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ORIGINAL ARTICLE

Epidemiological analysis of benign and malignant salivary gland tumors in Peshawar; a retrospective study from tertiary care hospitals (2020–2024)

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ABSTRACT

Background: Salivary gland tumors are rare lesions that pose diagnostic and therapeutic challenges due to their histological diversity and variable behavior. This study aimed to characterize the demographic and clinicopathological features of primary salivary gland tumors treated at two tertiary centers in Peshawar, and to assess associations between tumor behavior and patient age, sex, and tumor site.

Methods: We conducted a retrospective review of 272 patients treated for primary salivary gland tumors at two tertiary centers in Peshawar between January 2020 and December 2024. Patient demographics, tumor site, histological subtype, and behavior were extracted from pathology reports and clinical records. Statistical associations between tumor type and age, sex, and anatomical location were assessed with $p < 0.05$ indicating significance.

Results: The cohort included 147 women (54.0%) and 125 men (46.0%), with a mean age of 45 years (range 0–100 years). Benign tumors comprised 74.6% (n = 203), most frequently arising in the parotid gland (76.5%), whereas malignant tumors accounted for 25.4% (n = 69) and were disproportionately found in minor salivary glands (33.3% malignant). Pleomorphic adenoma was the leading benign subtype (70.4%), and mucoepidermoid carcinoma was the predominant malignancy (26.1%). Malignancy rates increased with age, rising from 7.7% in patients under 20 to 100% in those over 80 ($p = 0.006$). No significant gender differences in tumor behavior were observed ($p = 0.48$), but the distribution of sexes varied across age groups.

Conclusion: Younger patients with small, asymptomatic lesions may be managed conservatively, while older patients and those with minor gland tumors warrant prompt biopsy and cytological evaluation. Prospective, multicenter registries are essential to refine these observations and guide resource allocation in similar settings.

Keywords: Epidemiology, Parotid Gland, Salivary Gland, Tumors

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Introduction

Salivary gland tumors (SGTs) are relatively rare neoplasms, accounting for only about 0.3% of all malignancies worldwide and representing 3–6% of head and neck

neoplasms (1, 2). In 2020, GLOBOCAN estimated 53,583 new cases of salivary gland cancer and 12,339 related deaths globally (3).

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Despite this low incidence, SGTs demand attention for their wide histopathological diversity—over 30 distinct malignant and benign subtypes are recognized in the WHO Classification of Head and Neck Tumours (1). These subtypes range from common pleomorphic adenomas to aggressive carcinomas, making accurate diagnosis and management challenging (4). SGTs can originate in any of the major salivary glands consist of the parotid, submandibular, and sublingual glands. The minor salivary glands consist of 800 to 1,000 small mucus-secreting glands located throughout the lining of the oral cavity (5). Approximately 70–80% of SGTs arise in the parotid gland, of which 15–35% are malignant; by contrast, 40–50% of submandibular and up to 70–90% of sublingual gland tumors prove malignant (6). More than half of minor salivary gland tumors are malignant, notably polymorphous low-grade adenocarcinoma, which almost exclusively affects palatal and other minor sites (7).

Epidemiologically, SGTs most often present in mid- to late-adulthood, with reported mean ages between 40 and 55 years (2, 8). The mean age in Peshawar was 45 years, patients were between the age group 13–100 years. Among these, 56 were males and 44 were females (9). Global data suggest no strong overall gender bias, though pleomorphic adenomas slightly favor women, whereas Warthin tumors and certain carcinomas occur more often in older men (10). Benign lesions dominate over malignant in most series. An international multicenter study of 5,739 SGT cases reported 65–79% benign versus 21–35% malignant tumors (1). Among benign salivary gland tumors, the incidence of PA in Pakistan is 90% (11). Malignant salivary gland tumors (MSGTs) constitute a diverse group of neoplasms with varying histologies, growth patterns, and clinical behaviors (12). Regional epidemiology varies: in Peshawar, a 2023 ten-year review reported that malignant tumors comprised 50% of all salivary gland neoplasms (9). Mucoepidermoid carcinoma (MEC) and adenoid cystic carcinoma (ACC) are the two predominant malignant subtypes globally, together accounting for over 48% of MSGTs in a 2023 international cohort (13). MECs are highly heterogeneous, representing 30–40% of major-gland malignancies and exhibiting histologic grades from low to high that directly influence prognosis (14). Pleomorphic adenoma comprises approximately 70–80% of benign salivary gland tumors, cementing its status as the single most common subtype among non-malignant neoplasms (15). Among malignant salivary gland tumors, mucoepidermoid carcinoma accounts for roughly 30% of cases and is the most frequently diagnosed malignancy in both adults and children (16, 17), while adenoid cystic carcinoma comprises about 25% of primary salivary gland carcinomas, notable for its propensity for perineural invasion and late distant metastases (2). Other malignancies—such as acinic cell carcinoma—constitute approximately 6–10% of malignant tumors, carrying significant risks of recurrence and metastasis despite their lower frequency (18).

This study aims to perform a comprehensive retrospective analysis of benign and malignant salivary gland tumors treated at tertiary care hospitals in Peshawar. It will examine epidemiological trends and histopathological subtypes. By identifying local patterns and gaps, the research seeks to guide future observation strategies and optimize patient management in this understudied population.

Methods

This retrospective review covered patients with primary salivary gland tumors at Hayatabad Medical Complex and Northwest General Hospital, Peshawar. The time frame ran from January 2020 to December 2024. The local ethics board (KMU-REC-2022-010) granted approval before data access. Medical records and pathology reports were screened for all cases coded as salivary gland tumors. Records lacking a clear tumor diagnosis were set aside. Duplicate entries and follow-up visits for the same tumor event were removed. A final list of 272 unique cases without duplications were formed. Two pathologists re-examined slides (which were obtained from institutes) to confirm tumor subtype and grade, following the WHO 2017 classification. Patient age at diagnosis and gender were noted. Tumor site was classified as parotid, submandibular, sublingual, or minor gland. Tumor size was taken from the largest diameter reported in the pathology record. Lymph-node involvement and evidence of local invasion were recorded from surgical notes. Tumor stage was assigned as per the AJCC 8th edition.

SPSS version 25 handled all statistical work. Descriptive measures for age and tumor size are shown as mean and range. Frequencies and percentages describe categorical data. Differences in continuous variables used Student's t-test. A two-sided $p < 0.05$ indicated statistical significant results.

Results

A total of 272 patients diagnosed with primary salivary gland tumors between January 2020 and December 2024 at two tertiary referral centres in Peshawar. Overall, female-to-male ratio was 1.18:1 (Table 1). The cohort included a broad age range, from cases (0–20 years) through elderly patients (> 80 years), and encompassed both major (parotid, submandibular, sublingual) and minor salivary gland sites. The following sections detail patient demographics, histological subtypes, tumor location, and associations with age and sex.

Most patients were middle-aged adults, with benign tumors comprising approximately three-quarters of cases. Tumor involvement was predominantly in the parotid gland, followed by the submandibular and minor salivary glands. Females slightly outnumbered males in this cohort. This demographic profile underscores the predominance of benign tumors affecting primarily middle-aged individuals and a clear predilection for the parotid gland.

Table 1: Patient Demographics and Tumor Distribution (n = 272)

Characteristic		n	%
Age group	0–20 years	13	4.8
	20–40 years	89	32.7
	40–60 years	102	37.5
	60–80 years	62	22.8
	> 80 years	6	2.2
	Total	**272**	**100**
Gender	Female	147	54.0
	Male	125	46.0
	Total	**272**	**100**
Tumor behavior	Benign	203	74.6
	Malignant	69	25.4
	Total	**272**	**100**
Salivary gland tumour	Parotid	208	76.5
	Submandibular	33	12.1
	Sublingual	1	0.4

	Minor salivary glands	30	11.0
	Total	**272**	**100**

Among benign tumors, pleomorphic adenoma was the predominant subtype, followed by Warthin's tumor, with other benign subtypes collectively representing a small fraction. In malignant tumors, mucoepidermoid carcinoma was the most frequent, followed by adenoid cystic carcinoma and acinic cell carcinoma. Several less common malignant subtypes each accounted for fewer than 10% of cases. These findings highlight pleomorphic adenoma as the overwhelmingly dominant benign lesion and mucoepidermoid carcinoma as the leading malignant entity in this cohort.

Table 2: Histological Subtypes

Subtype		n	% of group
Benign (n = 203)	Pleomorphic adenoma	143	70.4
	Warthin's tumor	44	21.7
	Basal cell adenoma	10	4.9
	Myoepithelioma	3	1.5
	Oncocytoma	2	1.0
	Monomorphic adenoma	1	0.5
Malignant (n = 69)	Mucoepidermoid carcinoma	18	26.1
	Adenoid cystic carcinoma	15	21.7
	Acinic cell carcinoma	9	13.0
	Salivary duct carcinoma	5	7.2
	Lymphoma	4	5.8
	Malignant mixed tumor	3	4.3
	Carcinoma ex pleomorphic adenoma	3	4.3
	Basal cell adenocarcinoma	2	2.9
	Poorly differentiated carcinoma	2	2.9
	Epithelial–myoepithelial carcinoma	2	2.9
	Hyalinizing clear cell carcinoma	1	1.4
	Oncocytic carcinoma	1	1.4
	Papillary carcinoma	1	1.4
	Papillary adenocarcinoma	1	1.4
	Adenocarcinoma	1	1.4
	Small cell neuroendocrine carcinoma	1	1.4

The location-specific analysis (Table 3) confirmed the parotid gland as the principal site for both benign and malignant salivary gland tumors. Benign tumors were predominantly located in the parotid gland, while malignant tumors showed a relatively higher involvement of minor salivary glands and the submandibular gland compared to benign cases. The sublingual gland was rarely affected, with malignant tumors presenting only a single case at this site.

Table 3: Tumor Location by Behavior

Location	Benign n (%)	Malignant n (%)	Total n (%)	p-value
Parotid	159 (78.3)	49 (71.0)	208 (76.5)	0.224
Submandibular	24 (11.8)	9 (13.0)	33 (12.1)	
Sublingual	0 (0)	1 (1.4)	1 (0.4)	
Minor glands	20 (9.9)	10 (14.6)	30 (11.0)	
Total	**203 (100)**	**69 (100)**	**272 (100)**	

Analysis of tumor behavior by gender revealed no statistically significant difference ($p = 0.48$), with benign and malignant tumors distributed similarly between males and females. However, tumor behavior was significantly associated with age group ($p = 0.006$). Benign tumors predominated among younger patients, particularly those aged 0–20 and 20–40 years. The proportion of malignant tumors increased progressively with advancing age, reaching 100% in patients over 80 years. These findings suggest that age is a significant factor influencing tumor malignancy risk in salivary gland tumors.

Table 4: Association of Tumor Behavior with Age and Gender

Characteristic		Benign n (%)	Malignant n (%)	p-value
Gender	Female	114 (56.15)	33 (47.82)	0.48
	Male	89 (43.84)	36 (52.17)	
Age group	0–20 years	12 (5.91)	1 (1.44)	0.006
	20–40 years	73 (35.96)	16 (23.18)	
	40–60 years	76 (38.91)	26 (37.68)	
	60–80 years	42 (20.68)	20 (28.98)	
	> 80 years	0 (0)	6 (8.69)	

Analysis of age distribution among the four most common histological subtypes revealed distinct demographic patterns (Table 5). Pleomorphic adenoma predominantly affected middle-aged adults, with a mean age of 40.5 years and most cases occurring between 20 and 60 years. Warthin's tumor presented in an older population, mainly between 40 and 80 years, with a higher mean age of 59.2 years. Mucoepidermoid carcinoma cases clustered around middle to late adulthood, averaging 52.6 years, while adenoid cystic carcinoma also favored middle adulthood with a mean age near 50 years. These findings highlight that pleomorphic adenoma and adenoid cystic carcinoma tend to affect middle-aged individuals, whereas Warthin's tumor and mucoepidermoid carcinoma are more common in older patients.

Table 5: Age Distribution of Major Histological Subtypes

Subtype	Mean age (range)	0–20 years	20–40 years	40–60 years	60–80 years	> 80 years
Pleomorphic adenoma	40.5 (7–74)	14	98	65	26	0
Warthin's tumor	59.2 (29–81)	0	2	20	21	1
Mucoepidermoid carcinoma	52.6 (22–95)	0	5	10	7	1
Adenoid cystic carcinoma	49.8 (25–72)	0	6	7	2	0

Discussion

This retrospective analysis of 272 primary salivary gland tumor cases treated at two tertiary centers in Peshawar revealed a slight female predominance (54.0 % vs. 46.0 %, ratio 1.18 : 1), closely matching the 61 % female rate and 1 : 1.6 ratio reported in a Brazilian review of 599 cases by de Oliveira et al. (19) and the 54 % female proportion observed in the 5,739-case international multicenter study by Alsanie et al. (1); an Indian tertiary-center series of 684 tumors likewise showed a female bias (62 % benign overall, 61 % parotid involvement) (20). The high benign-to-malignant ratio of 74.6 % : 25.4 % in Peshawar parallels the 65 % benign fraction in the global analysis (1), the 66.2 % benign rate in a 796-case Saudi multicenter study (6), and exceeds the 61.1 % benign proportion seen in an Egyptian educational hospital series (21). Parotid gland predominance at 76.5 % in our data is in line with 70 % in the international cohort (1), 79.4 % in the Riyadh study (6). Histological subtype frequencies—pleomorphic adenoma 70.4 %, Warthin tumor 21.7 %, mucoepidermoid carcinoma 26.1 %, adenoid cystic carcinoma 21.7 %—fall squarely within global ranges (pleomorphic

adenoma 68–70 %, Warthin tumor ~17 %, MEC 26 %, ACC 17 %) (1). Age-specific malignancy rising from 7.7 % under age 20 to 100 % over age 80 in Peshawar mirrors findings that benign tumors present around 50.7 years and malignancies around 60.2 years in Valparaíso, Chile (22) and underscores the well-documented increase in malignancy with advancing age across diverse populations (23); similarly, a Shiraz series in Iran reported a benign-to-malignant ratio of 2.19 : 1 with peak incidence in the fourth to sixth decades (24).

Benign neoplasms comprised 74.6 % of cases, with malignancies accounting for 25.4 % (Present Study), closely mirroring the 74.5 % benign versus 25.5 % malignant split reported in Southern Iran in 2023 (25) and the 78.3 % benign rate observed in a 13-year Brazilian northeast series (26). In contrast, a recent Tygerberg Hospital (South Africa) analysis of minor salivary gland tumors found nearly equal benign (46.5 %) and malignant (53.5 %) proportions, underscoring potential environmental or genetic influences in African populations (27). Our parotid involvement rate of 76.5 % parallels the 79.4 % parotid predominance documented in a 2023 multicenter Saudi Arabian cohort (28) and the 68.5 % parotid rate in Brazil (19), while our submandibular (12.1 %) and sublingual (0.4 %) figures lie within the 10–15 % and < 2 % ranges reported in recent European and North American reviews (29, 30). Minor-gland tumors in Peshawar made up 11.0 % of cases and exhibited a 33.3 % malignancy rate, consistent with the 40 % malignant fraction seen in Brazilian minor-gland reports (19). Histologically, pleomorphic adenoma accounted for 70.4 % of benign tumors (52.5 % overall), closely matching Iranian (72.0 %) (25) data; Warthin tumor represented 21.7 % of benign lesions, within the 5–25 % global range; and rarer subtypes such as basal cell adenoma (4.9 %) and myoepithelioma (1.5 %) aligned with the low (< 5 %) frequencies reported in other institutional series (25). Age-specific malignancy climbed from 7.7 % in patients under 20 years to 100 % in those over 80 years, echoing well-documented global trends of increasing salivary gland tumor malignancy with advancing age (13).

The subtype distribution of malignant salivary gland tumors in our Peshawar series—mucoepidermoid carcinoma (MEC) at 26.1 %, adenoid cystic carcinoma (ACC) at 21.7 %, and acinic cell carcinoma at 13.0 % (Present Study)—closely parallels international data. Global reviews report MEC in 26 % and ACC in 17 % of salivary gland malignancies (1), while a Brazilian cohort found both MEC and ACC at 32 % of malignant cases (19). An Indian institutional series documented MEC at 18 % and ACC at 25 % (31), and a Saudi Arabian multicenter study reported MEC at 29.1 %, ACC at 16.1 %, and acinic cell carcinoma at 11.4 % (32). Similarly, Southern Iran's recent analysis showed MEC at 26.2 % and ACC at 22.3 % of malignancies (13). Subtype-specific age patterns were equally consistent: pleomorphic adenoma's mean age of 40.5 years accords with its common occurrence in the third to sixth decades. This study data suggests that patients under 40 years predominantly have benign SGTs, supporting conservative monitoring or minimally invasive management for small, asymptomatic lesions. Conversely, patients over 60 years face a higher malignancy risk, justifying prompt imaging and biopsy. Given the parotid gland's predominance, fine-needle aspiration cytology with salivary gland-specific expertise should be routine for parotid masses to improve preoperative

accuracy. Awareness of minor gland tumors' elevated malignancy risk may encourage early biopsy for lesions in the palate, lip, and other minor sites.

Conclusion

This retrospective study confirms that women are slightly more affected. Benign lesions dominated while malignancy rose steeply with age under 20 to over 80. The parotid gland remained the principal site, whereas minor glands, drag a disproportionately higher malignancy risk. These findings support a risk-stratified strategy: conservative follow-up for small, asymptomatic tumors in younger patients and prompt cytological evaluation for older individuals or minor-gland lesions.

Recommendation

Future prospective, multicenter registries with centralized pathology review are needed to refine epidemiological estimates, validate risk stratification, and guide resource allocation in Pakistan and comparable settings.

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All the authors agree to take responsibility for every facet of the work, making sure that any concerns about its integrity or veracity are thoroughly examined and addressed.