

ORIGINAL ARTICLE

Epidemiology of sinonasal undifferentiated carcinoma in Queensland, Australia, 1982-2024: insights from a population-based cohort

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Background: Sinonasal undifferentiated carcinoma (SNUC) is a rare and aggressive group of malignant tumours arising from the nasal cavity and paranasal sinuses. We present here the details of a population-based cohort over four decades.

Materials and methods: A retrospective cohort study was conducted using all histologically confirmed cases of SNUC diagnosed in Queensland between 1982 and 2024. Demographics, clinical features, treatment history and outcomes were extracted from the Queensland Oncology Repository. The Kaplan–Meier method was used to calculate 5-year all-cause survival by key variables of interest.

Results: Sixty-four cases were included in the study. Median age at diagnosis was 56.5 years. There was some evidence of an increase in the proportion of females, from 27% to 50% over the study period ($P = 0.08$). Over half (59%) were stage IV at diagnosis. The age-standardised incidence was 0.05 per 100 000 population and remained stable over time. Dual modality treatment was the most common approach ($n = 29$, 45%), with 79% of surgery, 53% of radiotherapy and 54% of chemotherapy requiring patients to travel elsewhere for treatment. Five-year all-cause survival was 35% [95% confidence interval (CI) 24% to 48%] for the total study cohort but varied by treatment modality (70%, 95% CI 33% to 89% for trimodal therapy, $P = 0.04$) and smoking status (76%, 95% CI 48% to 90% for never smokers, $P = 0.01$).

Conclusions: Our study offers real-world insights into the epidemiology of this very rare malignancy in one of the larger cohorts published to date. Development of a specialised national registry in Australia would enhance efforts to better understand and treat SNUC.

Key words: epidemiological studies, head and neck cancer, incidence rate, rare diseases, survival rate

INTRODUCTION

Sinonasal undifferentiated carcinoma (SNUC) is an extremely rare and aggressive form of cancer, defined by a lack of any identifiable histological differentiation (squamous, glandular or neuroendocrine) and can involve the nasal cavity or paranasal sinuses.^{1–3} SNUC is often difficult to diagnose in primary care due to its nonspecific early symptoms, such as nasal obstruction, facial pain, epistaxis or headache.⁴ Its rapid growth and local invasion commonly result in extension into nearby critical structures, including the orbit, extraocular muscles, skull base or

intracranial cavity. Given its protean symptoms and complex presentation, SNUC is often diagnosed at an advanced stage (typically stage III or IV); thus, effective management necessitates a multimodal approach, which may include surgery, radiation and systemic chemotherapy. Despite intensive treatment, SNUC is associated with a poor prognosis, marked by high recurrence rates and limited long-term survival.⁵

The precise aetiology of SNUC remains undefined. However, several factors have been proposed as potential contributors to its development. Prolonged occupational exposure to industrial agents, such as organic solvents and wood or leather dust, has been associated with increased incidence of certain subtypes of sinonasal malignancies, particularly adenocarcinomas, likely caused by chronic mucosal irritation and inflammation.⁶ Additionally, infection with human papillomavirus (HPV) may contribute, although evidence remains limited.⁷ No clear causal link has been

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established between smoking and SNUC specifically,^{1,2} although smoking has been consistently identified as a possible risk factor for other forms of sinonasal cancer.^{8,9}

Given the rarity of SNUC, current treatment protocols are primarily informed by small institutional case series, resulting in considerable variability in reported outcomes. This makes it challenging to evaluate the relative effectiveness of different therapeutic approaches, including the role of radiotherapy (RT) and chemotherapy, both as standalone treatments and in combination with surgical resection (either open resection or endoscopic). Accordingly, our aim was to examine the epidemiology of SNUC using a population-based cohort over an extended period, with a focus on treatment modalities and associated survival outcomes.

MATERIALS AND METHODS

Data

We conducted a retrospective cohort study of histologically confirmed cases of SNUC diagnosed between 1982 and 2024. Case identification was carried out using the Queensland Oncology Repository (QOR), a centralised, population-based database governed by Cancer Alliance Queensland. The QOR aggregates demographic, clinico-pathological and treatment information from over 60 linked data sources for all cancer patients residing in Queensland. Eligibility was determined based on the primary tumour site involving the nasal cavity (C30.0), maxillary sinus (C31.0), ethmoidal sinus (C31.1), frontal sinus (C31.2), sphenoidal sinus (C31.3), overlapping accessory sinus (C31.8) and accessory sinus (C31.9) as classified by the International Classification of Diseases, 10th Revision, Australian Modification and confirmed morphology consistent with undifferentiated carcinoma (M8020/3) on histopathological review, as defined by WHO classification criteria.¹⁰ A case-by-case review was undertaken by trained data analysts at Cancer Alliance Queensland and detailed clinical information was recorded in the SNUC Clinical Quality Registry. Core demographic characteristics were extracted directly from QOR. Additional variables including smoking status and occupational history were obtained through manual review of medical records.

Diagnosis of SNUC was primarily established through endoscopic biopsy. Histopathology reports were systematically reviewed and available immunohistochemical findings supporting the diagnosis were documented. Cases with ambiguous morphological or immunophenotypic features were independently reviewed by an experienced pathologist to ensure diagnostic accuracy. Tumours were excluded if they had identifiable histological lineage, such as squamous-cell carcinoma, adenocarcinoma or neuroendocrine differentiation. Where feasible, tumours were staged individually according to the American Joint Committee on Cancer eighth edition criteria,¹¹ with input from medical advisers and otolaryngologists. For the purpose of this study, clinical staging was used, based on radiological and clinical findings only, due to the possibility of downstaging before more

comprehensive pathological staging being carried out.¹¹ Accordingly, staging decisions were supported by detailed review of imaging reports, including computed tomography and magnetic resonance imaging, to assess tumour subsite, size and extent of local invasion.

Treatment modalities for both initial and subsequent lines of therapy were recorded. These included surgical interventions, RT and intravenous systemic chemotherapy. Treatment intent (curative, palliative or unclear), total radiation dose (Gy), number of fractions and chemotherapy regimen were recorded where relevant, providing thorough documentation of treatment patterns. To ensure data accuracy and resolve inconsistencies, treatment variables were cross-verified by trained data analysts against source documentation including electronic medical records and scanned clinical notes. Treatment administered in private health care settings was included when documentation was available, although chemotherapy details were incomplete for some cases because of data access limitations. The date and anatomical site of recurrence and disease progression were recorded based on documentation from multidisciplinary team discussions and review of radiology reports. Radiology findings were also assessed to determine treatment response.

Analysis

Chi-square tests were used to compare differences in the distribution of key demographic, clinical and treatment characteristics between two arbitrary diagnostic periods (1982-2004 versus 2005-2024). Age-standardised incidence rates were calculated both overall and by period using the 2001 Australian Standard Population. Changes in the incidence rate between the two periods were reported as a standardised rate ratio (SRR).

Five-year overall survival (OS) was calculated using the Kaplan–Meier method. For people who remained alive, survival was censored at either 5 years after diagnosis or at the end of the study period (31 December 2024), whichever occurred first. Differences in survival by diagnostic period, treatment modality (single, dual or trimodal), stage at diagnosis (stages I-III versus stage IV) and smoking status were assessed using the log-rank test. All estimates were presented along with the corresponding 95% confidence interval (95% CI) where appropriate.

RESULTS

Study cohort

Between 1982 and 2024, a total of 64 individuals were diagnosed with SNUC in Queensland, representing 0.2% of the total incidence of head and neck cancers during that period ($N = 31\,572$). Immunohistochemistry results were documented for 86% of patients ($n = 55$). There was a majority of males ($n = 37$, 58%) within the study cohort and the median age at diagnosis was 56.5 years [interquartile range (IQR) 48.5-68.0 years]. Approximately one in five patients resided in an outer regional, remote or very

remote location ($n = 12$, 19%) and around one-third ($n = 20$, 31%) lived in a socioeconomically disadvantaged area.

At baseline, two-thirds of the cohort ($n = 43$, 67%) had at least one comorbidity. Primary tumour site was most frequently the nasal cavity ($n = 29$, 45%), followed by the maxillary sinus ($n = 14$, 22%) and the ethmoid sinus ($n = 12$, 19%). Orbital invasion was present for 45% ($n = 23$ of 51) of patients for whom this detail was recorded. Clinical staging information was available for 76% ($n = 49$) of the study cohort, with 31% ($n = 15$) of these patients assessed by magnetic resonance imaging (MRI) only, a further 31% ($n = 15$) by 2-fluoro-2-deoxy-D-glucose–positron emission tomography, 20% ($n = 10$) by computed tomography (CT) only and 8% ($n = 4$) by both CT and MRI; the remaining 10% ($n = 5$) did not have any imaging recorded, with stage obtained from other sources such as notes from multidisciplinary team meetings. Most patients with staging data had advanced disease at presentation, with 71% ($n = 35$ of 49) classified as either T-stage 4a or 4b and 31% ($n = 15$) having nodal involvement. Among the 38 patients with stage IV disease, most had locoregionally advanced disease [42% stage IVa ($n = 16$) and 45% stage IVb ($n = 17$)], with distant metastatic disease (stage IVc) at diagnosis in 13% ($n = 5$) of these patients (or 10% of all staged cases). Clinical stage was unable to be determined for 23% of patients ($n = 15$).

Smoking status was recorded for 73% ($n = 47$) of the study cohort. Of those with known smoking status, around two-thirds were either current ($n = 11$, 23%) or past smokers ($n = 19$, 40%). No clear patterns were evident from occupational history. The most common occupations were a combination of trade workers, construction or mining labourers ($n = 16$, 25%) followed by clerical/administrative or home duties (each $n = 8$, 13%).

None of the characteristics of interest showed any statistically significant variation over time (see Table 1), although the small numbers in each group meant that there was limited statistical power to detect any differences. Nonetheless, it was noted that the proportion of females increased from 27% ($n = 6$ of 22) for 1982–2004 to 50% ($n = 21$ of 52; $P = 0.08$) for 2005–2024. Clinical stage at diagnosis was missing for 63% ($n = 14$ of 22) of people diagnosed between 1982 and 2004.

Incidence rate

The age-standardised incidence rate over the entire study period was estimated to be 0.05 per 100 000 population (95% CI 0.04–0.06 per 100 000 population). Although the number of cases almost doubled from 22 to 42 between 1982–2004 and 2005–2024, respectively, there was no evidence of any change in the incidence rate over time after adjusting for population growth and ageing, with an SRR of 1.20 (95% CI 0.70–2.11, $P = 0.54$) for 2005–2024 compared with the baseline of 1982–2004.

Table 1. Incidence distribution of SNUC by key patient and clinical characteristics, Queensland, 1982–2024

Characteristic of interest	1982–2004		2005–2024		Total	
	<i>n</i>	Col %	<i>n</i>	Col %	<i>n</i>	Col %
Sex ($P = 0.08$)						
Male	16	72.7	21	50.0	37	57.8
Female	6	27.3	21	50.0	27	42.2
Age group at diagnosis ($P = 0.57$)						
<50 years old	7	31.8	9	21.4	16	25.0
50–64 years old	9	40.9	17	40.5	26	40.6
>65 years old	6	27.3	16	38.1	22	34.4
Remoteness of residence ($P = 0.71$)						
Major city	13	59.1	24	57.1	37	57.8
Inner regional	4	18.2	11	26.2	15	23.4
Outer regional/remote	5	22.7	7	16.7	12	18.8
Area-based SES ($P = 0.63$)						
Affluent	1	4.5	4	9.5	5	7.8
Middle SES	15	68.2	24	57.1	39	60.9
Disadvantaged	6	27.3	14	33.3	20	31.3
Number of comorbidities ($P = 0.13$)						
None	10	45.5	11	26.2	21	32.8
One	3	13.6	15	35.7	18	28.1
Two or more	9	40.9	16	38.1	25	39.1
Clinical stage at diagnosis ($P = 0.27$) ^a						
I–III	3	13.6	8	19.0	11	17.2
IV	5	22.7	33	78.6	38	59.4
Not specified	14	63.6	1	2.4	15	23.4
Primary site ($P = 0.65$)						
Nasal cavity	9	40.9	20	47.6	29	45.3
Maxillary sinus	4	18.2	10	23.8	14	21.9
Ethmoidal sinus	6	27.3	6	14.3	12	18.7
Other primary site	3	13.6	6	14.3	9	14.1

SES, socioeconomic status; SNUC, sinonasal undifferentiated carcinoma.

^a P value for stage excludes 'not specified'.

Treatment modalities

The median interval between diagnosis and initiation of first treatment was 25 days (IQR 15.5–31 days). Figure 1 summarises the treatments received. Of the 64 patients, 13% ($n = 8$) had no active therapy. One in four patients ($n = 16$, 25%) received single modality therapy only. Dual modality was the most common treatment approach ($n = 29$, 45%), either as surgery plus RT ($n = 7$, 11%) or chemotherapy combined with RT ($n = 22$, 34%). Most of the latter group received concurrent chemoradiotherapy ($n = 19$, 30%). Eleven patients (17%) underwent trimodality therapy, consisting of surgery followed by concurrent chemoradiotherapy. There was no significant difference in treatment modality by year of diagnosis ($P = 0.31$), although the majority of patients ($n = 9$ of 11, 82%) who received trimodal therapy were diagnosed more recently (2005–2024).

Around one-third ($n = 19$, 30%) of the cohort underwent surgery at some point during their treatment course and four of these patients (21%) had two or more procedures. Nearly all patients who had surgery had either chemotherapy and/or RT ($n = 18$, 95%), given as an adjuvant therapy with curative intent. Access to surgical care often required travel, with 79% of surgical patients ($n = 15$) having at least one procedure outside of their local health district. Most surgeries ($n = 18$ of 25, 72%) were conducted in public facilities.

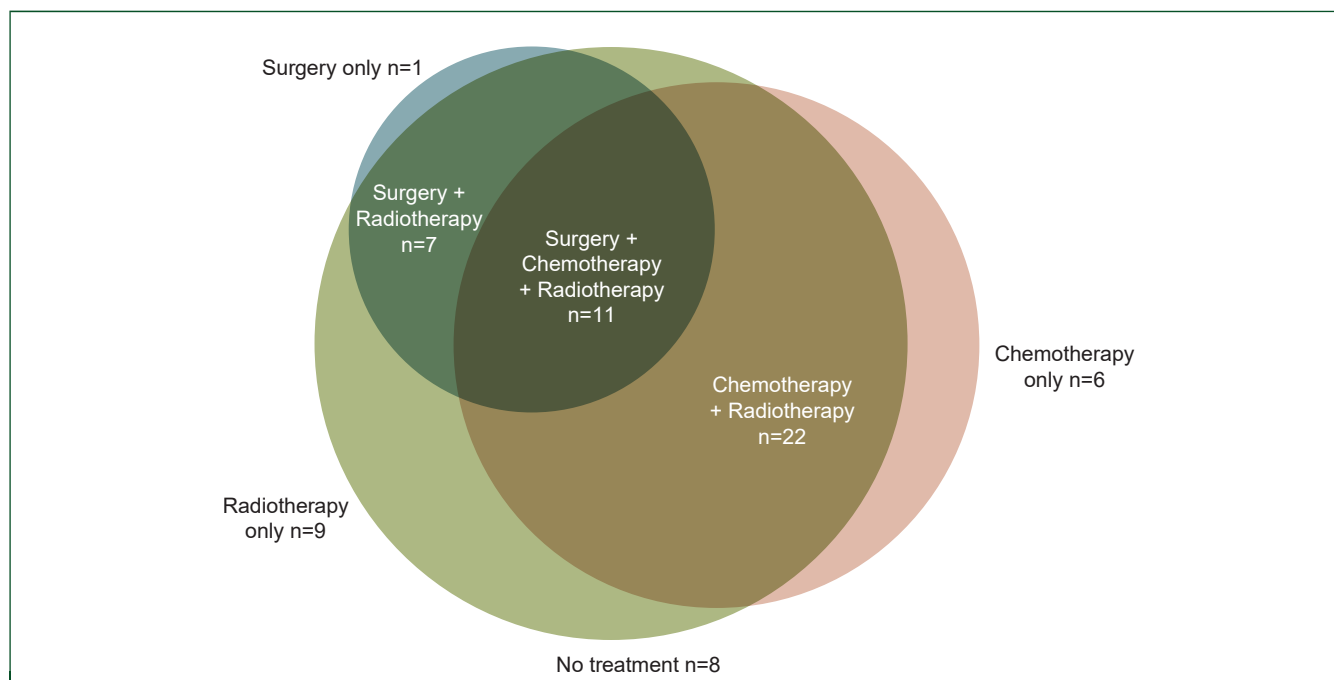


Figure 1. Treatment modalities for sinonasal undifferentiated carcinoma, Queensland, 1982-2024. When chemotherapy and/or radiotherapy (RT) was received with surgery, the chemotherapy/RT was always adjuvant. Chemotherapy + RT was given concurrently in 19 out of the 22 cases.

RT was administered to 49 patients in total (77%), either alone or in combination with chemotherapy and/or surgery, underscoring its key role in SNUC management. The initial course of RT was most often given with curative intent ($n = 43$, 88%), with a median dose of 60 Gy delivered in 30 fractions. Palliative RT doses ranged from 20 to 40 Gy, typically delivered in up to 25 fractions. As with surgery, RT was primarily delivered in high-volume centres, requiring just over half of the patients who received RT to travel beyond their local health service area for treatment ($n = 26$ of 49, 53%). The majority of RT ($n = 41$ of 49, 84%) was administered in the public sector.

Almost two-thirds of patients received systemic chemotherapy at diagnosis ($n = 39$, 61%), with 72% ($n = 28$) of the initial regimens recorded as having curative intent. All chemotherapy protocols were platinum-based, most commonly using cisplatin, either as monotherapy or in combination ($n = 23$ of 28, 82% of cases where the drugs were specified). Protocols involving cisplatin were almost always given with curative intent ($n = 21$ of 23, 91%) in contrast to 40% ($n = 2$ of 5) of carboplatin-based protocols. More than half of those who received chemotherapy ($n = 21$, 54%) had to travel outside of their local health service district to be treated and 74% of chemotherapy ($n = 29$) was delivered at a public facility.

Outcomes

Median follow-up time was 23 months (IQR 8-75 months). By the end of the study period, 18 patients (28%) had documented disease recurrence, with a median time to recurrence of 12 months (IQR 8-21 months).

Three-quarters ($n = 47$, 73%) of the patients died during the study period, with most of these deaths ($n = 37$, 79%) attributed to SNUC. Five-year OS for all patients combined was 35% (95% CI 24% to 48%). Although there appeared to be some improvement in survival over time, with 5-year OS rising from 27% (95% CI 11% to 46%) during the earlier diagnostic period (1982-2004) to 41% (95% CI 25% to 56%) among those diagnosed more recently (2005-2024), the difference was not significant ($P = 0.67$; see Figure 2A).

The number of treatments administered impacted 5-year OS (Figure 2B), ranging from 21% (95% CI 5% to 44%) for single mode therapy to 41% (95% CI 23% to 59%) for dual modes and 70% (95% CI 33% to 89%) for trimodal ($P = 0.04$). However, the statistical significance by treatment modality dissipates if patients treated with palliative intent only are removed from the analysis ($P = 0.62$; results not shown). People with stages I-III SNUC at diagnosis (62%, 95% CI 28% to 84%) tended to have better survival than those with stage IV disease (35%, 95% CI 19% to 51%) but the number of stage I-III cases was very small ($n = 11$) and the comparison was not statistically significant ($P = 0.14$; Figure 2C). The largest difference was by smoking status (Figure 2D), with never smokers (76%, 95% CI 48% to 90%) having a clear advantage in 5-year OS compared with current or past smokers (30%, 95% CI 14% to 47%, $P = 0.01$).

DISCUSSION

This study leverages a comprehensive, population-based dataset across Queensland spanning 43 years, thereby offering real-world insights into the epidemiology, treatment patterns and outcomes of SNUC, an approach that distinguishes it from most prior cohorts in the literature, which focused on hospital-based series of patients. SNUC remains

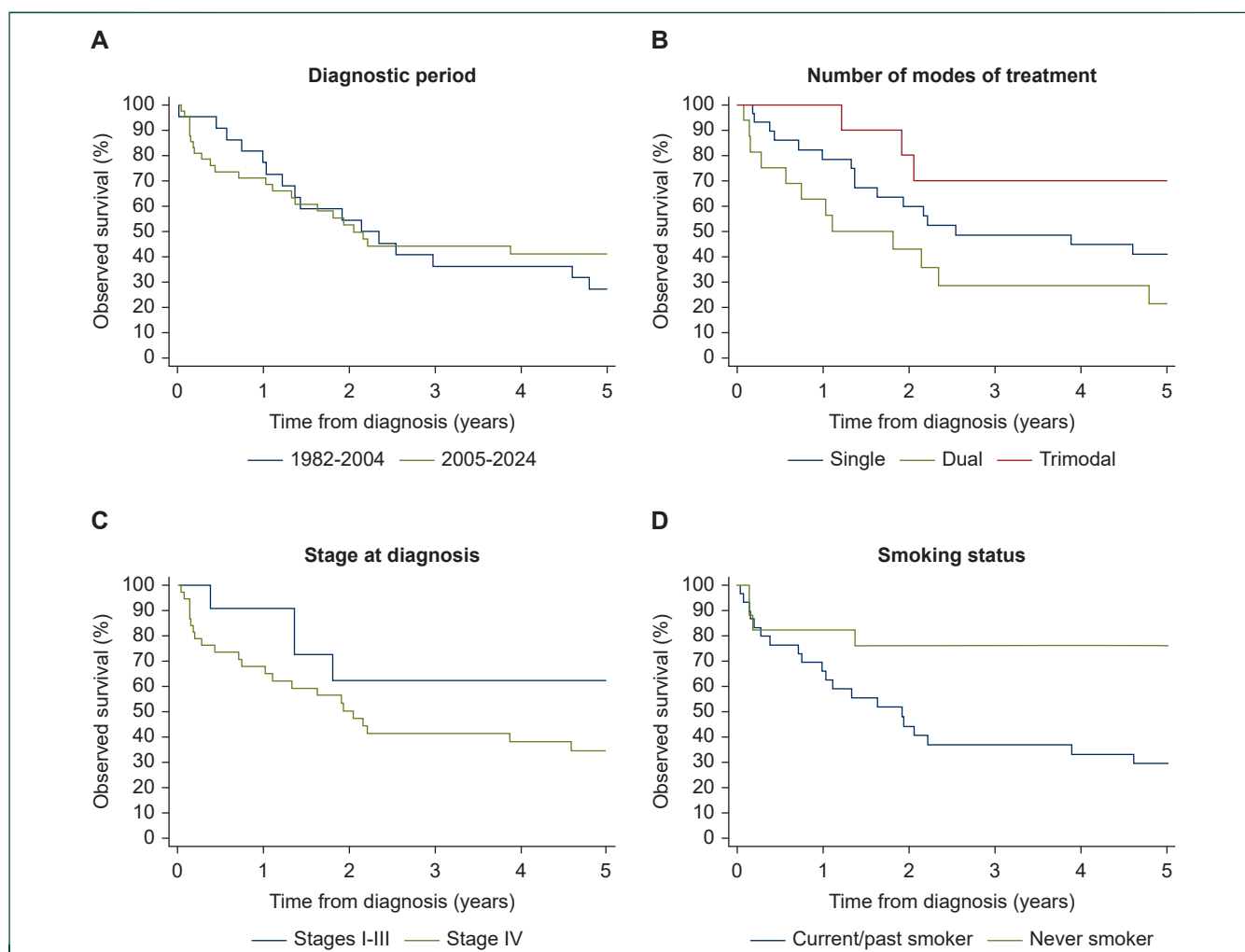


Figure 2. Five-year overall survival for sinonasal undifferentiated carcinoma by (A) diagnostic period; (B) number of modes of treatment, Queensland, 1982-2024; (C) stage at diagnosis; and (D) smoking status.

one of the rarest yet most aggressive malignancies of the head and neck, with an incidence in our study of just 0.05 per 100 000 population. This is, however, notably higher than the incidence reported in a US population-based study spanning 1973-2010, which found a rate of only 0.02 per 100 000.¹² Despite its rarity, the clinical burden of SNUC is substantial, owing to its rapid progression, diagnostic complexity and poor prognosis.

Unlike other literature, which has consistently reported a male-to-female ratio of around 2 : 1 for SNUC,^{12,13} our findings indicate a narrowing gender gap to almost equal numbers of males and females diagnosed in Queensland over the past two decades. This unexpected discovery requires further consideration but may signify a combination of changing occupational exposures, prevalence of HPV and/or convergence in the rates of sex-specific smoking prevalence in Australia since the mid-20th century.¹⁴

The data presented here reaffirm the poor survival associated with SNUC. Just over one-third (35%) of patients survived for 5 years from diagnosis, consistent with published literature from the United States (1973-2011), where 5-year survival was reported at 30%.¹⁵ A newly published

multicentre paper from Europe and North America reported 5-year OS of 47% for patients with SNUC treated between 1997 and 2021,¹³ again similar in magnitude to the result of 41% between 2005 and 2024 for Queensland. Orbital involvement and metastatic disease were found to be independent prognostic factors by Liu et al.¹³ The percentages of both orbital involvement (45% and 50%) and distant metastases (10% versus 4%) were comparable between Queensland and the international study cohort, respectively.¹³

Notably, although 5-year survival for SNUC in Queensland increased somewhat over time, the difference was not statistically significant after multivariable analysis. This lack of significance appears to be driven by patients diagnosed between 2005 and 2024 exhibiting worse survival rates during the first year after diagnosis, despite having higher 5-year survival compared with those diagnosed between 1982 and 2004, suggesting that only some patients with SNUC experience a survival benefit from more aggressive contemporary treatments, particularly trimodal therapy with upfront surgery. Increasing treatment intensity to improve survival may at times cause unintended harm due

to toxicity, leading to recent efforts to de-escalate therapies for some other types of head and neck cancers.^{16,17} Conversely, the morbidity associated with uncontrolled disease resulting from ineffective therapy, including poorer quality of life, as well as the intrinsic sensitivity of this tumour type to treatment, must also be carefully considered. Given the rarity of SNUC, no randomised data exist to guide management,¹⁸ and such evidence is unlikely ever to become available. Consequently, the most widely adopted strategy is to provide treatment that minimises morbidity,^{19,20} both from disease progression and from the treatment itself.

Another factor to consider when comparing survival for SNUC over time is that diagnostic resolution has improved between the two periods, i.e. some patients diagnosed as SNUC between 1982 and 2004 would now be classified as another type of head and neck tumour with a different/better prognosis. Immunohistochemistry and molecular testing are becoming increasingly important in defining 'true' SNUC by helping to differentiate it from other specific entities such as SWI/SNF-related, matrix-associated, actin-dependent regulator of chromatin, subfamily B, member 1 (SMARCB1)-deficient or nuclear protein in testis carcinomas, which were previously grouped under SNUC.^{3,21}

Although trimodal treatment for SNUC appeared to offer a survival advantage in the current study, this result was only statistically significant when patients initially treated by single and dual modalities with palliative intent were included in the analysis. For locally advanced SNUC, it can be challenging for clinicians to be definitive regarding intent of therapy at baseline, and therefore, some cases were 'unclear' or treated with 'curative intent' with best intentions. Results from other studies have been mixed. Most have demonstrated that multimodal therapy is generally preferred over single therapy, whereas a clinically meaningful benefit of triple over dual modality approaches is more difficult to establish.^{22,23} For example, Kuo et al.²⁴ concluded that surgery plus chemoradiotherapy outperformed surgery with RT or RT alone but not chemoradiotherapy without surgery. Whether the improved survival for trimodal therapy in our study reflects true treatment superiority as opposed to selection bias towards younger, fitter patients remain unclear; however, multi-variable analysis to more fully examine this question was precluded because of an insufficient number of patients.

A large survival advantage was observed among never smokers (5-year OS 76% compared with 30% for smokers). Further exploration of the effect of smoking on survival for SNUC is warranted. A biological or behavioural influence on disease progression and treatment response due to smoking is possible. There may be aggressive inflammation driving SNUC in at least some current and former smokers, with a reduced immune response, as has been observed for squamous-cell carcinomas of the head and neck.^{25,26}

The challenges of rurality at presentation were also evident, with many patients with SNUC requiring travel for treatment at tertiary centres that manage more complex cases of head and neck cancer. As for other rare cancers,

there is a need for centralisation of care^{27,28} with specialised multidisciplinary teams having an important role.²⁹ Nonetheless, patients from rural or remote parts of Queensland who have to travel long distances to metropolitan centres for treatment face a variety of drawbacks, including transportation and accommodation costs, as well as the social isolation that comes with being away from home and support networks for extended periods of time.^{30,31}

This study benefits from a comprehensive dataset spanning a 42-year period. A key strength is the use of real-world, population-based data, capturing all diagnosed cases of SNUC across Queensland rather than a selective hospital cohort. The QOR employs a delayed coding process, whereby cancer diagnoses are finalised ~18-24 months after the initial diagnosis, allowing incorporation of all available clinical and histopathological information accrued over the disease course. Accordingly, cases are classified based on their most up-to-date and validated diagnosis. Although this approach reduces the impact of diagnostic uncertainty, we acknowledge that it does not permit direct assessment of misclassification at initial presentation.³²

A descriptive approach was necessary for the analysis, with an insufficient number of cases to carry out multi-variable modelling. We were therefore unable to determine independent factors associated with either incidence or survival. The survival estimates should also be interpreted with caution given the wide confidence intervals, which reflect the small number of cases per group when stratifying survival by diagnostic period, treatment modalities or clinical stage at diagnosis.

Potential variations in data quality over time must also be taken into consideration. Automated data capture for RT improved in completeness from 2007 onwards and chemotherapy data achieved full coverage from 2009. Treatment details were manually obtained from the medical records for cases that were diagnosed before this, raising the possibility that patients diagnosed in earlier years may have incomplete information on their treatment modality. Chemotherapy data were restricted to intravenous only, limiting insight into alternative treatment routes such as oral therapy (although this is uncommon for SNUC). Chemotherapy protocols were also not consistently available when treatments were administered through private hospitals, leading to gaps in regimen-specific information. Baseline staging was unknown for ~17% of cases due to missing or destroyed historical records, particularly from the 1980s, which may impact the accuracy of survival outcome comparisons. Although smoking status was relatively well captured, occupational and environmental exposure data were inconsistently recorded and therefore could not be meaningfully analysed.

Conclusions

The value of long-term, population-based data in understanding rare cancers such as SNUC cannot be overstated.

Establishment of the Queensland SNUC Clinical Quality Registry as part of this study marks a pivotal step towards further improving and broadening data capture and facilitating collaborative research. To build on the insights offered by the current study and enable more robust analyses, efforts should be directed towards the development of a national SNUC registry. Such an initiative would facilitate greater case accrual, improve data completeness and support collaborative research across jurisdictions both within Australia and internationally. Integration of the SNUC registry with molecular and genomic platforms, such as the Australian Rare Cancer Portal and the Stafford Fox Rare Cancer Program at the Walter Eliza Hall Institute, offers promising avenues to identify aetiological factors, actionable targets and prognostic biomarkers, ultimately advancing precision medicine for this challenging malignancy.

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DATA AVAILABILITY

The unit record data used in this study are not publicly available to protect patient privacy and confidentiality. Deidentified data may be available from the corresponding author on reasonable request.

DECLARATION OF AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

Generative AI and AI-assisted technologies were not used in the preparation of this work.

ETHICS STATEMENT

Epidemiology of sinonasal undifferentiated carcinoma in Queensland, Australia, 1982-2024: insights from a population-based cohort.

The study was conducted under Section 82 of the Hospital and Health Boards Act (2011), which allows members of the Queensland Cancer Control Safety and Quality Partnership access to identifiable administrative data for the purpose of quality improvement and clinical research. There was no contact with patients included in the study cohort. As such, specific approval for this study from a human research ethics committee was not required.

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DISCLOSURE

The authors have declared no conflicts of interest.

REFERENCES

- Agaimy A, Franchi A, Lund VJ, et al. Sinonasal undifferentiated carcinoma (SNUC): from an entity to morphologic pattern and back again—a historical perspective. *Adv Anat Pathol*. 2020;27(2):51-60.
- Sideris G, Solomos P, Gogoulos P, et al. Neuroendocrine and undifferentiated sinonasal and skull base tumors: an up-to-date narrative review. *Oral Maxillofac Surg*. 2024;28(3):1009-1017.
- Tandon A, Kakkar A. Sinonasal undifferentiated and poorly differentiated carcinomas: an update. *Surg Pathol Clin*. 2024;17(4):615-635.
- Khalil H, Mehana M, Kanaan Y. Sino-nasal cancers. In: Elwany S, editor. *Current Rhinology*. Springer; 2024. p. 711-720.
- Abdelmeguid AS, Bell D, Hanna EY. Sinonasal undifferentiated carcinoma. *Curr Oncol Rep*. 2019;21(3):26.
- Binazzi A, Ferrante P, Marinaccio A. Occupational exposure and sinonasal cancer: a systematic review and meta-analysis. *BMC Cancer*. 2015;15:49.
- Gray ST, Herr MW, Sethi RKV, et al. Treatment outcomes and prognostic factors, including human papillomavirus, for sinonasal undifferentiated carcinoma: a retrospective review. *Head Neck*. 2015;37(3):366-374.
- International Agency for Research on Cancer. Tobacco smoke and involuntary smoking. In: *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans*, 83. Lyon, France: International Agency for Research on Cancer; 2004.
- Elgart K, Faden DL. Sinonasal squamous cell carcinoma: etiology, pathogenesis, and the role of human papilloma virus. *Curr Otorhinolaryngol Rep*. 2020;8(2):111-119.
- WHO Classification of Tumours Editorial Board. *Head and Neck Tumours. WHO Classification of Tumours Series*. 5th ed. Vol 9. Lyon, France: International Agency for Research on Cancer; 2024.
- Amin MB, Edge SB, Greene FL, et al., editors. *AJCC Cancer Staging Manual*. 8th ed Springer; 2017.
- Chambers KJ, Lehmann AE, Remenschneider A, et al. Incidence and survival patterns of sinonasal undifferentiated carcinoma in the United States. *J Neurol Surg B Skull Base*. 2015;76(2):94-100.
- Liu J, Takahashi Y, Rehman U, et al. Outcomes for sinonasal undifferentiated carcinoma (SNUC): an international multi-center retrospective cohort study. *Cancers (Basel)*. 2026;18(3):366.
- Greenhalgh EM, Bayly M, Jenkins S, Scollo MM. Chapter 1: Trends in the prevalence of smoking. In: Greenhalgh EM, Scollo MM, Winstanley MH, editors. *Tobacco in Australia: Facts & Issues*. Melbourne, Australia: Cancer Council Victoria; 2024.
- Kuan EC, Arshi A, Mallen-St Clair J, Tajudeen BA, Abemayor E, St John MA. Significance of tumor stage in sinonasal undifferentiated carcinoma survival: a population-based analysis. *Otolaryngol Head Neck Surg*. 2016;154(4):667-673.
- Rosenberg AJ, Vokes EE. Optimizing treatment de-escalation in head and neck cancer: current and future perspectives. *Oncologist*. 2021;26(1):40-48.
- Chen AM. De-escalated radiation for human papillomavirus virus-related oropharyngeal cancer: evolving paradigms and future strategies. *Front Oncol*. 2023;13:1175578.
- Zhao X, Pei Z, Song X, Jin G. The role of radiotherapy in the treatment of sinonasal undifferentiated carcinoma: a population-based analysis. *Head Neck*. 2025;47(1):150-158.
- Ferrari M, Orlandi E, Bossi P. Sinonasal cancers treatments: state of the art. *Curr Opin Oncol*. 2021;33(3):196-205.

20. Melder KL, Geltzeiler M. Induction chemotherapy for locoregionally advanced sinonasal squamous cell carcinoma and sinonasal undifferentiated carcinoma: a comprehensive review. *Cancers (Basel)*. 2023;15(15):3798.
21. Vaziri Fard E, Zhang S, Cai Z, et al. Sinonasal undifferentiated carcinoma: clinicopathological spectrums and diagnosis reappraisal. *Hum Pathol*. 2019;89:62-70.
22. Morand GB, Anderegg N, Vital D, et al. Outcome by treatment modality in sinonasal undifferentiated carcinoma (SNUC): a case-series, systematic review and meta-analysis. *Oral Oncol*. 2017;75:28-34.
23. See ASY, Chu C, Lim ICZY, et al. Meta-analysis of multi-modality therapies in sinonasal undifferentiated carcinoma—a timely update. *Clin Otolaryngol*. 2024;49(1):29-40.
24. Kuo P, Manes RP, Schwam ZG, Judson BL. Survival outcomes for combined modality therapy for sinonasal undifferentiated carcinoma. *Otolaryngol Head Neck Surg*. 2017;156(1):132-136.
25. de la Iglesia JV, Slebos RJC, Martin-Gomez L, et al. Effects of tobacco smoking on the tumor immune microenvironment in head and neck squamous cell carcinoma. *Clin Cancer Res*. 2020;26(6):1474-1485.
26. Li Y, Yadollahi P, Essien FN, et al. Tobacco smoke exposure is a driver of altered oxidative stress response and immunity in head and neck cancer. *J Transl Med*. 2025;23(1):403.
27. Gatta G, Capocaccia R, Botta L, et al. Burden and centralised treatment in Europe of rare tumours: results of RARECAREnet-a population-based study. *Lancet Oncol*. 2017;18(8):1022-1039.
28. Valverde C. Centralisation of care in rare cancers—what are the next steps? ESMO Daily Reporter. Available at <https://dailyreporter.esmo.org/esmo-sarcoma-and-rare-cancers-congress-2024/opinion/centralisation-of-care-in-rare-cancers-what-are-the-next-steps>. Accessed August 23, 2026.
29. Rosell L, Wihl J, Hagberg O, Ohlsson B, Nilbert M. Function, information, and contributions: an evaluation of national multi-disciplinary team meetings for rare cancers. *Rare Tumors*. 2019;11:2036361319841696.
30. Skrabal Ross X, Gunn KM, Olver I. Understanding the strategies rural cancer patients and survivors use to manage financial toxicity and the broader implications on their lives. *Support Care Cancer*. 2021;29(9):5487-5496.
31. Pradhan P, Sharman AR, Palme CE, Elliott MS, Clark JR, Venchiarutti RL. Survivorship needs in patients with head and neck cancer in regional, rural and remote areas: a systematic review. *Psychooncology*. 2024;33(9):e9311.
32. Choi KY, Amit M, Tam S, et al. Clinical implication of diagnostic and histopathologic discrepancies in sinonasal malignancies. *Laryngoscope*. 2021;131(5):E1468-E1475.