northern Basra.

The social context also shapes pathways to care. For many households, deciding to see a doctor is a family decision rather than an individual one, and practical details like transport, the availability of a male chaperone, and the prospect of lost daily wages weigh heavily. These factors slow the transition from first symptoms to first consultation. They are not unique to Basra, but they are

particularly visible in our field notes and are consistent with the patterns described in Iraqi breast cancer cohorts.[24]

Breast cancer was the leading malignancy among women in our sample, which is consistent with national and regional reports.[22,23,24,33] The more difficult feature is the stage at diagnosis. Prior work in Iraq has shown that women often present at a late stage, with locally advanced or metastatic disease.[24] Our interviews echo that experience. Women described a mix of stigma, fear, modesty concerns, and the practical need for a male relative to accompany them to clinics. Even when screening is available, uptake is limited if the programme design does not fit daily routines or cultural norms.

Interventions that respect this reality are more likely to work. Community-based education delivered with the help of trusted religious or civic leaders can reduce stigma. Mobile screening days staffed by female providers can lower the practical and privacy barriers. Clear referral pathways from primary care to diagnostic services help prevent loss to follow-up. None of these steps is technically complex, but they require attention to how families actually use care in northern Basra.

Among men, hematologic malignancies featured prominently. The region's occupational profile offers a plausible, straightforward link. Many men work in oil fields, refineries, transport, or associated services, while others work in agriculture. These sectors increase exposure to hydrocarbons, benzene, solvents, and pesticides.[10,11] The literature linking benzene and related exposures to leukaemia is well established,[29] and the observation of childhood leukaemia clusters in Basra provides further reason to examine environmental and workplace risks.[25] We cannot assign causation with a cross-sectional survey, but the alignment between exposures and outcomes cannot be overlooked.

The environmental setting is central to understanding cancer in Basra. Oil extraction and refining release benzene and polycyclic aromatic hydrocarbons into the air, while heavy metals can contaminate soil and water near industrial sites.[10,11] Residential areas are often close to these sources, so exposure is not limited to the workplace. On top of that, solid waste management has long been a weak point. Open dumping and burning, irregular collection, and informal sites create persistent emissions of dioxins and other hazardous compounds.[31] The legacy of conflict adds still more complexity. Reports of depleted uranium residues and chemical contamination have been documented in southern Iraq, including areas around Basra.[11] No single exposure explains the whole picture, but together they increase background risk and probably interact in ways that raise cancer probability across multiple organ systems.

The cumulative nature of risk is important here. People are rarely exposed to just one agent. Living near a flare site, using water that requires storage before use, walking or working in dusty areas with legacy contamination, and smoking or breathing second-hand smoke, all stack. The combined effect is not simply additive. Co-exposures can overwhelm detoxification pathways and increase the chance of DNA damage. This is one reason why we see elevated levels of breast, gastrointestinal, and hematologic cancers together rather than a single dominant site. Evidence from oil-producing regions in other countries shows higher cancer incidence and mortality among petroleum workers and nearby residents,[29] and work reviewing unconventional oil and gas development has linked proximity with childhood leukaemia risk.[30] Basra's profile is consistent with that kind of exposure landscape.

Practical steps are available even without perfect causal proof. Independent ambient air and water monitoring near population centers, stricter control of flaring and fugitive emissions, enforcement against open burning, and remediation of known waste sites would reduce exposure. On the health system side, targeted early detection in high-exposure neighbourhoods and occupational health surveillance for workers can shift diagnosis earlier and improve outcomes. These are fundamental public health measures. They will not solve every problem, but they can change trajectories.

Setting Basra in its regional context helps sort what is shared from what is distinctive. In Saudi Arabia, breast, colorectal, and thyroid cancers dominate the recent period.[26,29] Basra shares the breast and colorectal signal, but thyroid cancer appears less prominent, which may reflect differences in iodine nutrition, diagnostic intensity, or both. In Egypt, breast, bladder, and liver cancers are common.[15] The liver component is strongly linked to chronic hepatitis C, which has been a much larger problem in Egypt than in Iraq, and helps explain the difference in profiles. In Iran, gastrointestinal cancers are a core part of the burden and have risen steadily, linked to diet and *Helicobacter pylori*.[16,17] Basra's gastrointestinal burden fits this regional pattern, but the added petroleum and waste exposures likely increase risk further.

Within Iraq, heterogeneity matters. Cancer incidence and mix in the Kurdistan region differ from those in Basra, consistent with different exposure profiles and service configurations.[18] Karbala has seen a rising incidence, but without the same proximity to oil production.[26] These comparisons make a simple point. Iraq needs a national plan, but it also needs region-specific priorities. For Basra, environmental and occupational risk reduction deserves equal footing with screening and treatment capacity.

Breast cancer's leading position among women in Basra mirrors national and global experience.[23,24,33,34] The fastest way to change outcomes is to shift the stage at diagnosis. That means awareness and access. Clinical breast examination in primary care, timely diagnostic imaging, and clear referral lines help. Mobile mammography, weekend clinics, and women-led outreach can be tailored to local norms. It is also sensible to fold risk factor counselling into routine visits, focusing on weight management and smoking reduction, which have broader health benefits.

Colorectal and stomach cancers were common in our sample, as they are across Iraq and the region.[22,23,26] Food patterns, water quality, smoking, and infection all play roles. In Basra, co-exposure to hydrocarbons and metals could add risk by increasing chronic inflammation and oxidative stress. Faecal immunochemical testing with colonoscopy for positives is a realistic starting point for colorectal screening in constrained settings. Parallel work on safe water, food hygiene, and tobacco control will help bend the curve.

The prominence of hematologic cancers, particularly in men, and the prior documentation of childhood leukaemia clusters in Basra,[25,26] justify focused attention. Global analyses show a rising burden of blood cancers,[35,36] but Basra's levels and context require a local plan. A practical step is to enrich the regional registry with standardised exposure histories for cases of leukaemia and lymphoma, including geocoded residence and employment. This builds the dataset needed for more definitive studies, and it provides a basis for targeted worker health programmes now. Schools and primary care clinics can help with early symptom awareness for families.

The burden we describe is made worse by delays along the care pathway. Diagnostic services access varies, with limited imaging and pathology capacity outside major cities.[7] Referral routes are not always clear, so patients may move from clinic to clinic before they arrive at a centre that can diagnose and treat them. Radiotherapy is concentrated, chemotherapy supply can be inconsistent, and travel costs are real barriers. Families reported lost income and the practical strain of travel and accommodation during treatment. These are not marginal issues. They shape when and whether people seek care.

There are strengths to build on. Primary care remains widespread and is a realistic platform for awareness and early triage. Nurses and community health workers are trusted and can deliver simple but important interventions, including breast awareness, tobacco counselling, and symptom checklists. Recent investments in registry infrastructure[20,21] are positive and can be extended by adding community-sourced data. Our experience suggests families are willing to talk about cancer when approached respectfully and when confidentiality is clear.

As this is a cross-sectional prevalence study, we cannot measure incidence or observe trends over time. We cannot establish causation, only association and coherence with other sources. We relied on family reporting for case identification, and although we required documentation, recall bias about dates and care pathways is still possible. Migration and temporary treatment-related relocation could have led to under- or over-counting in some neighbourhoods. We did not stratify by socioeconomic status, which limits our understanding of inequality in exposure and access. Nor did we directly measure pollutants or collect detailed occupational histories, so environmental links remain inferential.

At the same time, several features add weight to the findings. Families were willing to share documentation and medical records, which is not trivial in this context. Our method avoided a common weakness of official registries: the exclusion of patients diagnosed or treated abroad. By recording these cases, we captured a fuller picture of prevalence. The survey timing, during relative stability, reduces the chance that data were distorted by temporary crises. Most importantly, our results align with hospital series,[20] household surveys,[25] and national trends,[19,20,26,27] and they are biologically plausible given Basra's exposures.[10,11,29,30]

Looking ahead, future research should move beyond prevalence. Longitudinal cohort studies are needed to link exposures with incident cancers. Environmental monitoring of air, water, and soil should be paired with biomarker studies. Intervention research can test whether mobile, women-staffed breast screening improves uptake, and whether primary care colorectal screening via faecal testing is feasible. Qualitative work with families can clarify barriers to timely care. These steps will make the next round of evidence stronger and more actionable.

While our study has limitations, its community-based design and diagnostic verification strengthen confidence in the findings. The priority now is to strengthen surveillance, address environmental hazards, and implement culturally sensitive screening and prevention. Lessons from Basra can guide responses in other regions facing the intertwined challenges of industrialisation, weak health systems, and post-conflict environments.

5. Conclusion

This study highlights a measurable cancer burden in Basra and underscores the need for a comprehensive cancer-control strategy. Cancer control cannot rely on treatment

alone, but also requires a strengthened surveillance system, culturally appropriate screening and awareness programs, enhanced registry systems that include community data, and expanded oncology capacity outside Baghdad. Preventive strategies such as tobacco control and vaccination must be scaled up. Basra should be treated as a sentinel site for Iraq's broader non-communicable disease agenda. By aligning action with WHO targets,[1,33,] Iraq can start to reduce premature mortality from cancer.

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Conflict of interest

The authors declared that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

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Ethics approval and consent to participate

The project required ethical and governance approval (approval ID: 845), which was obtained from the Medical Research Unit in Basrah before the beginning of the study. Informed consent for publication was obtained from the participants.

Consent for publication

Informed consent for publication was obtained from the participants.

Availability of data

Data is available from the corresponding author upon reasonable request.

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