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Original Article

Patient-related factors influencing delays in oral cancer diagnosis: Insights from Pakistan

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Abstract *Background/purpose:* South Asia has a high burden of oral cancer (OC); however, delays in diagnosis remain under-researched. The study investigated delay intervals in OC diagnosis and the contributing factors in rural Pakistan, considering its unique sociocultural context.
Materials and methods: This multi-center cross-sectional study employed a structured questionnaire to interview 152 oral squamous cell carcinoma (OSCC) patients. The diagnostic intervals were determined using the Aarhus Statement. Logistic regression assessed the association between independent factors and delay types.
Results: Patient delays occurred in 76.3 % of cases, mostly due to appraisal delays (65 %), while diagnostic delays appeared in 51.3 %. Median durations for patient, diagnostic, and total delays were 3, 1, and over 4 months, respectively. Appraisal delay was associated with infrequent dental visits (adjusted odds ratio [AOR]: 11.04, confidence interval [CI]: 2.29–81.53), advanced stage OSCC (AOR: 5.42, CI: 2.35–13.03), and rural residence (AOR: 3.99, CI: 1.75–9.35). Help-seeking delay was linked to use of home remedies (AOR: 5.74, CI: 2.35–14.46) and homeopathy (AOR: 4.72, CI: 1.90–11.91). Patient delay associated with advanced stage OSCC (AOR: 7.73, CI: 3.28–19.12) and rural residence (AOR: 3.91, CI: 1.62–9.69). Diagnostic delay was influenced by patients' lack of OC knowledge (AOR: 7.33, CI: 1.30–51.74), more than two visits before biopsy (AOR: 52.88, CI: 1.50–270.88), and initial treatment with analgesics (AOR: 13.37, CI: 3.68–60.99) or antimicrobials (AOR: 3.95, CI: 1.06–18.23).
Conclusion: Delays in OC diagnosis arise from inadequate patient awareness, rural residence, traditional and complementary medicine use, and health system challenges. Improving healthcare access and public awareness are crucial.

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Introduction

Oral cancer (OC) is a significant global health challenge, with 389,846 new cases and 188,438 deaths reported in 2022.[1] Globally, South Asia (SA) has the highest OC incidence and mortality rates, with Pakistan ranked fourth (ASIR 9.2) and third (ASMR 5.9). Among Pakistani men, OC is the most common cancer and the second leading cause of cancer-related deaths in both sexes.[1]

OC exhibits a poor five-year survival of around 50 %—66 %,[2,3] which is related mostly to advanced stage disease. Early detection and timely treatment are crucial for reducing OC mortality and morbidity. Advanced stage presentation is strongly associated with delays in diagnosis.[4]

Several variables have been reported to be related to OC burden.[5] Most studies about delays in diagnosis originate from different healthcare systems or high-income settings.[3,5,6] Factors contributing to diagnostic delays in South Asia may differ from those in other regions. Lack of awareness about OC symptoms,[7,8] and its risk factors,[9] has been reported from Pakistan. Sociodemographic variables—such as older age,[10,11] and low literacy,[10]—were also found to be linked with longer delays in Indian studies. Financial constraints[7,10,12] and limited access to healthcare facilities[13] play a significant role. The latter may be attributed to the large proportion of the South Asian population residing in rural areas, which can hinder access to early screening and treatment.[9] Variability in findings may also arise from methodological flaws, such as the absence of a standardized theoretical framework for the design and reporting of time points, as well as the definition and measurement of diagnostic intervals in cancer studies.[14]

The Aarhus Statement was developed to standardize the pre-diagnostic journey of cancer patients by clearly defining key time points, diagnostic intervals, and methodological approaches. Thus, it enhances the comparability and reliability of research findings.[14] Studies in Asia have rarely employed the Aarhus Statement,[12,13] limiting the standardization and comparability of OC research on delay in diagnosis.

South Asia has the highest OC burden, with a unique sociocultural background influencing OC diagnosis. However, research on diagnostic delays in South Asia remains scarce. Thus, this study aimed to assess the delay intervals of OC using the Aarhus Statement framework and identify factors contributing to delay in diagnosis in Khyber Pakhtunkhwa (KPK), a province with a predominantly rural population in Pakistan.

Materials and methods

This multi-center cross-sectional study was conducted on consecutive histopathologically confirmed oral squamous cell carcinoma (OSCC) patients (ICD: C00—C06)[15] between April and September 2023 in KPK, a province in northwest Pakistan. Patients with recurrent OSCC and those unable to answer the questionnaire were excluded. Data were collected from four hospitals, including three tertiary care centers: Hayatabad Medical Complex (HMC), Institute of Radiotherapy and Nuclear Medicine (IRNUM), and Mardan Medical Complex (MMC); and Sardar Begum Dental College and Hospital (SBDC&H).

Ethical approval for this study was obtained from the Human Research Ethics Committee of the Faculty of Dentistry, Prince of Songkla University, Thailand (EC6602-009), as well as from the respective ethics committees of the participating hospitals: HMC (HMC-QAD-F-00), IRNUM (IRNM/RDPC/2023/27), MMC (327/BKMC), and SBDC&H (approved by hospital authority on May 5, 2023). All study procedures were conducted in accordance with relevant guidelines and regulations, in compliance with the Declaration of Helsinki. Written informed consent was obtained from all participants prior to their enrollment in the study.

A structured questionnaire was developed to investigate patient-related factors. Diagnostic intervals were determined using the Aarhus Statement.[14] In the study, appraisal and help-seeking intervals combined are regarded as patient intervals, and the total interval is the sum of the latter and diagnostic intervals (Fig. 1). Appraisal, help-seeking, or diagnostic delays were recorded if they exceeded 30 days.[12,16] Patient delay was defined as either appraisal or help-seeking delay. Total delay was determined as the presence of either patient or diagnostic delay. The questionnaire covered sociodemographic factors, prior knowledge, barriers to healthcare access, diagnostic barriers, OSCC clinical history, treatments received before professional consultation, and a timeline of events prior to diagnosis. The questionnaire was translated from English to Urdu, the national language of Pakistan, using the back-translation method to ensure cultural and linguistic appropriateness.[17] UA conducted face-to-face interviews to complete the questionnaires, each lasting 15—20 min. Patient responses were verified with referral letters and medical records during the interview. TNM staging and related history were retrieved from individuals' medical records.

The study is part of a large project. The sample size of 152 participants was calculated based on a 5:1 participant-to-item ratio of another part involving Exploratory Factor Analysis (EFA) of a 31-item questionnaire.[18]

Statistical analysis

The data collected were initially entered into Microsoft Excel (version 2303) for organization and preliminary checks. Descriptive statistics were used to summarize the baseline sociodemographic and clinical characteristics of the study population. Continuous variables related to time intervals, such as appraisal, help-seeking, diagnostic, and

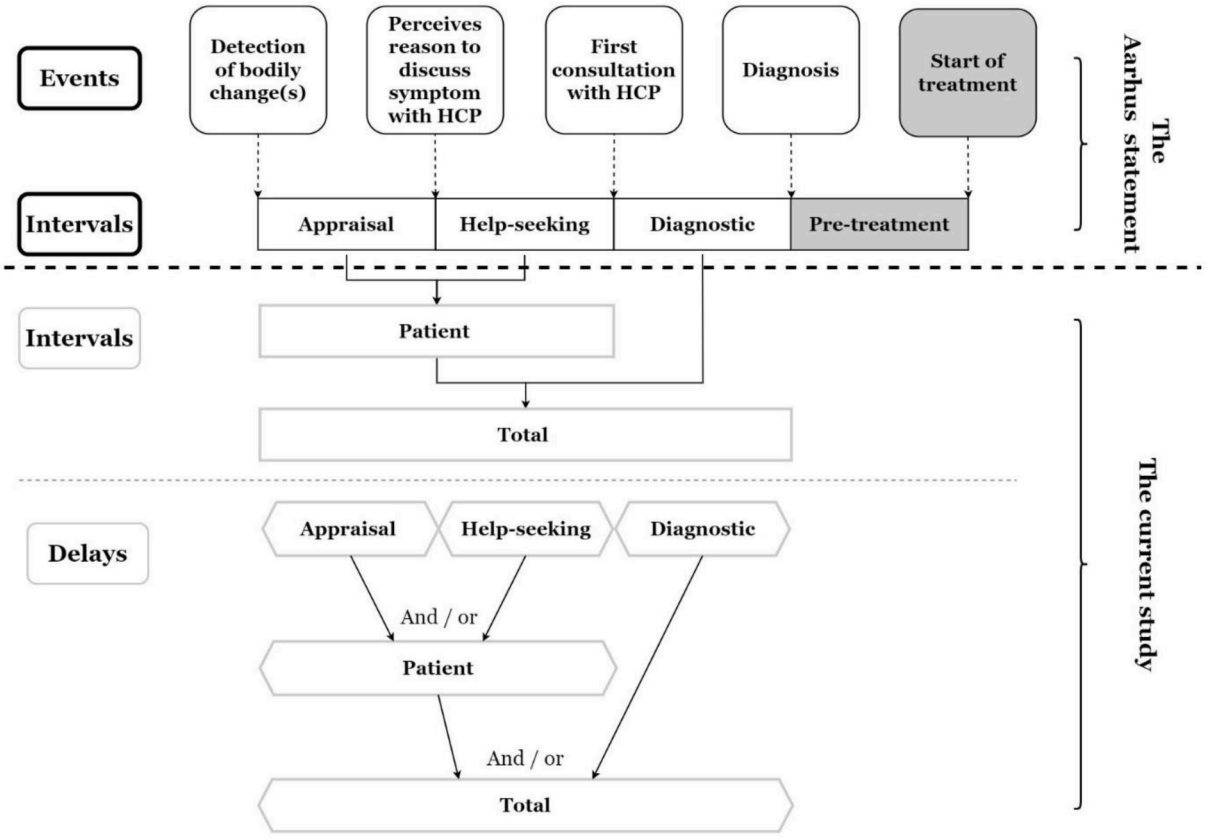

Figure 1 Key events, time intervals, and delays in the diagnosis of oral squamous cell carcinoma (OSCC): in relation to the Aarhus Statement framework.[14]; HCP, healthcare provider.

patient delays, were analyzed using measures of central tendency (mean, median) and dispersion (standard deviation, interquartile range).

Univariable and multivariable logistic regression analyses examined the associations between various independent variables (sociodemographic factors, cancer characteristics, and healthcare barriers) and different types of delay. Four specific delay outcomes were assessed: appraisal, help-seeking, patient, and diagnostic delay. Univariable analysis assessed each independent variable individually to identify potential associations with the delay outcomes. Statistically significant variables were included in the multivariable models to account for confounding factors. The analysis provided adjusted odds ratios (AOR) and 95 % confidence intervals (CI) to evaluate the strength of the associations between independent variables and outcomes.

The delay outcomes were categorized as binary (yes/no) variables for all analyses. Additionally, independent variables were transformed into binary or ordinal categories where applicable to enhance the analysis. All statistical analyses were conducted using R software (version 4.2.2, R Foundation for Statistical Computing, Vienna, Austria), and statistical significance was set at $P < 0.05$.

Results

The study included 152 OSCC patients; 69 (45.4 %) were newly diagnosed cases, while 83 (54.6 %) were follow-up cases, diagnosed within the last two years. The subgroup analysis of newly diagnosed and follow-up cases revealed no statistically significant differences in any delay interval. Thus, both groups were included in the statistical analysis. Table 1 summarizes characteristics of the patients. The participants had a male-to-female ratio of 2:1, with a mean age of 53.6 years (range: 21—90 years). The majority received either no formal education or less than 10 years of schooling and had public health coverage. Most of the patients had never had routine dental checkups or only sought dental care when experiencing symptoms. Travel distance and cost of medical care were the primary barriers to accessing healthcare. Women (69.7 %) reported healthcare access challenges more frequently than men (52 %).

The majority of the patients sought treatment, including over-the-counter medications (73.6 %) and Traditional and Complementary Medicine (T&CM) therapies (65 %), prior to visiting healthcare providers (HCPs). For the latter, faith healing was the most common therapeutic approach.

HCPs provided appropriate initial treatments to 73.6 % of patients, including a prompt biopsy (12.5 %), scheduling a biopsy for the next visit (15.8 %), or referral to a specialist (45.4 %). The majority of patients (76 %) underwent a biopsy within the first four HCP visits. Additionally, over half (58.6 %) received a biopsy within one month of initial contact, while 18.4 % had their biopsy during the second month.

Patient delays were reported in 116 patients (76.3 %), with 99 experiencing appraisal delays, 37 reporting help-seeking delays, and 20 experiencing both. Diagnostic delays

Table 1 Baseline sociodemographic and clinical characteristics of patients with oral squamous cell carcinoma (n = 152).

Variable	No. of patients (%)
Demographic and socioeconomic factors	
Sex	
Male	104 (68.4)
Female	48 (31.6)
Age	
≤40	34 (22.3)
40—60	66 (43.4)
≥60	52 (34.2)
Area of residence	
Rural	110 (72.4)
Urban	42 (27.6)
Marital status	
Currently married	124 (81.6)
Previously married	21 (13.8)
Never married	7 (4.6)
Employment status	
Employed	92 (60.5)
Unemployed	60 (39.5)
Education level	
No formal education	60 (39.5)
Formal education	
≤10 years	62 (40.7)
>10 years	30 (19.7)
Average monthly income in Pakistani rupees (PKR)[a]	
No income	5 (3.3 %)
Less than 15,000 PKR	48 (31.6 %)
Between 15,001 and 25,000 PKR	36 (23.7 %)
Between 25,001 and 50,000 PKR	37 (24.3 %)
More than 50,000 PKR	26 (17.1 %)
Health insurance	
No	27 (17.8)
Yes	125 (82.2)
Dental checkups	
Never had dental checkup	41 (26.9)
Only when symptoms occur	100 (65.7)
At least once per year	11 (7.2)
Disease-related factors	
Initial symptoms	
Pain	97 (63.8)
Ulcer and other symptoms	55 (36.2)
Cancer stage	
Early (I/II)	39 (25.7)
Advance (III/IV)	113 (74.3)
Cancer site	
Buccal mucosa	68 (44.7)
Tongue and floor of mouth	40 (26.3)
Other parts of lip and oral cavity	44 (28.9)
Healthcare accessibility and alternative treatment	
Convenience to receive medical care	
Convenient	65 (42.8)
Inconvenient	87 (57.2)
Treatment received before HCP consultation[b]	113 (74.3)
Over-the-counter medication	112 (99.1)
T&CM[c]	99 (87.6)
Faith healing	71 (62.8)
Home remedies	31 (27.4)
Homeopathy	31 (27.4)
Religious verses	22 (19.4)
Hakeem/Tabeeb	18 (16.0)
Delay in HCP consultation despite not seeking T&CM[c]	39 (25.7)
Waiting for spontaneous healing	32 (82.0)
Observing the progress of the symptoms	22 (56.4)
Consulting with friends and family	9 (23.0)

(*continued on next page*)

(*continued*)

HCP, healthcare provider; PKR, Pakistani rupees; T&CM, traditional and complementary medicine.

[a] Exchange rate in September 2023: 280 PKR per 1 US dollars.

[b] Participants could provide more than one response.

[c] T&CM encompasses various modalities, including faith healing (spiritual or religious rituals conducted by faith healers), home remedies (utilization of natural substances for self-treatment), homeopathy (an alternative medical system based on highly diluted substances derived from plants, minerals, or animal sources to stimulate the body's self-healing mechanisms), religious verses (recitation of Quranic verses for healing), and Hakeem/Tabeeb (a traditional Greco-Arabic medical system incorporating herbal formulations, dietary modifications, and physical therapies for holistic healing).

were observed in 78 patients (51.3 %), of whom 64 had both patient and diagnostic delays. The median appraisal interval was 61 days, accounting for the largest portion of the patient interval (median: 89 days). The patient interval was three times longer than the diagnostic interval, making it the primary contributor to the total delay (Table 2). Patient delay ranged from 0 to 1067 days, while total delay ranged from 16 to 1444 days.

Multivariable analysis identified several significant factors associated with delay in OSCC diagnosis. Appraisal delay was linked to never visiting the dentist or visiting only when experiencing symptoms (AOR: 11.04, CI: 2.29—81.53), advanced stage OSCC (AOR: 5.42, CI: 2.35—13.03), and rural residence (AOR: 3.99, CI: 1.75—9.35) (Table 3). Help-seeking delay was related to reliance on home remedies (AOR: 5.74, CI: 2.35—14.46) and the use of homeopathy (AOR: 4.72, CI:

Table 2 Overview of the time intervals in the diagnosis of oral squamous cell carcinoma (n = 152).

Time intervals (days)	Mean	SD	Q1	Median	Q3	Range
Appraisal interval	114.6	179.6	16	61	123	0—1067
Help-seeking interval	42.3	128.6	0	0	18	0—974
Patient interval	156.9	210.3	31	89	181	0—1067
Diagnostic interval	63.6	102.6	15	32	62	4—778
Total interval	220.6	245.7	72	135	265	16—1444

SD, standard deviation; Q1, quartile 1 (25th percentile); Q3, quartile 3 (75th percentile).

Table 3 Association of appraisal delay with characteristics of the oral squamous cell carcinoma patients.

Variable	Appraisal delay[a] n (row %)		Crude odds ratio		Adjusted odds ratio	
	Yes	No	COR (95 % CI)	*P*-value	AOR (95 % CI)	*P*-value
Overall	99 (65.1)	53 (34.9)				
Age						
<53	39 (55.7)	31 (44.3)	Ref	0.025		
≥ 53	60 (73.2)	22 (26.8)	2.16 (1.10–4.31)			
Area of residence						
Urban	18 (42.9)	24 (57.1)	Ref	<0.001	Ref	0.001
Rural	81 (73.6)	29 (26.4)	3.72 (1.78–7.94)		3.99 (1.75–9.35)	
Occupation						
Employed	53 (57.6)	39 (42.4)	Ref	0.017		
Non-employed	46 (76.7)	14 (23.3)	2.42 (1.19–5.13)			
Level of education						
>10 years	14 (46.7)	16 (53.3)	Ref	0.020		
≤10 years	85 (69.7)	37 (30.3)	2.62 (1.16–6.0)			
Knowledge of oral cancer before diagnosis						
Yes	7 (33.3)	14 (66.7)	Ref	0.001		
No	92 (70.2)	39 (29.8)	4.71 (1.81–13.30)			
Frequency of dental checkup						
At least one visit per year	2 (18.2)	9 (81.8)	Ref	0.004	Ref	0.005
Never or only when having symptoms	97 (68.8)	44 (31.2)	9.92 (2.43–66.86)		11.04 (2.29–81.53)	
Last dental checkup						
Checkup within last 1 year	16 (43.2)	21 (56.8)	Ref	0.001		
Never had checkup or long time since last checkup	83 (72.2)	32 (27.8)	3.40 (0.39–1.45)			
Cancer stage						
Early	14 (35.9)	25 (64.1)	Ref	<0.001	Ref	<0.001
Advance	85 (75.2)	28 (24.8)	5.42 (2.51–12.11)		5.42 (2.35–13.03)	
Healthcare accessibility						
Convenient	35 (53.0)	30 (46.0)	Ref	0.012		
Inconvenient	64 (73.6)	23 (26.4)	2.38 (1.21–4.76)			
First HCP consultation						
Dentist	19 (43.2)	25 (56.8)	Ref	0.029		
Doctor	70 (71.4)	28 (28.6)	2.15 (1.08–4.32)			
Number of biopsy visits						
≤2	29 (51.8)	27 (48.2)	Ref	0.009		
>2	70 (72.9)	26 (27.1)	2.50 (1.26–5.04)			
Perception of spontaneous healing						
No	73 (60.8)	47 (39.2)	Ref	0.036		
Yes	26 (81.3)	6 (18.7)	2.78 (1.12–7.94)			
Initial symptoms						
Red, white patch	28 (53.8)	24 (46.2)	Ref	0.036		
Other symptoms	71 (71.0)	29 (29.0)	2.09 (1.04–4.22)			

AOR, adjusted odds ratio; COR, crude odds ratio; CI, confidence interval; HCP, healthcare provider; T&CM, traditional and complementary medicine.

[a] Appraisal delay was recorded if it exceeded 30 days.

1.90–11.91) (Table 4). Patient delay was also associated with advanced stage OSCC (AOR: 7.73, CI: 3.28–19.12) and rural residence (AOR: 3.91, CI: 1.62–9.69) (Table 5).

Diagnostic delay was associated with a lack of prior knowledge of OC (AOR: 7.33, CI: 1.30–51.74), more than two visits to HCPs prior to undergoing a biopsy (AOR: 52.88, CI: 1.50–270.88), and initial treatment with analgesics (AOR: 13.37, CI: 3.68–60.99) or antimicrobials (AOR: 3.95, CI: 1.06–18.23) (Table 6).

Discussion

The present study systematically assessed delays in the diagnosis of OC, highlighting aspects of early detection in low-resource and culturally distinct settings in South Asia. By evaluating appraisal, help-seeking, patient, and diagnostic intervals independently, the study identifies delay-specific factors, providing more nuanced insights than

Table 4 Association of help-seeking delay with characteristics of the oral squamous cell carcinoma patients.

Variable	Help-seeking delay n (row %)[a]		Crude odds ratio		Adjusted odds ratio	
	Yes	No	COR (95 % CI)	*P*-value	AOR (95 % CI)	*P*-value
Overall	37 (24.3)	115 (75.7)				
Cancer stage						
Early	4 (10.3)	35 (89.7)	Ref	0.023		
Advance	33 (29.2)	80 (70.8)	3.60 (1.31–12.77)			
Reasons for delay in HCP consultation						
Perception of spontaneous healing						
No	34 (28.3)	86 (71.7)	Ref	0.035		
Yes	3 (9.4)	29 (90.6)	3.82 (1.24–16.69)			
Over the counter medication						
No	4 (10.0)	36 (90.0)	Ref	0.019		
Yes	33 (29.5)	79 (70.5)	3.75 (1.36–13.30)			
Home remedies[b]						
No	20 (16.5)	101 (83.5)	Ref	<0.001	Ref	<0.001
Yes	17 (54.8)	14 (45.2)	6.13 (2.63–14.68)		5.74 (2.35–14.46)	
Homeopathy[c]						
No	21 (17.4)	100 (82.6)	Ref	<0.001	Ref	<0.001
Yes	16 (51.6)	15 (48.4)	5.08 (2.18–12.01)		4.72 (1.90–11.91)	
Hakeem/Tabeeb[d]						
No	29 (21.7)	105 (78.3)	Ref	0.040		
Yes	8 (44.4)	10 (55.6)	2.90 (0.18–0.41)			
Faith healing[e]						
No	11 (15.5)	60 (84.5)	Ref	0.019		
Yes	26 (32.1)	55 (67.9)	2.57 (1.19–5.89)			

AOR, adjusted odds ratio; COR, crude odds ratio; CI, confidence interval; HCP, healthcare provider; T&CM, traditional and complementary medicine.

[a] Help-seeking delay was recorded if it exceeded 30 days.

[b] Home remedies:utilization of natural substances for self-treatment.

[c] Homeopathy: an alternative medical system based on highly diluted substances derived from plants, minerals, or animal sources to stimulate the body's self-healing mechanisms.

[d] Hakeem/Tabeeb: a traditional Greco-Arabic medical system incorporating herbal formulations, dietary modifications, and physical therapies for holistic healing.

[e] Faith healing (spiritual or religious rituals conducted by faith healers.

previous research that often assessed delay as a single composite measure. Although T&CM is common in this region, the current study is the first to report its association, specifically homeopathy and faith healing, with help-seeking delay. Rural residence and lack of patient knowledge were also among the most notable factors. Appraisal and diagnostic delays were the primary contributors to significant delays in diagnosis. The variability in the definitions of delay and the examined variables complicates the comparison of outcomes across research.

Advanced stage diagnosis was observed in 74 % of patients, aligning with the range (58 %–91 %) reported in South Asian studies.[10,19] In contrast, significantly lower rates (33 %–40 %) have been documented in high-income countries (HICs).[20,21] These findings highlight the pressing need for targeted interventions to reduce patient intervals in lower-middle income countries (LMICs), enabling earlier detection and better survival outcomes.

Most studies combine appraisal and help-seeking delays into a single patient interval. In this study, the median patient interval of three months is consistent with the 90–92 day range reported in South Asia.[9,13] This duration is slightly longer than the 75-day median reported for other LMICs and nearly three times the one-month average for HICs as reported in a meta-analysis study.[3] The median diagnostic interval in this study was 32 days, aligning closely with the 35-day average reported across both LMICs and HICs.[3] The income level of a country seems to affect patient delay but not diagnostic delay.

Reducing appraisal delay is crucial, as it constitutes major part of patient delay. Appraisal delay was significantly associated with rural residence, the absence of routine dental checkups, and advanced stage of disease. Rural residence and advanced stage diagnosis were also associated with patient delay, with rural residence having four times the odds of experiencing delays than their urban counterparts. Similar findings have been reported in other South Asian studies.[9,22] These prolonged delays in rural Pakistan reflect deeper socioeconomic disparities, limited awareness of early OC symptoms, and systemic barriers such as inadequate healthcare access, transportation challenges, and financial hardships. Similar trends have been reported in other rural South Asian settings.[9,23]

Regular dental visits offer the potential for early, and often incidental, detection of OC through routine screenings, even during asymptomatic phases.[24] Nevertheless, this

Table 5 Association of patient delay with characteristics of the oral squamous cell carcinoma patients.

Variable	Patient delay[a] n (row %)		Crude odds ratio		Adjusted odds ratio	
	Yes	No	COR (95 % CI)	*P*-value	AOR (95 % CI)	*P*-value
Overall	116 (76.3)	36 (23.7)				
Age						
<53	47 (67.1)	23 (32.9)	Ref	0.015		
≥ 53	69 (84.1)	13 (15.9)	2.59 (1.21–5.76)			
Area of residence						
Urban	24 (57.1)	18 (42.9)	Ref	<0.001	Ref	0.002
Rural	92 (83.6)	18 (16.4)	3.83 (1.73–8.55)		3.91 (1.62–9.69)	
Occupation						
Employed	65 (74.7)	22 (25.3)	Ref	0.045		
Non-employed	51 (85.0)	9 (15.0)	2.35 (1.04–5.70)			
Level of education						
>10 years	16 (53.3)	14 (46.7)	Ref	0.001		
≤10 years	100 (82.0)	22 (18.0)	3.97 (1.68–9.40)			
Knowledge of oral cancer before diagnosis						
Yes	10 (47.6)	11 (52.4)	Ref	0.001		
No	106 (80.9)	25 (19.1)	4.66 (1.78–12.41)			
Frequency of dental checkup						
At least 1 visit per year	4 (36.4)	7 (63.6)	Ref	0.003		
Never or only when having symptoms	112 (79.4)	29 (20.6)	6.75 (1.91–27.29)			
Last dental checkup						
Checkup within last 1 year	20 (54.1)	17 (45.9)	Ref	<0.001		
Never had checkup or long time since last checkup	96 (83.5)	19 (16.5)	4.29 (1.90–9.77)			
Cancer stage						
Early	18 (46.2)	21 (53.8)	Ref	<0.001	Ref	<0.001
Advance	98 (86.7)	15 (13.3)	7.62 (3.36–17.90)		7.73 (3.28–19.12)	
Healthcare accessibility						
Convenient	72 (82.8)	15 (17.2)	Ref	0.032		
Inconvenient	44 (67.7)	21 (32.3)	2.29 (1.07–4.97)			
First HCP consultation						
Dentist	35 (64.8)	19 (35.2)	Ref	0.014		
Doctor	81 (82.7)	17 (17.3)	2.58 (1.20–5.61)			
Travel for medical care						
Convenient	45 (68.2)	21 (31.8)	Ref	0.041		
Inconvenient	71 (82.6)	15 (17.4)	2.20 (1.03–4.79)			
Health condition prevented medical access						
No	73 (69.5)	32 (30.5)	Ref	0.005		
Yes	43 (91.5)	4 (8.5)	4.71 (1.72–16.62)			
Referral to specialist on first HCP consultation						
Yes	58 (69.9)	25 (30.1)	Ref	0.043		
No	58 (84.1)	11 (15.9)	2.27 (1.04–5.20)			
Appointment for biopsy on second visit						
No	102 (79.7)	26 (20.3)	Ref	0.027		
Yes	14 (58.3)	10 (41.7)	2.80 (1.09–7.00)			

AOR, adjusted odds ratio; COR, crude odds ratio; CI, confidence interval; HCP, healthcare provider.
[a] Patient delay was recorded with either appraisal or help-seeking delay.

study found that the absence of consistent dental examinations was a major contributor to appraisal delays, reinforcing similar findings from an Indian study.[12] This may serve as an explanation for the correlation between advanced stage disease at the time of diagnosis and both appraisal and patient delay. It is important to consider that the two findings may be triggered by residing in a rural area.

T&CM practices are prevalent among cancer patients in South Asia, such as Pakistan, India and Nepal.[25] The use of T&CM emerged as a significant factor contributing to help-seeking delays in this study. Other studies from Pakistan also reported the use of homeopathy and spiritual healing among OC patients.[7,26] T&CM use is deeply embedded in Pakistan's cultural landscape, with reported prevalence ranging from 51 % to 70 %.[27,28] In the current study, 65 % of OC patients reported using one or more forms of T&CM prior to consulting HCPs. This behavior likely reflects not only cultural preferences and the perceived non-toxicity of

Table 6 Association of diagnostic delay with characteristics of the oral squamous cell carcinoma patients.

Variable	Diagnostic delay[a] n (row %)		Crude odds ratio		Adjusted odds ratio	
	Yes	No	COR (95 % CI)	*P*-value	AOR (95 % CI)	*P*-value
Overall	78 (51.3)	74 (48.7)				
Area of residence						
Urban	13 (30.9)	29 (69.1)	Ref	0.002		
Rural	65 (59.1)	45 (40.9)	3.22 (1.53–7.04)			
Knowledge of oral cancer before diagnosis						
Yes	3 (14.3)	18 (85.7)	Ref	0.001	Ref	0.03
No	75 (57.3)	56 (42.7)	8.03 (2.56–35.50)		7.33 (1.30–51.74)	
Health insurance						
Yes	20 (23.0)	67 (77.0)	Ref	0.011		
No	58 (89.2)	7 (10.8)	3.30 (1.35–8.92)			
Cancer stage						
Early	13 (33.3)	26 (66.7)	Ref	0.010		
Advance	65 (57.5)	48 (42.5)	2.70 (1.28–5.95)			
Cancer site						
Tongue	72 (55.0)	59 (45.0)	Ref	0.030		
Oral cavity	6 (28.6)	15 (71.4)	3.05 (1.16–9.00)			
Healthcare accessibility						
Convenient	23 (35.4)	42 (64.6)	Ref	<0.001		
Inconvenient	55 (63.2)	32 (36.8)	3.13 (1.62–6.20)			
First HCP consultation						
Dentist	18 (33.3)	36 (66.7)	Ref	0.001		
Doctor	60 (61.2)	38 (38.8)	3.15 (1.59–6.44)			
Cost of travel for medical care						
Affordable	28 (38.9)	44 (61.1)	Ref	0.003		
Unaffordable	50 (62.5)	30 (37.5)	2.61 (1.36–5.09)			
Distance and time of travel for medical care						
Convenient	23 (34.8)	43 (65.2)	Ref	<0.001		
Inconvenient	55 (63.9)	31 (36.1)	3.31 (1.71–6.57)			
Health condition prevented medical access						
No	47 (44.8)	58 (55.2)	Ref	0.017		
Yes	31 (65.9)	16 (34.1)	2.39 (1.18–4.97)			
Referral to specialist on first HCP consultation						
Yes	28 (40.6)	41 (59.4)	Ref	0.016		
No	50 (60.2)	33 (39.8)	2.21 (1.16–4.29)			
Homeopathy						
No	57 (47.1)	64 (52.9)	Ref	0.043		
Yes	21 (67.7)	10 (32.3)	2.35 (1.04–5.62)			
Faith healing						
No	30 (42.3)	41 (57.7)	Ref	0.037		
Yes	48 (59.3)	33 (40.7)	1.98 (1.04–3.82)			
Number of biopsy visits						
≤2	3 (5.4)	53 (94.6)	Ref	<0.001	Ref	<0.001
>2	75 (78.1)	21 (21.9)	63.09 (20.63–277.71)		52.88 (1.50–270.88)	
Proper treatment on first HCP consultation						
Yes	43 (38.4)	69 (61.6)	Ref	<0.001		
No	35 (87.5)	5 (12.5)	6.64 (3.26–14.14)			
Antimicrobial treatment on first HCP consultation						
No	42 (44.2)	53 (55.8)	Ref	0.024	Ref	0.053
Yes	36 (63.2)	21 (36.8)	2.16 (1.11–4.29)		3.95 (1.06–18.23)	
Analgesic treatment on first HCP consultation						
No	19 (26.8)	52 (73.2)	Ref	<0.001	Ref	<0.001
Yes	59 (72.8)	22 (27.2)	7.33 (3.64–15.38)		13.37 (3.68–60.99)	
Reassurance of benign lesion on first HCP consultation						
No	59 (44.7)	73 (55.3)	Ref	0.002		
Yes	19 (95.0)	1 (5.0)	23.50 (4.66–428.55)			

(*continued on next page*)

Table 6 (*continued*)

Variable	Diagnostic delay[a] n (row %)		Crude odds ratio		Adjusted odds ratio	
	Yes	No	COR (95 % CI)	*P*-value	AOR (95 % CI)	*P*-value
Biopsy on first HCP consultation						
No	1 (5.3)	18 (94.7)	Ref	0.002		
Yes	77 (57.9)	56 (42.1)	24.74 (4.88—451.82)			
Utilization of T&CM prior to HCP consultation						
No	62 (47.3)	69 (52.7)	Ref	0.019		
Yes	16 (76.2)	5 (23.8)	3.56 (1.30—11.40)			

AOR, adjusted odds ratio; COR, crude odds ratio; CI, confidence interval; HCP, healthcare provider; T&CM, traditional and complementary medicine.

[a] Diagnostic delay was recorded if it exceeded 30 days.

T&CM, but also barriers such as limited access to healthcare, workforce shortages, and affordability issues.[26,27] Importantly, the observed association between the use of home remedies and homeopathy and help-seeking delay is a novel finding. This may encourage future research to systematically assess T&CM use as a potential contributor to delay in diagnosis in South Asian settings.

After the implementation of Universal Health Coverage (UHC), comparative studies of diagnosis delays have revealed that traditional medication is no longer a significant factor in both patient and total delays of OC.[6,29] Systemic reforms that enhance healthcare accessibility may mitigate health seeking delays in comparable environments.

Both patients and HCPs are responsible for diagnostic delays. Patients' lack of awareness about OC symptoms prior to diagnosis was associated with a seven-fold increase in the odds of delay. Studies conducted in South Asia have consistently reported limited patient awareness of OC symptoms.[7,8,12] This aligns with systematic reviews, which link patients' insufficient knowledge of OC signs and symptoms to delayed diagnosis.[5,6] Patients' limited understanding of the disease and its severity may lead to no show for follow-up care, further prolonging the diagnostic process.

Improper initial treatments, such as prescribing analgesics or antibiotics, by HCPs significantly increased the likelihood of diagnostic delay. Several studies from South Asia have reported low clinical suspicion that results in frequent misdiagnosis of OC by HCPs.[9,11,12] A systematic review highlighted HCPs' challenges in recognizing early OC lesions, often resulting in misdiagnoses and inappropriate treatment.[5] Additionally, needing more than two visits to perform a biopsy further contributed to delays, likely due to initial misdiagnoses, patients failing to follow up, or concurrent use of alternative treatments.

In the study, some variables, such as "frequency of dental checkup," "knowledge of OC before diagnosis," and "number of biopsy visits," exhibit wide confidence intervals. This observation is likely due to some comparison groups having very low prevalence compared to another group. This situation decreased the statistical power of the regression models.

This study has several limitations. First, it relied on patient recall for symptom onset and healthcare interactions, which may introduce recall bias, particularly in estimating delay durations. To mitigate this, responses regarding diagnostic timelines were corroborated with referral letters and medical records, and accompanying persons were allowed to assist with recall. Additionally, the study focused only on delays up to diagnosis and did not include the pre-treatment interval.

This study contributes to the limited literature from LMICs by applying the Aarhus Statement framework to define and analyze diagnostic delays in OC. By assessing appraisal, help-seeking, patient, and diagnostic intervals separately, the study identifies delay-specific factors, offering more nuanced insights compared to previous research that often assessed delay as a single composite measure.

The delay in OC diagnosis observed in this study reflects a complex interplay of cultural, systemic, and individual barriers. While rural healthcare disparities and the prevalence of T&CM usage contribute significantly to prolonged delays, the findings also emphasize the importance of strengthening healthcare infrastructure and improving public awareness. By addressing these gaps through targeted interventions, such as enhanced healthcare access in rural areas, HCPs training on early OC detection, and tailored education campaigns, there is an opportunity to mitigate delays and improve survival outcomes.

Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

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