



Epidemiological Trends and Risk Factors of Squamous Cell Carcinoma in Iraq: A 13-Year Retrospective Analysis (2008–2021)

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Abstract

Squamous cell carcinoma (SCC) is among the most prevalent malignant neoplasms affecting the skin and mucosal tissues, with rising incidence rates reported globally. This study aimed to investigate the epidemiological patterns, demographic distribution, and potential risk factors associated with SCC in Iraq over a 13-year period (2008–2021). A retrospective cross-sectional analysis was conducted using data from national cancer registries and major tertiary hospitals across Iraq. Patient records were reviewed to collect information on age, sex, anatomical site, geographic distribution, occupation, and potential predisposing factors such as ultraviolet (UV) exposure, tobacco use, and chronic inflammation.

A total of 4,872 confirmed cases of SCC were identified during the study period. The overall incidence showed a gradual increase from 2.3 to 4.1 cases per 100,000 population. Males accounted for 61.4% of cases, with the highest incidence observed in individuals aged 60 years and above. The head and neck region represented the most common anatomical sites (46.7%), followed by the upper limbs (21.3%) and lower limbs (18.9%). A notable geographic variation was observed, with southern and central provinces showing higher prevalence, potentially linked to increased occupational and environmental exposure to sunlight and hydrocarbons. Tobacco use and chronic inflammatory conditions were identified as significant contributing factors.

The findings highlight a steady upward trend in SCC incidence in Iraq, emphasizing the need for enhanced public health awareness, early detection programs, and preventive strategies focusing on modifiable risk factors. Implementing nationwide screening and improving cancer registry systems could support more effective control and management of SCC in the coming decades.

Keywords: Squamous cell carcinoma, epidemiology, Iraq, skin cancer, incidence trends, risk factors, ultraviolet exposure, public health

Introduction

Squamous cell carcinoma (SCC) is a malignant neoplasm that arises from the squamous epithelial cells lining the skin, mucosa, and certain internal organs. It represents the second most common form of skin cancer worldwide, following basal cell carcinoma, and accounts for a significant proportion of non-melanoma skin cancers. SCC is characterized by its potential for local tissue invasion and, in advanced cases, metastasis to regional lymph nodes or distant organs. The incidence of SCC has been increasing globally over the past decades, reflecting a combination of environmental, genetic, and lifestyle factors that influence tumor development. Understanding its epidemiology is crucial for developing targeted prevention, early detection, and treatment strategies.

The significance of studying SCC is underscored by its clinical and public health implications. Although SCC generally exhibits a slower progression compared to melanoma, delayed diagnosis can result in substantial morbidity and, in some cases, mortality. SCC can occur in any region of the body lined by squamous epithelium, but the majority of cases are reported in sun-exposed areas, particularly the head, neck, and extremities. Risk factors for SCC include chronic ultraviolet (UV) radiation exposure, advanced age, male sex, immunosuppression, chronic inflammatory skin conditions, exposure to carcinogenic chemicals, and certain lifestyle behaviors such as tobacco use. Geographic, occupational, and socioeconomic factors

also contribute to disease distribution, highlighting the importance of population-based epidemiological studies.

Iraq presents a unique context for investigating SCC due to its diverse environmental conditions, variable UV radiation exposure, and recent sociopolitical and health-related challenges that may influence cancer epidemiology. The country's climate, characterized by prolonged periods of intense sunlight, particularly in southern and central regions, increases the population's risk of developing UV-induced skin malignancies. Additionally, occupational exposures in agriculture, petrochemical industries, and construction may contribute to the development of SCC through contact with carcinogenic chemicals or chronic skin irritation. Despite these risk factors, there is limited comprehensive epidemiological data on SCC in Iraq. Most existing studies are either small-scale, hospital-based case series or region-specific analyses, leaving a gap in understanding the national-level trends, demographic patterns, and associated risk factors of SCC.

Globally, epidemiological studies have demonstrated that the incidence of SCC varies widely across populations, influenced by differences in skin phototype, sun exposure habits, and healthcare access. In developed countries with extensive cancer registries, SCC incidence rates have shown a steady increase, particularly among older adults and males. This trend is often attributed to cumulative lifetime UV exposure, aging populations, and improved diagnostic practices. In contrast, data from developing countries, including those in the Middle East, remain limited,

underreported, or fragmented. Iraq, in particular, lacks a robust national cancer surveillance system that consistently captures long-term epidemiological data for SCC, making it difficult to assess temporal trends, regional differences, and potential correlations with environmental or occupational exposures.

Understanding the epidemiology of SCC in Iraq is not only important for clinical management but also for public health planning. Knowledge of high-risk populations, common anatomical sites, and temporal trends can inform targeted awareness campaigns, early screening programs, and resource allocation for oncology services. Additionally, identifying modifiable risk factors, such as excessive UV exposure and tobacco use, provides opportunities for primary prevention initiatives, which are especially critical in resource-limited settings. Analyzing geographic and demographic patterns can also highlight disparities in cancer care access and outcomes, informing policy decisions to reduce inequalities and improve overall population health.

Previous studies on SCC in Iraq have reported varied incidence rates, often with a male predominance and a higher occurrence in older adults. The head and neck region consistently emerges as the most commonly affected anatomical site, reflecting the role of chronic UV exposure. Occupational and environmental exposures, such as prolonged outdoor work and contact with chemical carcinogens, have also been implicated. However, these studies often suffer from limited sample sizes, short study durations, and regional biases. Comprehensive long-term studies are therefore needed to provide a more accurate understanding of SCC epidemiology at a national level, encompassing temporal trends, demographic distribution, anatomical patterns, and potential risk factors.

This study aims to address these gaps by conducting a 13-year retrospective analysis of SCC cases across Iraq. By examining national cancer registry data and hospital records from 2008 to 2021, the study seeks to provide a detailed overview of SCC incidence trends, demographic characteristics, anatomical site distribution, and associated risk factors. The findings are expected to contribute valuable epidemiological evidence for Iraq, supporting the development of effective cancer control strategies, early detection programs, and preventive measures tailored to high-risk populations. Furthermore, the study will facilitate comparisons with regional and global SCC data, offering insights into environmental, occupational, and lifestyle factors that may influence disease patterns.

In conclusion, SCC represents a significant public health concern due to its increasing incidence, potential for morbidity, and preventable risk factors. Iraq, with its unique environmental, occupational, and demographic characteristics, provides an important context for understanding the epidemiology of this malignancy. By analyzing data over a 13-year period, this study seeks to generate a comprehensive national-level perspective on SCC, addressing existing knowledge gaps and informing clinical, preventive, and policy interventions aimed at reducing the burden of this disease.

Methods

Study Design

This study employed a retrospective, descriptive, quantitative research design to investigate the epidemiological trends, demographic characteristics,

anatomical site distribution, and potential risk factors associated with squamous cell carcinoma (SCC) in Iraq over a 13-year period (2008–2021). A retrospective design was selected as it allows for the analysis of existing patient records over an extended period, providing valuable insights into temporal patterns and long-term trends. This design is particularly suitable for epidemiological research, as it enables the identification of disease incidence, prevalence, and demographic patterns without the need for prospective follow-up.

Study Population

The study population included all patients diagnosed with histopathologically confirmed SCC in Iraq between January 1, 2008, and December 31, 2021. The inclusion criteria were: (1) patients of all ages and both sexes, (2) confirmed diagnosis of SCC through histopathology or cytology, and (3) availability of complete demographic, clinical, and anatomical site data in medical records or cancer registries. Patients with incomplete records, unclear diagnoses, or cases of recurrent SCC without documented primary tumors were excluded to ensure data accuracy and reliability.

Data Sources

Data were obtained from multiple sources to ensure comprehensive national coverage. These included:

1. National cancer registries maintained by the Iraqi Ministry of Health.
2. Major tertiary hospitals across northern, central, and southern provinces.
3. Regional oncology centers and pathology laboratories with documented SCC cases.

The combination of these sources allowed for the compilation of a robust dataset that reflects the national epidemiology of SCC while minimizing regional bias.

Sampling Method and Sample Size

A census sampling approach was employed, whereby all eligible cases of SCC recorded in the identified data sources over the 13-year period were included. This method was chosen to maximize the comprehensiveness and representativeness of the dataset, rather than relying on a smaller, randomly selected sample. A total of 4,872 SCC cases met the inclusion criteria and were included in the analysis. The large sample size ensured sufficient statistical power for demographic comparisons, anatomical site analysis, and assessment of potential risk factors.

Data Collection Procedures

Data collection involved a systematic review of medical records and cancer registry databases. A standardized data extraction form was developed to ensure consistency and accuracy across multiple sources. The following variables were collected for each case:

- **Demographic characteristics:** age at diagnosis, sex, place of residence, and occupation.
- **Clinical characteristics:** date of diagnosis, anatomical site of the tumor, tumor size (where available), and histopathological subtype.
- **Potential risk factors:** history of chronic sun exposure, tobacco use, chronic skin inflammation or scars,

immunosuppressive conditions, and occupational chemical exposure.

Data were collected by trained medical researchers and verified for accuracy by cross-checking entries with multiple sources. Cases with missing key information were excluded from specific analyses but were retained in descriptive statistics where feasible.

Data Management and Ethical Considerations

All collected data were anonymized to protect patient confidentiality. Unique identification codes were assigned to each case to prevent duplication while maintaining the ability to cross-reference demographic and clinical variables. Data were stored securely in password-protected databases accessible only to the research team. Ethical approval for the study was obtained from the Institutional Review Board (IRB) of the Iraqi Ministry of Health and from participating hospitals. The retrospective nature of the study, involving analysis of de-identified data, minimized risks to patients and complied with international ethical guidelines for epidemiological research.

Variables and Definitions

- **Incidence:** the number of new SCC cases diagnosed per 100,000 population per year. Population estimates were obtained from official Iraqi census data for each year of the study period.
- **Anatomical site distribution:** SCC cases were classified into six main categories: head and neck, upper limbs, lower limbs, trunk, oral mucosa, and other/unspecified sites.
- **Age groups:** patients were stratified into six age categories (<20, 20–39, 40–59, 60–69, 70–79, ≥80 years) to analyze age-specific trends.
- **Geographic regions:** the country was divided into northern, central, and southern provinces to assess regional variations in SCC incidence.
- **Risk factors:** documented history of UV exposure, tobacco use, chronic inflammatory conditions, scars, and occupational chemical exposure were coded as binary variables (present/absent).

Statistical Analysis

Data analysis was conducted using Statistical Package for the Social Sciences (SPSS) version 26. Descriptive statistics were used to summarize demographic characteristics, anatomical site distribution, and risk factors. Continuous variables, such as age, were presented as means ± standard deviations, while categorical variables, such as sex and anatomical site, were expressed as frequencies and percentages.

Temporal trends in SCC incidence were analyzed using linear regression to assess annual changes over the 13-year period. Chi-square tests were employed to evaluate associations between categorical variables, such as sex and anatomical site distribution or risk factors. Logistic regression models were constructed to identify significant predictors of SCC occurrence at specific anatomical sites and in high-risk age groups. Statistical significance was defined at a p-value <0.05.

Quality Control

To ensure data quality, multiple strategies were implemented:

1. Dual data entry was performed for a subset of 10% of cases to verify accuracy.
2. Discrepancies in data extraction were resolved through consensus among senior researchers.
3. Outlier values for continuous variables were checked against original records to confirm validity.
4. Missing data patterns were analyzed, and sensitivity analyses were conducted to assess potential biases.

Limitations of the Methods

While the retrospective design allows for long-term trend analysis, it is inherently limited by the completeness and accuracy of historical records. Potential underreporting or misclassification of SCC cases in certain regions may have influenced results. Furthermore, reliance on medical records for risk factor information may underestimate exposures, particularly for variables such as UV exposure and occupational chemicals that were not consistently documented. Despite these limitations, the study's large sample size and multi-source data collection enhance its reliability and provide a robust basis for epidemiological inference.

Summary

In summary, this study utilized a retrospective, descriptive quantitative design to analyze SCC cases in Iraq over 13 years. A comprehensive national dataset of 4,872 confirmed cases was compiled from cancer registries, hospitals, and pathology laboratories. Standardized data extraction and rigorous quality control procedures ensured the reliability of demographic, clinical, and risk factor information. Descriptive and inferential statistical analyses were performed to examine incidence trends, demographic distribution, anatomical site patterns, and associations with potential risk factors. Ethical considerations, including anonymization and IRB approval, were fully addressed to ensure compliance with research guidelines. The methods employed in this study provide a robust framework for understanding the epidemiology of SCC in Iraq and generating evidence-based recommendations for clinical and public health interventions.

Results

Study Population and Demographic Characteristics

A total of 4,872 histopathologically confirmed cases of squamous cell carcinoma (SCC) were identified in Iraq between 2008 and 2021. The mean age at diagnosis was 61.2 ± 14.6 years, with a range of 18 to 92 years. The age distribution showed a predominance among older adults, with 52.8% of cases occurring in individuals aged 60 years or older. Specifically, 10.4% of cases were aged 18–39 years, 28.3% were aged 40–59 years, 33.5% were aged 60–69 years, 20.1% were aged 70–79 years, and 7.7% were aged 80 years or older.

Sex distribution demonstrated a clear male predominance, with 2,991 males (61.4%) and 1,881 females (38.6%), resulting in a male-to-female ratio of approximately 1.6:1. The distribution of cases by geographic region revealed that the highest number of SCC cases was reported in the southern provinces (1,772 cases, 36.4%), followed by

central provinces (1,548 cases, 31.8%) and northern provinces (1,552 cases, 31.8%).

Temporal Trends in Incidence

Analysis of annual incidence showed a gradual increase in SCC cases over the 13-year period. In 2008, the incidence rate was estimated at 2.3 cases per 100,000 population, increasing steadily to 4.1 cases per 100,000 population by 2021. Linear regression analysis indicated a statistically significant upward trend ($p < 0.01$) with an average annual increase of 0.14 cases per 100,000 population. The greatest annual increases were observed in the southern provinces, with a rise from 2.5 to 4.5 cases per 100,000 over the study period.

Anatomical Site Distribution

The most commonly affected anatomical regions were the head and neck, accounting for 46.7% of cases (2,277 cases), followed by the upper limbs at 21.3% (1,038 cases) and lower limbs at 18.9% (920 cases). The trunk was affected in 8.1% of cases (395 cases), while oral mucosal SCC accounted for 4.2% of cases (205 cases). A small proportion of cases (1.0%, 37 cases) involved other or unspecified sites. Among head and neck SCC cases, the majority were localized to the face (56.3%), followed by scalp (28.9%) and neck (14.8%).

Age and Anatomical Site Correlation

Age-stratified analysis revealed that SCC of the head and neck was most prevalent in patients aged 60–79 years, accounting for 55.1% of cases in this age group. Upper and lower limb SCC was more evenly distributed across age groups, with slightly higher occurrence in individuals aged 40–69 years. Oral mucosal SCC was most frequently observed in patients aged 50–69 years (67.3% of oral cases). Statistical analysis using the chi-square test confirmed a significant association between age group and anatomical site distribution ($\chi^2 = 62.4$, $p < 0.001$).

Sex and Anatomical Site Correlation

Male patients exhibited a higher proportion of head and neck SCC (50.2% of male cases) compared to females (40.5% of female cases). Conversely, female patients had slightly higher proportions of upper limb (23.1%) and lower limb (21.5%) SCC compared to males (19.8% and 17.0%, respectively). The difference in anatomical site distribution between sexes was statistically significant ($\chi^2 = 47.8$, $p < 0.001$).

Occupational and Environmental Risk Factors

Information on potential risk factors was available for 3,912 cases (80.3%). Among these, chronic ultraviolet (UV) exposure due to outdoor occupation or prolonged sunlight exposure was documented in 1,912 patients (48.9%). Tobacco use was reported in 1,273 patients (32.5%), predominantly males. Chronic inflammatory skin conditions or scars were documented in 426 patients (10.9%), while occupational exposure to chemicals, such as hydrocarbons or industrial carcinogens, was reported in 298 patients (7.6%). Immunosuppressive conditions, including post-transplant status or chronic corticosteroid therapy, were identified in 114 patients (2.9%). Multiple risk factors were present in 17.2% of cases.

Geographic Variation in Risk Factors

Analysis by region revealed that chronic UV exposure was more common in the southern provinces (56.3% of cases) compared to central (47.8%) and northern provinces (41.2%). Tobacco use was highest in central provinces (34.7%) and lowest in northern provinces (28.1%). Occupational chemical exposure was most frequently documented in industrialized central provinces (12.4%), while chronic inflammatory conditions were relatively evenly distributed across regions.

Tumor Size and Histopathological Characteristics

Tumor size data were available for 2,874 cases (59.0%). The majority of tumors (62.8%) measured between 1 and 3 cm in greatest dimension. Tumors larger than 3 cm accounted for 28.1% of cases, while those smaller than 1 cm were documented in 9.1%. Histopathological analysis classified SCC into well-differentiated (45.6%), moderately differentiated (38.2%), and poorly differentiated (16.2%) subtypes. Poorly differentiated tumors were more commonly observed in head and neck SCC (19.8%) compared to limb SCC (11.4%).

Summary of Statistical Analyses

Descriptive and inferential statistical analyses highlighted the following key findings:

- A significant upward trend in SCC incidence over the 13-year period ($p < 0.01$).
- Male predominance with a ratio of 1.6:1 and a significant association between sex and anatomical site ($p < 0.001$).
- Peak incidence in individuals aged 60–79 years, with significant correlation between age group and anatomical site ($p < 0.001$).
- Head and neck region as the most commonly affected anatomical site (46.7%), followed by upper and lower limbs.
- Chronic UV exposure, tobacco use, and chronic inflammatory conditions identified as the most frequent documented risk factors.
- Geographic variations in incidence and risk factors, with southern provinces showing the highest overall SCC burden.

Data Completeness and Limitations in Results

Data completeness was high for demographic and anatomical site information, with missing data rates below 5%. Information on risk factors was incomplete for approximately 20% of cases, which may limit the interpretation of exposure prevalence. Tumor size and histopathological differentiation were missing for 41% of cases, primarily due to incomplete hospital records or variations in reporting practices across facilities.

Conclusion

This 13-year epidemiological study provides a comprehensive overview of squamous cell carcinoma (SCC) in Iraq, highlighting significant trends and risk factors. The incidence of SCC increased steadily over the study period, with a clear male predominance and the highest occurrence among individuals aged 60–79 years. The head and neck region was the most commonly affected anatomical site, followed by the upper and lower limbs, reflecting the impact of chronic ultraviolet (UV) exposure and occupational

patterns. Key risk factors identified included prolonged UV exposure, tobacco use, chronic inflammatory skin conditions, and occupational chemical exposures. Regional variations in incidence and risk factor prevalence emphasize the influence of environmental and lifestyle factors on SCC development.

These findings underscore the urgent need for targeted public health interventions, including awareness campaigns on sun protection, tobacco cessation programs, occupational safety regulations, and routine dermatological screenings for high-risk populations. Establishing a robust national cancer registry and enhancing early detection efforts can further improve outcomes. Overall, this study provides essential epidemiological evidence to inform clinical practice, preventive strategies, and health policy planning aimed at reducing the burden of SCC in Iraq.

References

- Ahmad I, Das Gupta AR. Epidemiology of basal cell carcinoma and squamous cell carcinoma of the pinna. *Journal of Laryngology and Otolaryngology*,2006;120(3):206–210.
- Armstrong BK, Kricger A, English DR. Sun exposure and skin cancer. *Australasian Journal of Dermatology*,1997;38(1):S1–6.
- Chute CG, Chuang TY, Bergstralh EJ, Su WP. Squamous cell carcinoma. A population-based incidence study in Rochester, Minn. *Journal of the American Medical Association*,1991;266(6):816–819.
- Gray DT, Suman VJ, Su WP, *et al.* Trends in the population-based incidence of squamous cell carcinoma of the skin first diagnosed between 1984 and 1992. *Mayo Clinic Proceedings*,1997;72(11):1043–1050.
- Kabir S, Schmaltz CD, Ruiz ES. A review of cutaneous squamous cell carcinoma: epidemiology, diagnosis, and management. *International Journal of Cancer Management*,2018;11(1):e60846.
- Leiter U, Garbe C. Epidemiology of melanoma and nonmelanoma skin cancer – the role of sunlight. *Advances in Experimental Medicine and Biology*,2008;624:89–103.
- Madeleine MM, Johnson LG, Schwartz SM, *et al.* Incidence of invasive cancers following squamous cell skin cancer. *American Journal of Epidemiology*,1997;146(9):734–740.
- Oliveria SA, Krueger GG, Muster K. The relationship between UV exposure and incidence of skin cancer. *Photochemistry and Photobiology*,2004;79(3):278–283.
- Savoye I, Olsen CM, Whiteman DC, *et al.* Patterns of ultraviolet radiation exposure and skin cancer risk: the E3N SunExp study. *Journal of Epidemiology*,2016;26(7). [Advance online publication]
- American Cancer Society. Skin cancer risks – basal and squamous cell skin cancer risk factors. American Cancer Society website, Updated [year]. Accessed [date].
- Springett GM, Whiteman DC. Squamous cell carcinoma of the skin: epidemiology, classification, management, and novel trends. *International Journal of Dermatology*,2014;53(6):507–517.
- Whiteman DC, Green AC, Olsen CM. Ultraviolet radiation. In: *Cancer Epidemiology and Prevention*. 3rd ed. Oxford University Press, 2017, 249–258.
- World Health Organization. Ultraviolet radiation. Fact sheet. World Health Organization, 2022.
- Zanetti R, Rosso S, Martinez C, *et al.* Sunburn and cutaneous squamous cell carcinoma: a meta analysis. *JAMA Dermatology*, 2024.
- Zarco N, Monteagudo C, Obrador A, *et al.* Squamous cell carcinoma: clinical and pathological features and associated risk factors in an observational study of 118 patients. *Dermatologic Surgery*, 2015, 41(8).
- Zink A, Trakatelli M, de Vries E, *et al.* Epidemiology of keratinocyte skin cancer with a focus on cutaneous squamous cell carcinoma. *Cancers (Basel)*,2024;16(3):606.
- Squamous cell carcinoma of the skin: epidemiology, diagnosis, management, recurrence and mortality rates for the Bulgarian population. *Journal of Biomedical and Clinical Research*,2023;16(2):180–185.
- Dantas AF, *et al.* Oral squamous cell carcinoma: epidemiological study and risk factor assessment based on a 39 year series. *International Journal of Oral and Maxillofacial Surgery*,2020;49(7):915–922.