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Research Article

Epidemiological Characteristics of Lung Cancer Patients in the Middle Euphrates Region of Iraq: Retrospective Analysis from the Middle Euphrates Cancer Center (2018-2023)

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Abstract

Background: Lung cancer is a significant public health issue in the Middle Euphrates region of Iraq. ***Objective***: To identify socio-epidemiologic and histopathologic patterns of lung cancer patients in this region. ***Methods***: Medical records of lung cancer patients registered at the Middle Euphrates Cancer Center (January 2018 to December 2023) were analyzed. Demographic information and histopathologic classifications were reviewed. All confirmed lung cancer cases were included, while cases with incomplete data were excluded. ***Results***: A total of 1,162 patients were included, with a mean age at diagnosis of 64.47 years. The majority (64.4%) were over 60 years of age, and those between 40 and 60 years of age (34%). Males accounted for 68% of cases, with a male-to-female ratio of approximately 2:1. Patients with low or no formal education comprised 87.9% of the study population. The most prevalent subtype was squamous cell carcinoma (SCC), with adenocarcinoma (AC) coming in second at 37% and small cell lung cancer (SCLC) coming in third at 10.5%. While SCC remained the predominant subtype, AC incidence increased over time (31.7% in 2018 *vs*. 41.4% in 2023), particularly among females, younger individuals, and those with higher education. The proportion of NSCLC-NOS diagnoses declined from 11.1% in 2018 to 3.2% in 2023. ***Conclusions***: Lung cancer remains a major health concern, especially among older individuals. The rising incidence of AC underscores the need for enhanced screening strategies, targeted prevention programs, and tailored treatment approaches to address evolving risk factors.

Keywords: Epidemiology, Histopathological types, Lung cancer, Middle Euphrates region.

الخصائص الوبائية لمرضى سرطان الرئة في منطقة الفرات الوسطى في العراق: تحليل بأثر رجعي من مركز الفرات الأوسط للسرطان (2018-2023)

الخلاصة

الخلفية: يعد سرطان الرئة مشكلة صحية عامة مهمة في منطقة الفرات الأوسط في العراق. **الهدف**: تحديد الأنماط الاجتماعية الوبائية والنسيجية المرضية لمرضى سرطان الرئة في هذه المنطقة. **الطرائق**: تم تحليل السجلات الطبية لمرضى سرطان الرئة المسجلين في مركز الفرات الأوسط للسرطان (يناير 2018 إلى ديسمبر 2023). تمت مراجعة المعلومات الديموغرافية والتصنيفات النسيجية المرضية. تم تضمين جميع حالات سرطان الرئة المؤكدة، بينما تم استبعاد الحالات ذات البيانات غير المكتملة. **النتائج**: تم تضمين ما مجموعه 1,162 مريضا بمتوسط عمر عند التشخيص 64.47 عاما. كانت الغالبية (64.4٪) فوق سن 60 عاما، وأولئك الذين تتراوح أعمارهم بين 40 و 60 عاما (34٪). وشكل الذكور 68٪ من الحالات، حيث بلغت نسبة الذكور إلى الإناث حوالي 2:1. شكل المرضى الذين لديهم تعليم رسمي منخفض أو معدوم 87.9٪ من مجتمع الدراسة. كان النوع الفرعي الأكثر انتشارا هو سرطان الخلايا الحرشفية (SCC)، حيث جاء السرطان الغدي (AC) في المرتبة الثانية بنسبة 37٪ وسرطان الرئة ذو الخلايا الصغيرة (SCLC) في المرتبة الثالثة بنسبة 10.5٪. بينما ظل SCC هو النوع الفرعي السائد، زاد معدل تسجيل الحالات بمرور الوقت (31.7٪ في عام 2018 *مقابل* 41.4٪ في عام 2023) ، لا سيما بين الإناث والأفراد الأصغر سنا وأولئك الحاصلين على تعليم عال. انخفضت نسبة تشخيصات NSCLC-NOS من 11.1٪ في عام 2018 إلى 3.2٪ في عام 2023. **الاستنتاجات**: لا يزال سرطان الرئة مصدر قلق صحي كبير، خاصة بين كبار السن. يؤكد ارتفاع معدل الإصابة بالتيار المتردد على الحاجة إلى استراتيجيات فحص معززة وبرامج وقائية مستهدفة ونهج علاجية مصممة خصيصا لمعالجة عوامل الخطر المتطورة.

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INTRODUCTION

As the most common and deadly cancer globally, lung cancer continues to pose a serious threat to global health. Lung cancer accounted for 18.4% of all cancer deaths (1.8 million deaths) and 11.4% of all new cancer diagnoses (2.2 million cases) worldwide, according to data from the Global Cancer Observatory (GLOBOCAN) 2020 [1]. Because males have historically used tobacco more than women, the male-to-female ratio of lung cancer incidence varies by location but is generally higher in men. In high-income countries, the gender gap is narrowing due to lower male rates and growing female rates in recent decades [2]. Cigarette smoking is the leading cause of lung cancer, accounting for 80-85% of all cases, making it the main risk factor for lung cancer [1]. Other risk factors include occupational exposure to poisons like radon and asbestos, environmental contaminants, and a history of long-term lung issues

[3]. Familial history and genetic predisposition are additional risk factors. Histopathology distinguishes two types of lung cancer: small cell lung cancer (SCLC), which is aggressive and rapidly progresses, and non-small cell lung cancer (NSCLC), which includes adenocarcinoma (AC), squamous cell carcinoma (SCC), large cell carcinoma (LCC), and other less common entities. AC has increased in prevalence in recent years, owing in part to changes in cigarette composition and smoking behaviors [2]. Epidemiologic trends reveal that the incidence and death rate from lung cancer in high-income countries are decreasing because of successful tobacco control programs and advances in early detection and treatment [1]. However, the burden continues to rise in many low- and middle-income countries due to increased tobacco use, limited access to medical resources, and a lack of effective cancer screening and education initiatives [3]. Lung cancer is one of the most common malignancies identified in Iraq, and more specifically in the Middle Euphrates region, especially in men. According to data from the Iraqi Cancer Registry and regional studies, the incidence of lung cancer has gradually increased. These increases are probably caused by increased tobacco use, air pollution, and exposure to environmental toxins from industrial operations and regional conflicts [3,4]. In line with worldwide trends, a greater male-to-female incidence ratio is noted. Nevertheless, inadequate screening initiatives and postponed diagnoses lead to subpar results in these domains. To properly address this expanding health issue, more regional research and updated registries are necessary [4]. This study aimed to identify socio-epidemiologic and histopathologic patterns of lung cancer patients in this region.

METHODS

Study design and setting

This retrospective analysis used medical records from lung cancer patients registered at the middle Euphrates cancer center in Iraq between January 2018 and December 2023.

Data and outcome measurements

Data collection involved demographic and clinical information such as number of registered patients, age, gender, histopathological classification, governorate of residency, and educational level. Data were extracted using a structured data collection form and then analyzed to discover patterns and relationships between demographic and clinical factors.

Inclusion criteria

The inclusion criteria included all confirmed instances of lung cancer that occurred over the indicated time period. Exclusion criteria included incomplete data or cases with disputed diagnoses, as well as those with non-lung cancer as the primary diagnosis.

Ethical considerations

Ethical approval was obtained from the Middle Euphrates Cancer Center and the Najaf Health Directorate Ethical Committee, ensuring confidentiality and compliance with international research ethics standards. No patient consent was needed as the study involved data collected from patients' reports.

Statistical analysis

The statistical analysis was carried out using IBM SPSS Statistics version 26. Descriptive statistics, including frequencies, percentages, means ± standard deviation, and quartiles, were used to summarize the data. The chi-square test was used to explore the correlations between categorical variables with a *p*-value significance level of < 0.05.

RESULTS

A total of 1162 patients were included in this study. The mean age at diagnosis is 64.47±11.45 years and a median of 66 years. The 25th percentile is 57 years, and the 75th percentile is 72 years, with a range of 23-106 years. The distribution of cases across age groups forms a roughly bell-shaped pattern skewed toward older ages. Very few cases appear in individuals younger than 40, and even in the 40–49 age range, the numbers remain relatively low. As age increases, the count rises substantially, reaching its peak in the 65–69 and 70–74 age groups. Beyond these peak ranges, there is a gradual decrease in the number of cases, though the counts remain higher for ages above 50 than for younger populations (Figure 1).

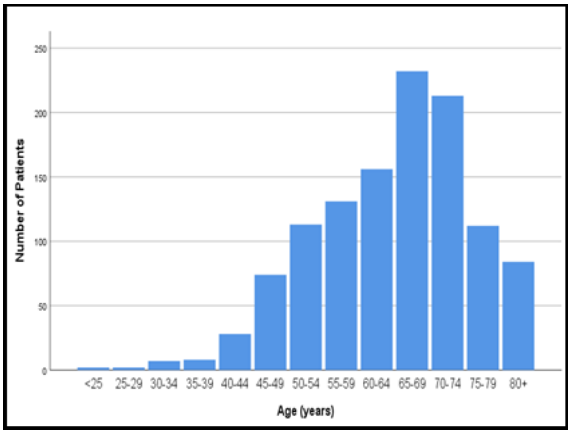

Figure 1: Distribution of lung cancer patients according to age groups.

Table 1 shows a detailed summary of lung cancer cases, categorized by gender, age, education level, histopathology, year of diagnosis, and geographical distribution (governorate). The data highlights the distribution and trends in lung cancer cases across these variables. Male patients account for approximately 68% of the total population, while female patients represent about 32%. The annual male-to-female ratios showed fluctuation over the

study period, ranging between a minimum of 1.8 in 2018 and a maximum of 2.68 in 2021 (Figure 2).

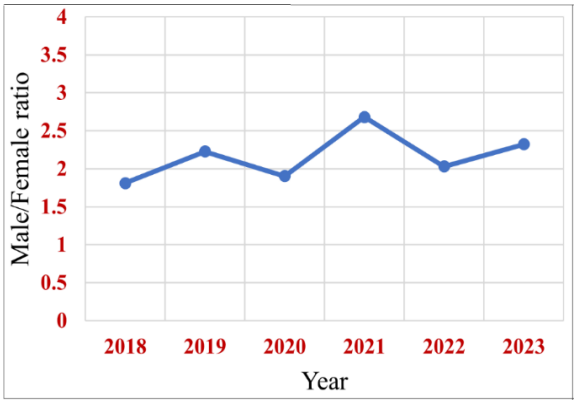

Figure 2: Annual male-to-female lung cancer incidence ratio.

Regarding the educational level of the sample studied, over half of the patients (54.7%) are categorized as illiterate, and an additional third (33.2%) have a low educational level. Together, these two groups represent the vast majority (87.9%) of the study population. Such a demographic profile suggests that limited formal education is a common characteristic among these patients. A relatively small proportion (12.2%) falls into the intermediate education category, and a very small fraction (0.3%) have a high level of education (Table 1). The data concerning the governorates indicates that the Middle Euphrates Center in Najaf primarily serves its immediate region, with the vast majority of registered lung cancer cases originating in Najaf itself (41.8%). This predominance is to be expected, as patients typically seek care at the nearest specialized medical facilities. In addition to Najaf, a significant proportion of cases come from Baghdad and Dhi-Qar, accounting for about 16% and 19 % of the total, respectively. This shows that the center is not just a local service provider but also a regional referral hub attracting patients from these areas. In contrast, the contributions from other governorates, namely, Muthanna, Qadisiyah, Wasit, Maysan, and Babylon, are relatively modest but still meaningful.

Table 1: Distribution of lung cancer patients according to socio-demographic and clinical characteristics

	Criteria	n(%)	*p*-value
Gender	Male	790(68.0)	<0.0001
	Female	372(32.0)	
Age	<40 years	19(1.6)	<0.0001
	40 - 60 years	395(34.0)	
	> 60 years	748(64.4)	
Education Level	Illiterate	636(54.7)	<0.0001
	Low Education	386(33.2)	
	Intermediate Education	137(11.8)	
	High Education	3(0.3)	
Histopathology	SCC	484(41.7)	<0.0001
	AC	430(37.0)	
	SCLC	122(10.5)	
	NSCLC-NOS	88(7.6)	
	LCC	20(1.7)	
	Carcinoid	9(0.8)	
	Epithelial Carcinoma	1(0.1)	
	Lymphoepithelioma-like	1(0.1)	
	ASC	7(0.6)	
Year	2018	208(17.9)	0.015
	2019	229(19.7)	
	2020	180(15.5)	
	2021	162(13.9)	
	2022	197(17.0)	
	2023	186(16.0)	
Governorate	Najaf	486(41.8)	<0.0001
	Nineveh	5(0.4)	
	Erbil	7(0.6)	
	Duhok	2(0.2)	
	Diyala	13(1.1)	
	Saladin	1(0.1)	
	Al-Anbar	1(0.1)	
	Muthanna	94(8.1)	
	Qadisiyah	44(3.8)	
	Dhi Qar	195(16.8)	
	Basra	8(0.7)	
	Wasit	39(3.4)	
	Baghdad	226(19.4)	
	Maysan	31(2.7)	
	Babil	10(0.9)	

Chi-square test is used to characterize significance at $p<0.05$.

There are also minimal numbers from the northern and western governorates, including Nineveh, Erbil, Duhok, Saladin, and Al-Anbar. Regarding the histopathologic types, the data shows that SCC and AC are the two most predominant types, together accounting for the vast majority of cases. SCC slightly surpasses adenocarcinoma, but their proportions are nearly balanced, with both making up around 80% of all observed tumors. Small cell lung cancers (SCLC) also represent a notable portion, albeit at a considerably lower level than the two main categories (nearly about 10%). The remaining categories, such as

non-small cell lung cancers—not otherwise specified (NSCLC-NOS), large cell carcinoma (LCC), carcinoid tumors, and more rare variants—are collectively present in only a small fraction of the population. Table 2 presents the distribution of histopathologic subtypes of lung cancer cases as determined by other patients' characteristics, including the year of diagnosis, the gender, the age group, and the educational level.

Table 2: Distribution of lung cancer histopathological subtypes by year, age group, gender, and educational level

Characteristic		Histopathological Types n(%)									*p*-value
		SCC	AC	SCLC	NSCLC-NOS	LCC	C	EC	LE-Like	ASC	
Year	2018	90(43.3)	66(31.7)	21(10.1)	23(11.1)	3(1.4)	2(1.0)	1(0.5)	1(0.5)	1(0.5)	0.032
	2019	89(38.9)	77(33.6)	21(9.2)	34(14.8)	4(1.7)	3(1.3)	0(0.0)	0(0.0)	1(0.4)	
	2020	80(44.4)	69(38.3)	18(10.0)	10(5.6)	3(1.7)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	
	2021	66(40.7)	61(37.7)	22(13.6)	7(4.3)	5(3.1)	1(0.6)	0(0.0)	0(0.0)	0(0.0)	
	2022	79(40.1)	80(40.6)	23(11.7)	8(4.1)	3(1.5)	1(0.5)	0(0.0)	0(0.0)	3(1.5)	
	2023	80(43.0)	77(41.4)	17(9.1)	6(3.2)	2(1.1)	2(1.1)	0(0.0)	0(0.0)	2(1.1)	
Age (year)	<40	5(26.3)	9(47.4)	0(0.0)	2(10.5)	0(0.0)	3(15.8)	0(0.0)	0(0.0)	0(0.0)	<0.0001
	40-60	138(34.9)	176(44.6)	45(11.4)	20(5.1)	9(2.3)	4(1.0)	0(0.0)	1(0.3)	2(0.5)	
	>60	341(45.6)	245(32.8)	77(10.3)	66(8.8)	11(1.5)	2(0.3)	1(0.1)	0(0.0)	5(0.7)	
Gender	M	373(47.2)	253(32.0)	90(11.4)	51(6.5)	14(1.8)	5(0.6)	1(0.1)	1(0.1)	2(0.3)	<0.0001
	F	111(29.8)	177(47.6)	32(8.6)	37(9.9)	6(1.6)	4(1.1)	0(0.0)	0(0.0)	5(1.3)	
Education	Illiterate	282(44.3)	219(34.4)	57(9.0)	59(9.3)	12(1.9)	2(0.3)	0(0.0)	1(0.2)	4(0.6)	0.001
	Low	164(42.5)	146(37.8)	46(11.9)	17(4.4)	4(1.0)	6(1.6)	1(0.3)	0(0.0)	2(0.5)	
	Intermediate	38(27.7)	64(46.7)	18(13.1)	12(8.8)	3(2.2)	1(0.7)	0(0.0)	0(0.0)	1(0.7)	
	High	0(0.0)	1(33.3)	1(33.3)	0(0.0)	1(33.3)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	

Chi-square test is used to characterize significance at $p<0.05$. SCC: squamous cell carcinoma, AC: adenocarcinoma, SCLC: small cell lung cancer, NSCLC-NOS: non-small cell lung cancer-not otherwise specified, LCC: large cell carcinoma, C; carcinoid tumor, EC: epithelial carcinoma, LE-like: lymphoepithelioma-like carcinoma, ASC: adenosquamous carcinoma.

Figure 3 shows the annual distribution of the registered cases according to histologic type. The significant observations include the noticeable reduction in the total number of patients during the period between 2020 and 2021, with recovery over the subsequent years. SCC (41.7%), AC (37.0%), and SCLC (10.5%) are the three most frequent histopathologies over the six-year period from 2018 to 2023. Although SCC consistently holds the highest proportion overall, the percentage of AC increases noticeably in certain years—rising from 31.7% in 2018 to over 40% in 2022 and 2023. The SCLC incidence showed less variability, fluctuating between 9% and 13% across the years. Less common entities, such as LCC, carcinoid, lymphoepithelioma-like carcinoma, and ASC, remained more stable, each accounting for less than 2% in any given year. While NSCLC-NOS cases have undergone significant decline over the study period. Overall, the trends over time between the main histologic types—SCC, AC, and SCC—are nearly stable over the study period, except for the noticed dip in 2020-2021.

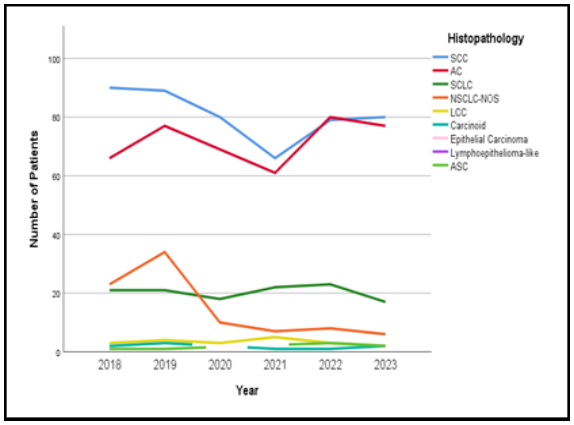

Figure 3: Trends in lung cancer subtypes over time (2018–2023).

Also, the difference in incidence between SCC, which remains slightly more common, and AC has gradually narrowed over the years. When comparing the distribution of cases according to histopathologic types in 2018 and 2023 (Figures 4 and 5), we can see that SCC was the dominant subtype in 2018, making up nearly 44% of cases compared to about 32% for AC. Other types, such as SCLC, LCC, and NSCLC-NOS, occupied smaller but still meaningful portions of the distribution, with NSCLC-NOS notably contributing around 9.6%. By 2023, AC cases had grown significantly, reaching almost 42% and coming close to SCC, which remained almost stable and accounted for 43% of the cases studied.

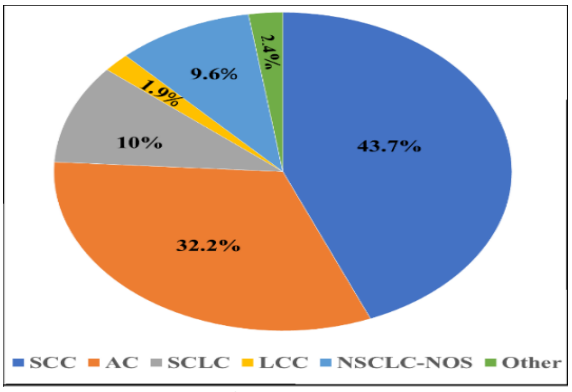

Figure 4: Distribution of lung cancer subtypes in 2018.

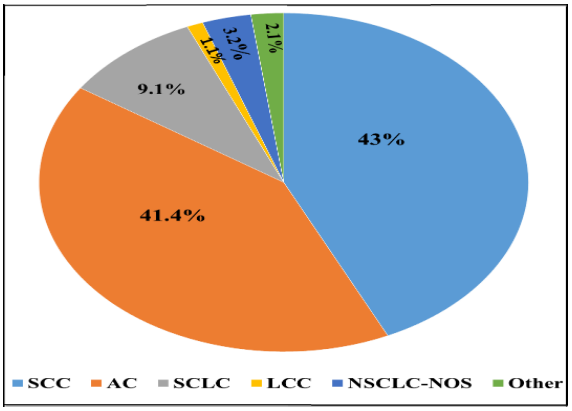

Figure 5: Distribution of lung cancer subtypes in 2023.

On the other hand, while the frequency of SCLC and other less common entities remained nearly the same, there is a significant reduction in the number of NSCLC-NOS, reaching about 3.2% in 2023. When distributing the histologic types according to gender (Figure 6), the significant observations include that while SCC represents the most prevalent category in males, with an obviously higher number of patients being classified as SCC than AC (47.2% vs. 32.2%). In contrast, AC is more common than SCC in females (47.6% vs. 30.4%).

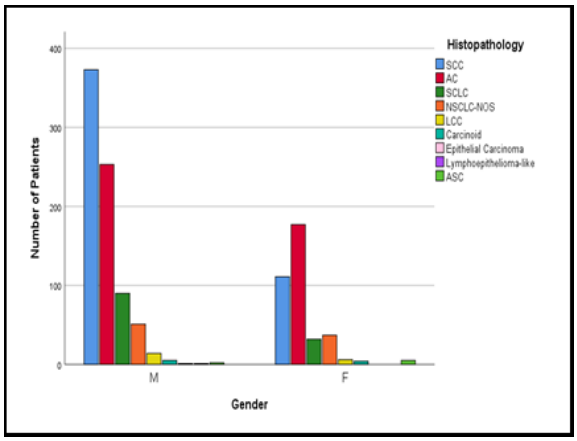

Figure 6: Gender-wise distribution of patients by histopathologic types.

Other histopathology types, such as SCLC, NSCLC-NOS, LCC, and other less common entities, are less frequent in both genders, but males consistently have higher counts for all other subtypes compared to females. Furthermore, the age-wise distribution of patients (Figure 7) reveals that younger individuals show a higher incidence of adenocarcinoma than squamous cell carcinoma (44.8% vs. 34.9% among those aged 40–60 years and 47.8% *vs*. 26.3% in those under 40 years).

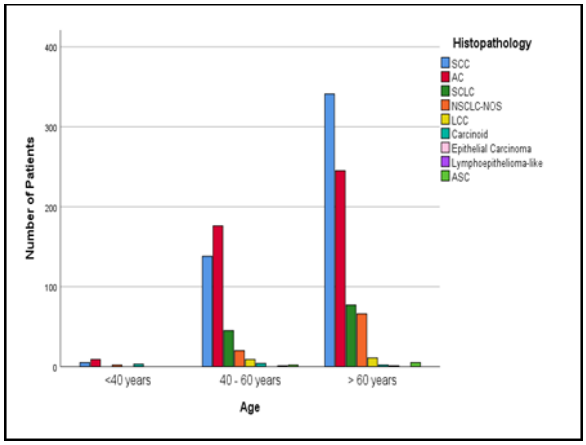

Figure 7: Age-wise distribution of patients by histopathologic types.

In contrast, squamous cell carcinoma predominates in older patients (>60 years), accounting for 46% of cases compared to 32.8% for adenocarcinoma. Small cell lung cancer only appears in individuals over 40 years old, with similar rates in the 40–60 and over-60 age groups. Notably, carcinoid tumors are found more often in younger patients (<40 years), whereas the remaining subtypes tend to affect older populations. Lastly, when comparing the histopathologic types according to the educational status of the patients (Figure 8), there are also some significant observations. Although the number of patients with high educational levels is minimal and difficult to compare, we can notice that the percentage of patients with AC tends to rise significantly with higher educational attainment. Obviously, in the intermediate education group, AC (46.7%) surpasses SCC (27.7%) as the leading subtype. Conversely, SCC remains predominant in illiterate and low-education cohorts, accounting for 44.7% vs. 34.6% and 42.5% vs. 37.8%, respectively. Other types, including SCLC, NSCLC-NOS, and less common variants, do not show significant variation across different educational levels.

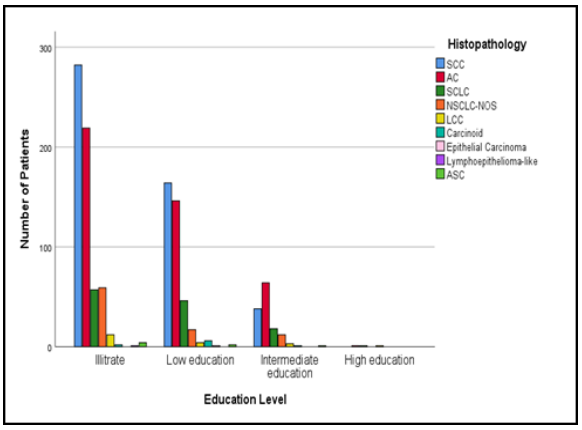

Figure 8: Distribution of histopathologic types by education level.

DISCUSSION

Lung cancer remains a major public health challenge in Iraq and the most common malignancy in incidence and mortality among males. According to Iraqi cancer registry statistics, the mean age at diagnosis is 66.2, and the median is 68 years, with the highest mortality rates registered in Najaf city, which represents the center of the Middle Euphrates region [4]. The data of the current study indicates that lung cancer diagnoses are most common among individuals in their mid-to-late 60s, with a central concentration around the late 60s to early 70s. While the patient population spans a remarkably broad age range, the majority are clustered within a relatively narrow band of older adulthood. The pattern of age distribution (Figure 1) suggests that lung cancer incidence is strongly associated with advancing age, with the bulk of cases occurring in older adults. The sharp increase in middle to late adulthood highlights the importance of targeted screening and preventive measures in these age groups. The natural mortality curve and the comorbidities in this age group that prevent the interventional procedures necessary for the disease's diagnosis could both be contributing factors to the decline after the early 70s. This age-specific distribution of lung cancer incidence has also been reported in other studies conducted in nearby Arab and Middle Eastern region countries [5,6]. Regarding the patients' distribution according to their gender,

Such a male-skewed distribution is not uncommon in lung cancer epidemiology, where historically, higher rates of lung cancer have been associated with men, often due to factors like higher historical smoking prevalence or occupational exposures [7]. However, although the gender gap in lung cancer incidence has been narrowing over time in many regions [6], the male-to-female ratios of lung cancer incidence in the Middle Euphrates region showed modest fluctuations between 2018 and 2023 but remained consistently above 2:1 in most years (Figure 2). This trend aligns with smoking behavior patterns observed in many Middle Eastern populations, where tobacco use is more common among men. When making comparisons with male-to-female incidence ratios in the neighboring countries [5,8,9], similar or even higher ratios have been documented. In contrast, some nearby countries with growing female smoking rates have reported a narrowing gap, although men still predominate in overall lung cancer incidence [1,10]. The obvious disparity in educational levels of the patients highlights a critical sociodemographic aspect of the study cohort. The predominance of limited educational achievement may have implications for different aspects of lung cancer prevention, early detection, and adherence to treatment plans, as the individuals with lower education levels may be less aware of risk factors (such as smoking, environmental exposures, or occupational hazards) and have more difficulty navigating healthcare systems or understanding and following medical advice [11]. Ultimately, the data reveals that the patient population might benefit from increased educational outreach and support to improve health outcomes. From a public health perspective, these findings underscore the need for targeted educational interventions, culturally appropriate health communication strategies, and community-based support systems. Addressing such educational gaps could improve health literacy, encourage earlier detection, and ultimately enhance patient outcomes [12]. While the data here does not explain causality, it serves as an important indicator of the socioeconomic and educational context in which these patients live, prompting further investigation into how education and related factors influence lung cancer incidence, severity, and mortality. The Middle Euphrates region, which is in the center of Iraq and includes the five governorates of Babil, Najaf, Karbala, Qadisiyah, and Muthanna, makes up roughly 22.7% of the country's total area [13]. Although most of these governorates have their own specialized cancer centers, the Middle Euphrates Cancer Center is still receiving a significant proportion of patients from those and other Iraqi governorates given its central location in the Middle Euphrates region, well-known reputation, and available expertise and facilities in radiotherapy and new cancer therapies. The substantial representation from Dhi-Qar may be explained by the relative lack of nearby specialized centers or trust in the Najaf facility’s services. The notable number of patients from Baghdad, despite the capital’s extensive healthcare infrastructure, indicates that the center provides certain specialized treatments, shorter waiting times, and unique expertise that draws patients even from areas well outside the Middle Euphrates region. The less but still meaningful share from Muthanna, Qadisiyah, Wasit, Maysan, and Babil governorates points to the broader role of the center in serving the southern and central Iraqi population. This pattern is likely influenced by factors such as transportation ease, existing referral patterns, and physician-to-physician links. On the other hand, the minimal contribution from the northern and western governorates likely reflects geographical distance, travel difficulty, and the availability of oncology services closer to those regions. Patients generally prefer treatment centers that are more accessible and better integrated into their local healthcare systems. Given that places like Erbil and Duhok have their own well-established healthcare infrastructures, it is logical that relatively few patients would seek treatment so far away. In summary, the distribution of patients by governorate shows that the Middle Euphrates Cancer Center in Najaf functions as both a primary local treatment center and a secondary regional referral destination. Differences in patient numbers across governorates are shaped by proximity, healthcare infrastructure variations, referral networks, and patient preferences, as well as broader systemic and sociocultural factors influencing where individuals choose to receive oncological care. When coming to the histopathologic distribution of lung cancer patients in the Middle Euphrates region, one can notice that it aligns with common global patterns, where SCC and AC are the most frequently encountered histological types in many lung cancer registries [14]. The prevalence of these two categories may influence diagnostic priorities, therapeutic targets, and resource allocation for early detection and treatment. Furthermore, the presence of a small but significant percentage of SCLC patients highlights the need for targeted therapies for this aggressive subtype. Although other histological categories are important, their rarity may hinder large-scale clinical research and budget allocation. The global trend indicates a shift towards a higher incidence of AC compared to SCC in lung cancer cases [15,16]. Regarding the trends of the main histologic types of lung cancer over the period between 2018 and 2023, although specific data on the percentages of AC and SCC in the Middle East over the past decade are limited, available studies suggest that the region mirrors global trends, with AC becoming increasingly prevalent, especially in non-smokers [6,17]. These results show that the risk factors that cause lung cancer are changing around the world [18]. These factors include people's smoking habits and possibly new effects of environmental exposures. These findings underscore the need for enhanced cancer surveillance and research in the region to obtain more accurate and up-to-date data. Meanwhile, NSCLC-NOS has a declined relative frequency, indicating a possible improvement in diagnostic specificity and more accurate histopathologic classification due to better diagnostic facilities and reporting system advancement, which comes in parallel with the progress in lung cancer diagnosis worldwide [19]. The noted dip in the total cases and major lung cancer subtypes during the

period between 2020 and 2021 may be largely attributable to the COVID-19 pandemic, which severely affected healthcare systems around the same period. Because of the lockdown limitations, limited access to healthcare institutions, or fear of exposure, many individuals may have postponed or avoided getting medical care, including a cancer diagnosis and treatment. Additionally, many individuals were misdiagnosed or had their diagnoses delayed due to the similarity between the symptoms of COVID-19 and lung cancer [20]. It's possible that hospitals gave priority to COVID-19 cases, which limited their ability to provide normal or non-urgent medical services like cancer reporting and diagnosis. Lack of medical personnel or their redistribution to pandemic-related services may also have contributed to delays in diagnosis or fewer cancer screenings. The possibility that fewer cases were reported while diagnostic labs or cancer clinics were temporarily closed. Data collection and reporting for other illnesses, such as cancer instances, may have been delayed as a result of the period's emphasis on the pandemic [21]. Additionally, the pandemic's economic effects might have affected people's ability to receive healthcare, especially in areas where the cost of care is a barrier. Recorded frequencies may have been impacted by patients delaying or skipping medical appointments due to financial problems [22]. Curfews, travel restrictions, and lockdowns enforced by the government may have made it more difficult for people to receive medical care in 2020–2021. In addition, patients may have changed their attitudes as a result of their fear and concern about COVID-19, refusing to get regular check-ups or diagnostic tests [23]. These elements most likely played a major role in the observed decline, either separately or in combination. Moreover, data shows that men tend to have disproportionately higher rates of SCC compared to women, reflecting longstanding patterns of heavier and more prolonged tobacco use among male populations. Among women, AC shows a higher frequency relative to other histological subtypes and has become the most frequently diagnosed lung cancer subtype in many regions, partly due to changing smoking behaviors and possibly distinct biological susceptibilities [1], and this aligns with the findings of the current study in which more than 47% of the female patients were classified as AC. SCLC, which is also strongly linked to smoking, is more common in men but still present in a notable fraction of women. These results are in line with larger epidemiologic evidence that shows how smoking rates, work-related exposures, and possible genetic factors can interact to create differences in lung cancer histopathology between men and women [2]. Additionally, in this study, lung cancer diagnoses concentrate predominantly in older age groups, with SCC and AC showing a pronounced rise in individuals over 40 years. This pattern is similar to epidemiological data from nearby countries, which show how risk factors like smoking for a long time and being exposed to chemicals at work can build up over time and show up more clearly in later years of life [6,8]. SCLC also shows higher frequency with increasing age, reflecting a strong correlation with cumulative tobacco exposure and underscoring the importance of smoking prevention and cessation in cancer control strategies [24]. A noticeable pattern is that SCC and AC predominate in individuals with lower education, particularly among those classified as illiterate and those with low educational attainment. This finding fits with others that say people with less education are more likely to smoke and be exposed to other things at work or in their environment that raise the risk of lung cancer types that are strongly linked to smoking, like SCC and SCLC [2]. In contrast, more educated groups in this study show markedly fewer cases across nearly all histopathological categories, possibly reflecting lower smoking prevalence and better awareness or avoidance of harmful exposures. Studies have demonstrated that smoking prevalence often correlates inversely with educational level, thereby driving the incidence of smoking-related lung cancers in populations with lower educational attainment [25]. AC, despite being relatively more common in both smokers and never-smokers compared to other subtypes, remains influenced by smoking intensity and duration; heavy or long-term smoking patterns are more often observed in socioeconomically disadvantaged populations [7].Variability in histological distributions across educational classes may also be partially explained by variability in the access to health care, availability of screening, and differences in preventive health behaviors [11].

Study limitations

Study limitations may include selection bias, as it is limited to a single center; the retrospective nature of the study; limited information about the possible risk factors and exposures; and a lack of data about the stages and survival of the patients in their records, which could provide further insight into the disease outcomes in specific groups of patients.

Conclusion

Lung cancer represents a significant public health concern in Iraq, particularly in the Middle Euphrates region. The incidence rates, which are primarily driven by the two predominant subtypes, squamous cell carcinoma (SCC) and adenocarcinoma (AC), indicate that SCC continues to be the predominant histopathology, with noticeable evolving trends in AC cases. While the majority of the affected individuals are elderly, male, and undereducated, AC is more common in younger populations, females, and those with higher educational achievement. These trends suggest evolving risk profiles that may involve changing smoking behaviors, environmental exposures, and possibly inherent biological variables. The decline in diagnoses of non-small cell lung cancer—not otherwise specified (NSCLC-NOS)—is probably due to advancements in molecular and histological classification in recent years. These results underscore the need for more comprehensive studies to emphasize the significance of patient-

tailored treatment plans, enhanced diagnostic capabilities, and focused preventive efforts.

Conflict of interests

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Data sharing statement

Supplementary data can be shared with the corresponding author upon reasonable request.

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