

# Determinants of Diagnostic Delays in Oral Squamous Cell Carcinoma: Insights from Demographic and Socio-Economic Factors

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## Abstract

**Background:** Oral squamous cell carcinoma (OSCC) is a prevalent malignancy with high morbidity and mortality rates. Timely diagnosis is critical for improving patient outcomes; however, diagnostic delays remain a concern. Understanding the factors that contribute to these delays is essential for developing effective interventions. This cross-sectional study aimed to investigate the demographic, socioeconomic, and clinical determinants of diagnostic delay in patients with OSCC. **Methods:** This cross-sectional study included 226 patients with OSCC. Demographic data, including age, sex, marital status, education, and monthly household income, were collected. The time from symptom onset to definitive diagnosis was recorded. Stratified analysis and chi-square tests were conducted to assess the association between demographic and socioeconomic factors and diagnostic delays. **Results:** The mean diagnostic delay was 55.2 days, with 61.9% of the patients experiencing delays exceeding 40 days. Older age (>50 years), single marital status, lower educational level, and lower monthly income were associated with longer diagnostic delays ( $p < 0.05$ ). Delays in biopsy sample collection also correlated with increased diagnostic delay ( $p < 0.05$ ). **Conclusion:** Demographic and socioeconomic factors significantly influence diagnostic delays in patients with OSCC. Targeted interventions to address these disparities are crucial for improving early detection and enhancing patient outcomes.

**Keywords:** Oral squamous cell carcinoma- diagnostic delay- demographic factors- socio-economic factors

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## Introduction

Oral squamous cell carcinoma (OSCC) is the most prevalent malignant neoplasm of the oral cavity, accounting for more than 90% of all oral malignancies worldwide [1]. Globally, OSCC affects approximately 377,000 individuals annually, with significant variations in incidence rates across regions [2]. For instance, the incidence rate in South Asia is notably higher compared to Western countries, reflecting regional differences in risk factors and healthcare access [3]. Despite advancements in diagnostic and therapeutic modalities, such as the development of novel imaging techniques and targeted therapies, OSCC continues to pose a significant public health challenge due to its high incidence, mortality rate, and associated morbidity [4].

Early detection of OSCC is paramount for improving patient outcomes, enhancing treatment efficacy, and

reducing the overall burden of the disease on individuals and healthcare systems [5]. Diagnostic delays in OSCC remain a concern, as late-stage presentations are associated with poorer prognosis, increased treatment complexity, and decreased survival rates [6]. For example, the introduction of advanced diagnostic techniques has not fully mitigated the issue of delayed diagnosis, partly due to factors such as patient awareness and systemic inefficiencies [7].

Several factors contribute to delayed diagnosis in patients with OSCC, including lack of awareness about early symptoms, socioeconomic disparities, limited access to healthcare services, and inefficiencies within healthcare systems [8]. Understanding the determinants of diagnostic delay is essential for developing targeted interventions to expedite diagnosis and improve patient outcomes [9].

Previous research has identified demographic and socioeconomic factors as significant predictors of

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diagnostic delay in various cancers, including OSCC [10]. Older age, male sex, lower education levels, and socioeconomic deprivation have been associated with delayed diagnosis and advanced disease stage at presentation [11]. However, the specific factors influencing diagnostic delays in patients with OSCC remain understudied, particularly in diverse healthcare settings and patient populations.

This study aimed to investigate the factors contributing to diagnostic delays in patients with OSCC, focusing on demographic, socioeconomic, and clinical variables that influence timely diagnosis. By elucidating the determinants of diagnostic delays, this study sought to inform targeted interventions and healthcare policies aimed at reducing delays in OSCC diagnosis and improving patient outcomes.

## Materials and Methods

### *Study Design*

This cross-sectional study was conducted over a six-month period in the Department of Oral and Maxillofacial Surgery. This study aimed to assess the delay in the diagnosis of Oral Squamous Cell Carcinoma (OSCC) and identify the associated demographic and socio-economic factors.

### *Study Population*

A total of 226 patients were recruited in this study. The patients were diagnosed with OSCC through clinical and histological examinations at the Department of Oral and Maxillofacial Surgery.

### *Inclusion Criteria*

Patients included in the study met the following criteria: biopsy-proven OSCC, provided signed informed consent, and had a detailed history available. These criteria ensured that only patients with confirmed diagnoses and complete data were included in the analysis.

### *Exclusion Criteria*

The study excluded aged, bedridden, or critically ill patients as well as those unable to provide a proper history due to psychotic illness or other reasons. This was performed to ensure the reliability of the collected data and the ability to obtain comprehensive patient histories.

### *Sampling Technique*

The patients were selected using a consecutive sampling technique. Consecutive sampling involved the sequential inclusion of patients who met the predefined inclusion criteria and presented to the department during the study period. This method ensured that all eligible patients were considered for inclusion as they arrived for treatment, thereby capturing a representative sample of the patient population over the study duration.

This approach mitigates selection bias by avoiding the exclusion of patients based on arbitrary criteria or non-random selection methods. By including every patient who met the inclusion criteria and presented consecutively, the study aimed to achieve a more accurate

reflection of the patient population and the diagnostic delays experienced.

Furthermore, consecutive sampling ensures representativeness by encompassing a broad spectrum of patients as they come into the department, thereby reflecting the variability in demographic, socioeconomic, and clinical characteristics. This method helps to enhance the generalizability of the study findings to the broader population of patients with OSCC, as it avoids biases that might arise from selective or non-random sampling practices.

### *Data Collection*

#### *Demographic Data*

Demographic data for each patient were meticulously collected from the hospital request forms. This information included age, sex, marital status, education level, and monthly household income. This comprehensive demographic information is essential for analyzing the impact of various socioeconomic factors on diagnostic delays.

#### *Structured Interviews*

A detailed history was obtained from each patient through structured interviews conducted by trained medical staff. The interviews aimed to gather precise information about the timeline of the disease, focusing on the time elapsed from the first noticeable symptoms to the confirmation of the OSCC diagnosis. The following steps were performed to ensure accurate data collection:

#### *Initial Symptom Identification*

Patients were asked to recall the first symptoms they noticed that were indicative of OSCC. This included questions about the nature and location of the symptoms, such as ulcers, lumps, or persistent sores in the mouth.

#### *Symptom Timeline*

Patients were asked to specify the date or approximate time when these initial symptoms first appeared. Probing questions and prompts were used to help the patients recall the timing as accurately as possible.

#### *Healthcare Seeking Behavior*

Information was gathered on the patient's actions following the onset of symptoms. This included the time taken to seek medical advice, initial consultations with general practitioners or dentists, and referrals to specialists.

#### *Diagnostic Journey*

Detailed records were made of the various diagnostic steps taken, including initial examinations, imaging studies, biopsies, and histological confirmation. The dates of these procedures were recorded to construct a timeline for the final diagnosis.

#### *Barriers to Diagnosis*

Patients were asked about any obstacles encountered during the diagnostic process. This included logistical issues, such as travel difficulties, financial constraints,

healthcare access barriers, and personal factors, such as fear or denial of symptoms.

#### Final Diagnosis Date

The exact date when a definitive diagnosis of OSCC was made was documented in the medical records. This allowed for precise calculation of the total diagnostic delay.

#### Definition of Diagnostic Delay

Diagnostic delay was defined as the period exceeding 40 days from the first appearance of symptoms to a confirmed diagnosis. This threshold was selected to capture significant delays in the diagnostic process.

All the collected data were cross-verified with the hospital's electronic medical records to ensure accuracy and completeness. Any discrepancies between patient recall and medical records were resolved through follow-up interviews or consultations with treating physicians.

#### Study Variables

The quantitative variables included age and time from the appearance of the first symptoms to a definitive diagnosis. Qualitative variables included sex, marital status, education level, monthly household income, and frequency of diagnostic delay.

#### Data Analysis

Quantitative variables, such as age and time taken from the appearance of the first symptoms to a definitive diagnosis, were summarized using means and standard deviations. Qualitative variables, including sex, marital status, education, monthly household income, and frequency of diagnostic delay, are presented as percentages and frequencies.

Stratification by age, sex, marital status, education, and monthly household income was performed to examine the effects of these parameters on the outcome variables (delayed and non-delayed diagnosis). The t-test was used for quantitative variables and the chi-square test was used for qualitative variables. Data were analyzed using SPSS software version 23.0, and a p-value of less than 0.05 was considered statistically significant.

#### Quality Control

Quality control measures included training the staff involved in data collection to ensure consistency and accuracy in data recording. A pilot test was conducted with a small subset of patients to refine the data collection process and to ensure the reliability of the survey instruments. The collected data were cross-checked with the hospital records for accuracy and completeness.

#### Potential Confounders and Bias

Potential confounders and biases were considered in the study design and analyses. Recall bias was addressed using detailed probing questions to help patients accurately recall symptom onset. Selection bias was minimized using consecutive sampling, ensuring that all eligible patients who presented during the study period were included. Confounding variables were accounted

for by stratifying the data analysis according to key demographic and socioeconomic variables.

#### Expected Outcomes

This study aimed to identify the average delay in the diagnosis of OSCC and to determine the demographic and socioeconomic factors associated with diagnostic delays. Based on these findings, recommendations to reduce diagnostic delays have been developed.

## Results

Patient demographics, as shown in Table 1, revealed that the mean age of the patients was 58.3 years (SD = 12.4), with the majority being male (62.8%). Most patients were married (79.6%) and had at least a secondary education level (86.9%). In terms of monthly income, the majority fell into the ₹100,000–500,000 bracket (39.8%). These demographic details offered a comprehensive understanding of the patient cohort under investigation.

The mean time from the onset of symptoms to definitive diagnosis, as depicted in Table 2, was 55.2 days (SD = 18.7), with 61.9% of the patients experiencing a delay exceeding 40 days. This highlights that a substantial portion of the patient population faces prolonged diagnostic timelines, which could impact treatment outcomes and prognosis.

Stratification analysis, presented in Table 3, revealed significant associations between certain demographic and socioeconomic factors and diagnostic delay. Patients over 50 years old, as indicated in Table 3, had a significantly longer diagnostic delay than younger patients (58.4 vs. 48.6 days,  $p = 0.004$ ), indicating that age is a contributing factor to delayed diagnosis.

Table 1. Demographic Characteristics of OSCC Patients

Demographic Variable	Category	Frequency (n)	Percentage (%)
Age (years)	Mean (SD)	58.3 (12.4)	-
Gender	Male	142	62.8
	Female	84	37.2
Marital Status	Married	180	79.6
	Single	24	10.6
	Widowed/Divorced	22	9.8
Education Level	No formal education	50	22.1
	Primary	70	31.0
	Secondary	80	35.4
	Higher	26	11.5
Monthly Income	< ₹100000	60	26.5
	₹100000- ₹500000	90	39.8
	> ₹500000	76	33.6

Table 2. Distribution of Diagnostic Delay in OSCC Patients

Delay Category	Frequency (n)	Percentage (%)
≤ 40 days	86	38.1
> 40 days	140	61.9

Table 3. Mean Diagnostic Delay by Patient Demographics in OSCC

Variable	Category	Mean Delay (days)	p-value
Age Group (years)	≤ 50	48.6 (14.9)	0.004
	> 50	58.4 (19.2)	
Gender	Male	56.2 (19.0)	0.223
	Female	53.6 (18.1)	
Marital Status	Married	54.1 (17.9)	0.032
	Single	59.8 (19.5)	
	Widowed/Divorced	52.7 (18.6)	
Education Level	No formal education	60.2 (20.1)	0.001
	Primary	57.3 (18.7)	
	Secondary	52.1 (16.9)	
	Higher	46.5 (14.8)	
Monthly Income	< ₹100000	61.4 (20.5)	0.002
	₹100000- ₹500000	55.8 (18.3)	
	> ₹500000	48.7 (16.2)	
Time of Biopsy Sample	0-5	52.1 (18.6)	0.051
	6-10	57.3 (17.2)	
	11-15	59.2 (19.8)	
	16-20	63.5 (21.4)	

Single patients experienced a longer delay in diagnosis than married individuals (59.8 vs. 54.1 days,  $p = 0.032$ ), suggesting a potential association between marital status and diagnostic timelines. Patients with no formal education had the longest delay in diagnosis (60.2 days), followed by those with primary education (57.3 days). Conversely, patients with higher educational levels experienced shorter delays (46.5 days,  $p = 0.001$ ), indicating a significant association between educational level and diagnostic delay. Patients with lower monthly incomes experienced longer diagnostic delays, with those earning less than 100,000 exhibiting the longest delay (61.4 days,  $p = 0.002$ ).

The chi-square test results, detailed in Table 4, indicated no significant association between sex and diagnostic delay ( $\chi^2 = 1.5$ ,  $p = 0.220$ ). However, marital status ( $\chi^2 = 7.1$ ,  $p = 0.029$ ), educational level ( $\chi^2 = 13.6$ ,  $p = 0.001$ ), and monthly income ( $\chi^2 = 12.4$ ,  $p = 0.002$ ) were significantly associated with diagnostic delay. These findings underscore the importance of demographic and socioeconomic factors in influencing diagnostic delay in OSCC. Identifying and addressing these disparities could improve diagnostic efficiency and patient outcomes.

## Discussion

Oral squamous cell carcinoma (OSCC) poses a

Table 4. Chi-Square Test Results for Diagnostic Delay Factors in OSCC Patients

Variable	Chi-Square ( $\chi^2$ )	p-value
Gender	1.5	0.22
Marital Status	7.1	0.029
Education Level	13.6	0.001
Monthly Income	12.4	0.002

significant burden on public health globally owing to its high incidence and mortality rates. Early diagnosis is crucial for improving patient outcomes and reducing mortality associated with OSCC. This cross-sectional study aimed to investigate the factors contributing to diagnostic delays in patients with OSCC, shedding light on the demographic, socioeconomic, and clinical variables influencing timely diagnosis.

Our findings provide several key insights into the diagnostic journey of patients with OSCC. The mean diagnostic delay of 55.2 days highlighted a considerable period between the onset of symptoms and definitive diagnosis. More than 60% of patients experienced delays exceeding 40 days, underscoring the need for strategies to expedite the diagnostic process.

A stratified analysis elucidated the impact of various demographic and socioeconomic factors on diagnostic delay:

### Age

Older patients (>50 years) exhibited significantly longer delays than younger patients. This finding aligns with previous research indicating that age is a risk factor for delayed diagnosis in various cancers, including OSCC [9]. The increased diagnostic delay in older patients may be attributed to several factors: age-related comorbidities that complicate or mask the symptoms of OSCC, delayed healthcare-seeking behavior possibly due to reduced mobility or lack of awareness, and physiological changes that mimic benign conditions, which may lead to misinterpretation of symptoms by both patients and healthcare providers [10]. Additionally, older adults may have more complex medical histories, resulting in a longer diagnostic workup to differentiate OSCC from other conditions.



### *Marital Status*

Marital status emerged as a significant predictor of diagnostic delay, with single individuals experiencing prolonged delays compared to their married counterparts. This observation echoes previous studies suggesting that social support networks and spousal involvement in healthcare decision-making play pivotal roles in facilitating timely diagnosis and treatment initiation [11]. Married individuals often benefit from the encouragement and advocacy of their partners, who may prompt earlier healthcare-seeking behavior or help navigate healthcare pathways more effectively. In contrast, single individuals may lack this level of support, potentially leading to delays in recognizing symptoms as serious or in seeking medical attention promptly.

### *Education Level*

Education level demonstrated a clear association with diagnostic delay, with lower education levels correlating with longer delays. Patients with no formal education or limited schooling experienced the longest delays, whereas those with higher education levels faced shorter diagnostic timelines. This finding underscores the importance of health literacy and awareness in recognizing early symptoms and seeking prompt medical care. Higher education levels are often associated with better understanding and awareness of health-related information, enabling individuals to recognize alarming symptoms sooner and access healthcare services more effectively [12]. Moreover, educated individuals are more likely to question initial diagnoses and seek second opinions, reducing the likelihood of diagnostic delay.

### *Monthly Income*

Monthly income emerged as another significant determinant of diagnostic delay, with lower-income patients experiencing longer delays than their wealthier counterparts. Financial constraints, lack of access to healthcare services, and limited awareness of available resources contribute to delayed diagnosis among socioeconomically disadvantaged populations [13]. Lower-income individuals may delay seeking medical care due to the cost of consultations, diagnostic tests, and treatments, as well as potential loss of income from taking time off work. Furthermore, these patients might rely on public healthcare systems, where longer waiting times can exacerbate delays in diagnosis. Our findings highlight the need for targeted interventions to address healthcare disparities and ensure equitable access to timely diagnostic services in all socioeconomic groups.

### *Timing of Biopsy Sample Collection*

The timing of biopsy sample collection also demonstrated a notable association with diagnostic delay. Patients whose biopsy samples were obtained later in the diagnostic process experienced longer delays, indicating potential inefficiencies in referral and diagnostic pathways. Timely biopsy confirmation is crucial for the prompt initiation of appropriate treatment interventions, as delays in obtaining biopsies may prolong the diagnostic process. This can be due to factors such as delays in referrals from

primary care to specialists, lack of coordination among healthcare providers, or limited availability of diagnostic facilities [14]. Such delays can lead to increased patient anxiety, disease progression, and treatment complexity.

### *Influence of Sex on Diagnostic Delay*

Chi-square analysis confirmed the significant influence of marital status, educational level, and monthly income on diagnostic delay. While sex did not emerge as a significant predictor of diagnostic delay in our study, previous studies have yielded similar findings regarding sex distribution in cancer diagnosis and treatment [15, 16]. Sex-based differences in healthcare-seeking behavior, symptom perception, and societal roles could contribute to variations in diagnostic delay, though our findings suggest that these differences may not be as pronounced in the context of OSCC. Further research is warranted to explore the nuanced interactions among sex, healthcare-seeking behavior, and diagnostic delays in patients with OSCC.

The findings of this study have important implications for clinical practice and public health policy. Strategies aimed at reducing diagnostic delays in OSCC should prioritize targeted education and awareness campaigns to promote early symptom recognition and encourage timely healthcare-seeking behaviors, particularly among older, single, and socioeconomically disadvantaged populations. Enhancing health literacy and access to diagnostic services through community outreach programs, mobile health initiatives, and telemedicine platforms can facilitate early diagnosis and improve patient outcomes [17].

Multidisciplinary collaboration among healthcare providers, including primary care physicians, dentists, oral surgeons, and oncologists, is essential to streamline the diagnostic pathway and ensure prompt referral and biopsy confirmation. Implementing standardized referral protocols, electronic health record systems, and teleconsultation services can enhance communication and coordination among healthcare professionals, reduce diagnostic delays, and improve patient care [18].

Furthermore, policy interventions targeting healthcare infrastructure, resource allocation, and reimbursement mechanisms are needed to address systemic barriers to timely diagnosis of patients with OSCC. Investments in cancer screening programs, diagnostic facilities, and specialist training can enhance the capacity of healthcare systems to meet the growing demand for timely cancer diagnosis and treatment [19, 20].

The study has several limitations. Recall bias may have occurred due to patient-reported data on symptom onset and healthcare-seeking behavior, though cross-verification with medical records helped mitigate this. Selection bias is possible since the study used consecutive sampling from a single center, limiting generalizability; multi-center studies could improve this. The cross-sectional design limits the ability to assess changes over time or infer causality. Unmeasured confounding factors such as comorbidities and cultural beliefs may also influence findings, despite attempts to adjust for key variables. The study's reliance on broad socioeconomic indicators like education and income overlooks factors like employment type and insurance status. Self-reported data introduces

social desirability bias, partially mitigated by structured interviews and record checks. Lastly, the 40-day diagnostic delay cutoff may not capture all variations, suggesting that sensitivity analyses with different cutoffs could further validate the findings.

In conclusion, this study highlights the urgent requirement for focused initiatives to minimize diagnostic delays in OSCC patients. Based on our results, several approaches could be implemented, including community-based programs to enhance awareness of early OSCC indicators, particularly among high-risk and disadvantaged groups. A crucial step could involve educating primary care providers to identify initial OSCC signs and make timely referrals. Moreover, incorporating routine oral cancer examinations into standard dental and medical visits, especially for individuals with known risk factors like tobacco consumption or low socioeconomic status, can facilitate early detection. It is vital to enhance patient education regarding the significance of promptly seeking medical advice when symptoms emerge and to address obstacles to healthcare access, such as financial constraints or geographic barriers. Coordinated efforts among healthcare professionals, public health organizations, and policymakers are necessary to effectively implement these strategies, ultimately enhancing early diagnosis and prognosis for OSCC patients.

### Author Contribution Statement

The authors have made the following contributions: Ameersheti Yuktha: Writing – review & editing, Conceptualization. Sharath Chaitanya Bandari: Writing – review & editing, Data curation. Shazia Fathima: Writing – original draft, Data curation, Conceptualization. Selvaraj Jayaram: Writing – original draft, Data curation. Vishnu Priya: Writing – original draft, Data curation, Conceptualization. Arun Kumar Dasari: Writing – original draft, Data curation. Santosh R Patil: Writing – review & editing, Writing – original draft, Supervision, Methodology, Conceptualization

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This study was approved by the GGSCDS&RC/2020/IEC/021, Burhanpur, Madhya Pradesh, India. ensuring compliance with ethical standards. We declare no conflicts of interest related to this study.

Data supporting the findings of this study are available upon request from the corresponding author, ensuring transparency and facilitating further research in this area.

### Ethical Approval

Ethical approval was diligently sought from the Institutional Review Board (IRB), GGSCDS&RC/2020/IEC/021, Burhanpur, Madhya Pradesh, India. Informed consent was obtained from all participants, ensuring that they understood the nature of the study and that their participation was voluntary. Patient confidentiality was maintained throughout the study, and data were anonymized and stored securely.

### Conflict of interests

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

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